Salt Lake County Emergency Management

# Multi-Jurisdictional Hazard Mitigation Plan—DRAFT

Salt Lake County

Salt Lake County
Emergency Management

3380 South 900 West
Salt Lake City, UT 84119

SALT LAKE COUNTY

2025

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# Executive Summary

Natural disasters, such as earthquakes, wildfires, and severe weather events, pose significant danger to life and property in Salt Lake County. Hazard mitigation planning is the process communities can use to identify and assess the risks posed by these hazards and implement measures to reduce the potential impacts of those hazards. It has been recognized that taking action prior to a natural disaster can substantially reduce the damage caused by these hazards and increase the overall resilience of the community to natural disasters.

Mitigation planning is a collaborative process that provides local governments a framework to reduce or eliminate long-term risk from hazards. Salt Lake County has joined with 23 cities and towns, 2 school districts, and 1 community college for this effort. The planning process includes establishing a planning team to review data regarding past hazard events and possible future events, evaluate current capabilities, and develop strategies to address hazards. To inform his process, participants from each jurisdiction have collaborated with local emergency managers, planning and development departments, floodplain managers, economic development staff, health and human services departments, public works, city administrators, and geographic information system (GIS) specialists. Participants also consulted existing planning documentation to integrate this plan with other community planning efforts.

Mitigation plans are updated every 5 years. This plan updates the 2019 Salt Lake County Hazard Mitigation Plan and reaffirms the participant's commitment to reducing hazard risk. It is organized in two volumes. Volume 1 contain comprehensive details on each step of the planning process, profiles of each hazard identified by the planning team as having potential to affect the county, an evaluation of previous mitigation strategies, and the mitigation strategies for the next 5-year planning cycle. Because each community may face different hazards or have unique vulnerabilities to hazards, Volume 2 contains annexes for individual participating jurisdictions. These annexes describe jurisdiction-specific hazard histories and vulnerabilities, an evaluation of the status of previously identified mitigation actions, and new mitigation strategies that have been identified.

This document will describe each stage of the planning process, which includes building the planning team, creating an outreach strategy for identifying community stakeholders and seeking public input, conducting a risk assessment, documenting capabilities, developing and prioritizing mitigation actions, and establishing a strategy for implementing them. Once adopted, this plan makes communities eligible for a variety of grant funding programs to implement identified mitigation actions. Twenty-five jurisdictions participated in this planning update.

# Promulgation

This plan is promulgated as "Salt Lake County's Multi-Jurisdictional Hazard Mitigation Plan." It is designed to comply with all applicable federal, state, and local ordinances and resolutions and provides guidance for preparing for and mitigating hazards that threaten the community.

This plan has been constructed using the best available information and from a planning perspective. It is recognized that as new information becomes available, decisions and actions may differ from those envisioned when the plan was developed.

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

This plan supersedes all previous hazard mitigation plans.

Promulgated this ____ day of _________ 2025.

# 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 identifying, evaluating, and mitigating 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 provided 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 in 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, Code of Federal Regulations, 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 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; Coordination of emergency operations plans with emergency plans of the federal government; and
6. Other measures necessary, incidental, or appropriate to this chapter

## Local Authority

Local governments play an essential role in implementing effective mitigation. For this plan, local governments include cities, counties, and 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 to effectively protect their citizens. All jurisdictions in Salt Lake County participated in the development of this plan.

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# 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 minimize conditions that have an undesirable impact on our citizens, the economy, the environment, and the well-being of Salt Lake County and surrounding municipalities. This mitigation plan is intended to enhance the awareness of elected officials, agencies, and the public of these hazards and their associated threats to life and property. The plan also details what actions can be taken to help prevent or reduce hazard vulnerability to each jurisdiction.

Hazard mitigation is often a neglected aspect of 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 conveyed through complete hazard identification and impact studies and 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 intending to guide 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, Building Resilient Infrastructure in Communities (BRIC), 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 2019 Salt Lake County Multi-Jurisdictional Multi-Hazard Mitigation Plan. The 2019 plan was reviewed to evaluate its strengths, weaknesses, and utility. The hazards, vulnerabilities, and risks were examined regarding their impact, severity, and how they may affect the population. 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 further align the mitigation plan with other community planning efforts. The revision process also included a review of proposed mitigation goals, objectives, and actions 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 the identified changes. The mitigation plan was also evaluated to support the state mitigation plan goals and objectives and other local planning efforts. Finally, an implementation strategy and timeline will assign the responsibility and schedule for tracking the implementation of the identified mitigation actions. The mitigation plan will be adopted through the regular legal process and 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 geographic information systems (GIS) and assessor's data as resources for the planning team. Salt Lake County Emergency Management staff, planning team members, county, city, and applicable emergency managers/planners, subject matter experts, recruits from other jurisdictions such as other local government units, the private sector, non-governmental organizations, academia, airports, and the military were consulted during this planning activity. This plan also demonstrates that the public and all community stakeholders have proactively offered opportunities for participation in the planning process. Examples of participation include relevant involvement in any planning process, attendance at meetings, contributing research, data, and other information, and commenting on drafts of the plan.

This plan was developed in accordance with the requirements of the FEMA Section 322 regulations, 44 Code of Federal Regulations Part 201, the Utah Division of Emergency Management (UDEM), and local planning agencies. FEMA regulations were followed during the development of this plan. Future monitoring, evaluation, 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 threatening our citizens' health, welfare, and security. Action taken to reduce or eliminate the long-term risk to human life and property from these hazards is known as mitigation. The losses of life and property and 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 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 reduces, limits, or prevents 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 update the 2019 Salt Lake County Multi-Jurisdictional Multi-Hazard Mitigation Plan. This mitigation plan is a collaborative effort that will serve all of Salt Lake County, including each of the participating jurisdictions and 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 assessing their resilience to disasters and disruptions. It will serve as a guide to prioritize mitigation and preparedness efforts, allocate funding, guide development in innovative ways, and effectively utilize and share scarce resources. It represents the county’s commitment to reducing 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 be easily 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 the annexes of each participating jurisdiction.

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

# Community Profile

## 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 it 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 eastern and western borders of the county, respectively (Figure 1).

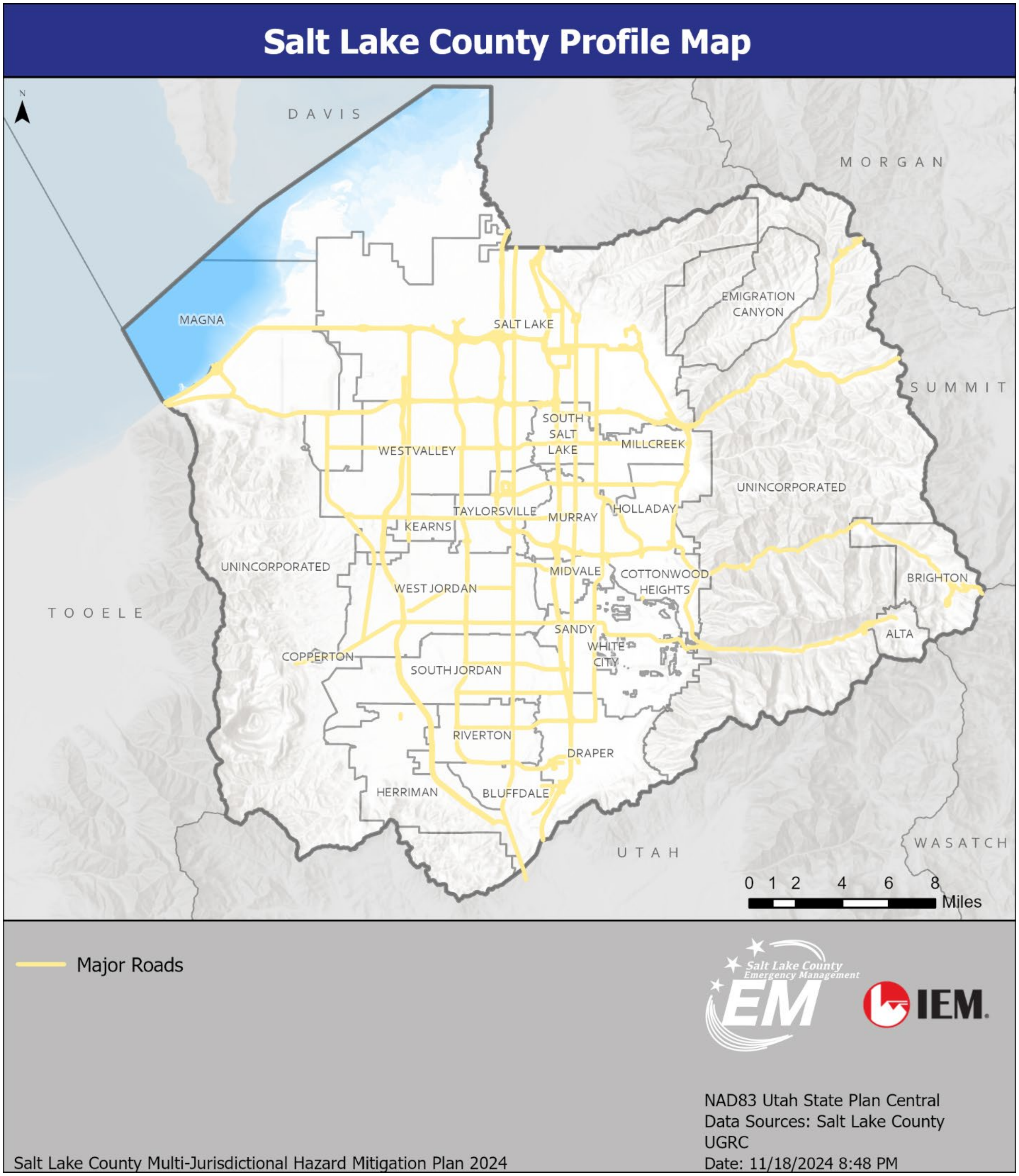


**Figure 1: Salt Lake County Profile Map**

## Land Use and Development

There are 17 cities within Salt Lake County: 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. Five metro townships have been incorporated since the last plan: Copperton, Emigration Canyon, City of Kearns, City of Magna, and White City. The Town of Brighton was also incorporated in 2020. Several distinct nearby unincorporated areas with permanent populations include 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 79.4% private, 6% federal, and 10% state. 4.6% of this area is water. Figure 2 shows the locations of lakes, rivers, and canals in the county.

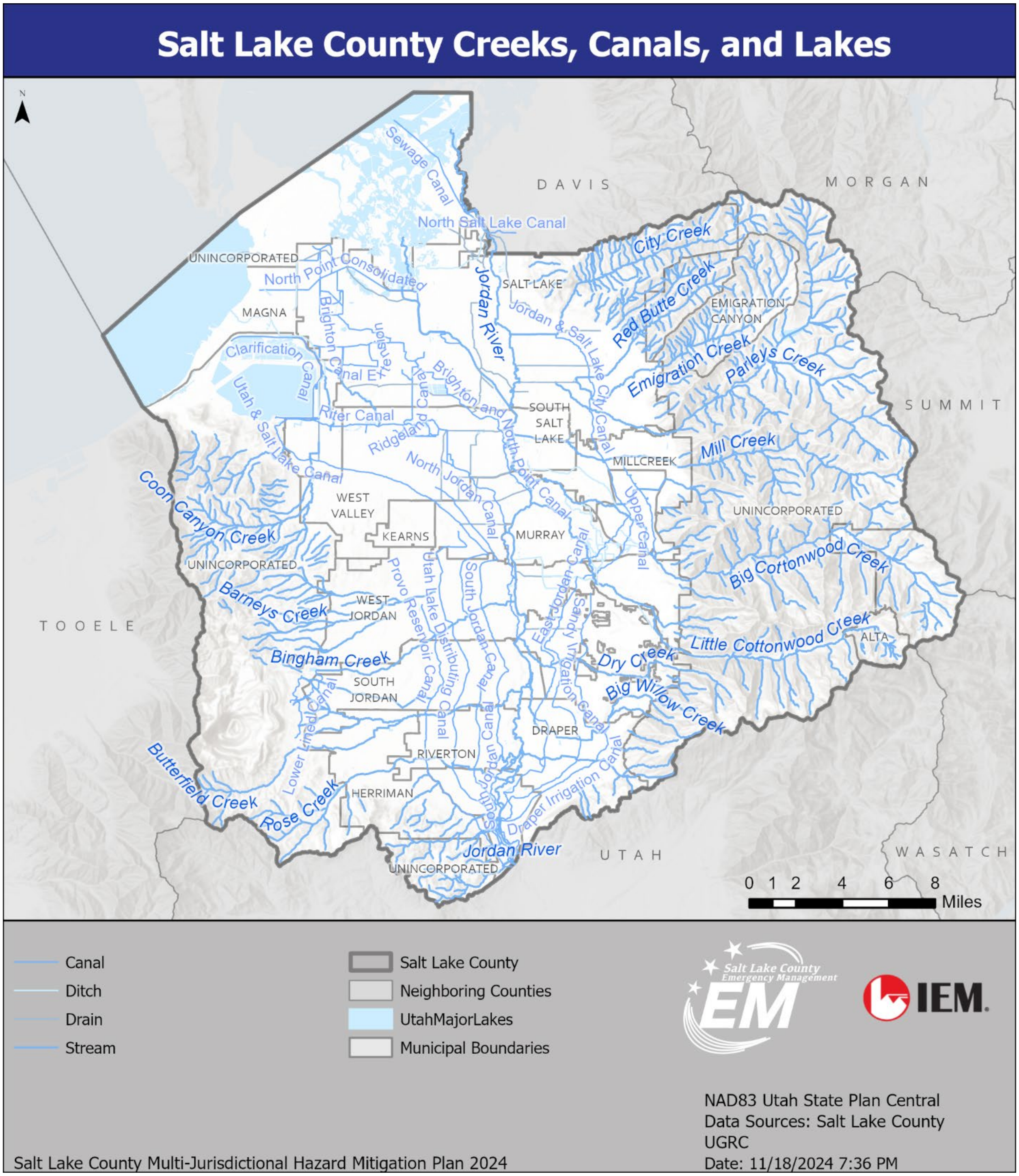


**Figure 2: Salt Lake County Rivers and Lakes Map**

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 southern areas of Salt Lake County are zoned for lower housing density. 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 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 remain undeveloped because of specific environmental constraints, such as steep slopes or prime wetlands. Some areas currently used for industrial or mining activity may be redeveloped for commercial and residential purposes. Kennecott Utah Copper Corporation currently owns much of this land.

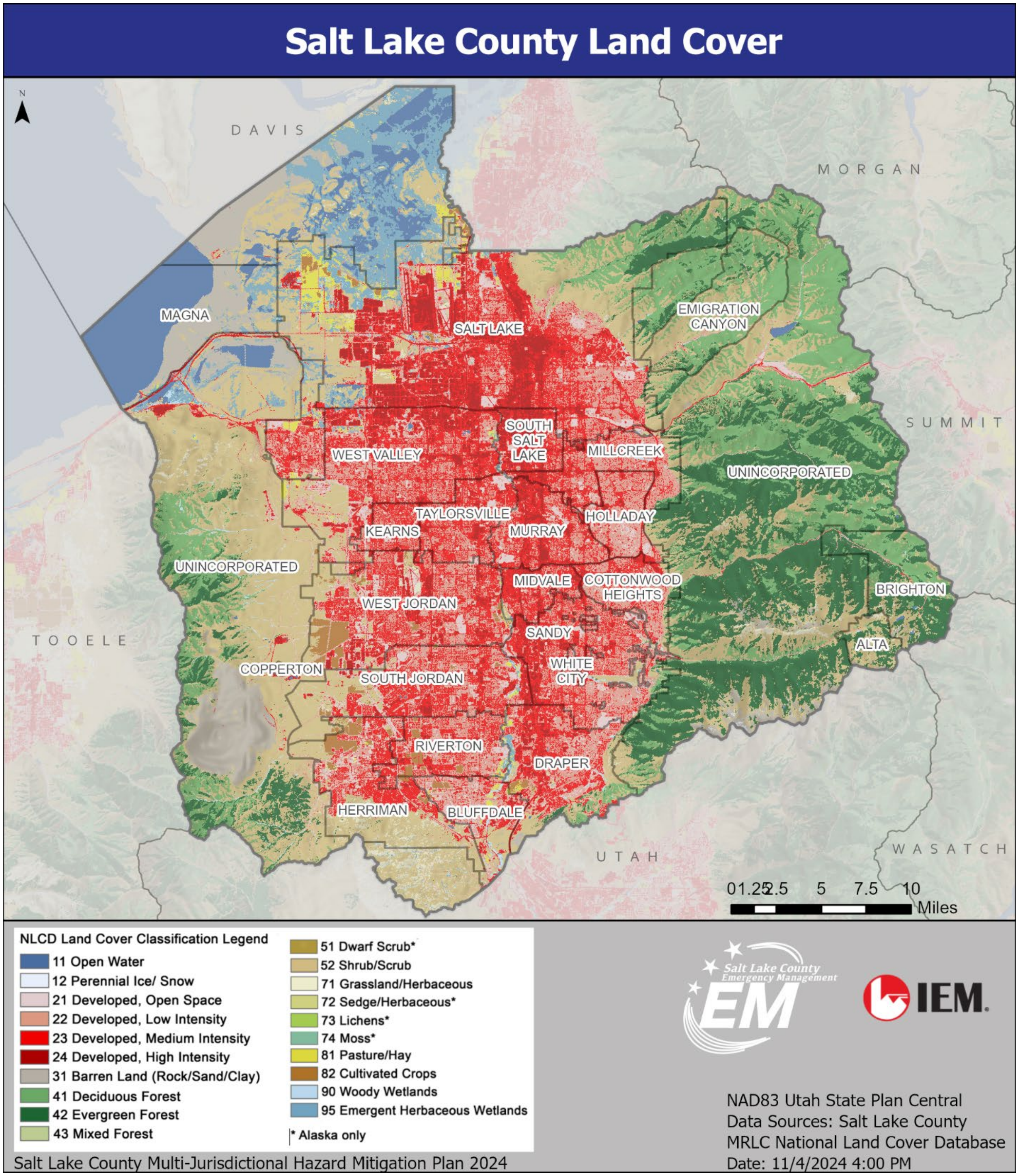


**Figure 3: Salt Lake County Land Cover**

## Climate and Weather

Table 1, Figure 4, and Figure 5 provide a climate overview, climate averages, and weather data for Salt Lake County.

**Table 1: Salt Lake County Climate Overview[1]**

| | 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** | 91.4° | 85.8° |
| **Avg. Jan Low** | 22.8° | 21.7° |
| **Comfort Index (higher=better)** | 7.1 | 7 |
| **UV Index** | 4.7 | 4.3 |
| **Elevation** | 5599 ft. | 2443 ft. |

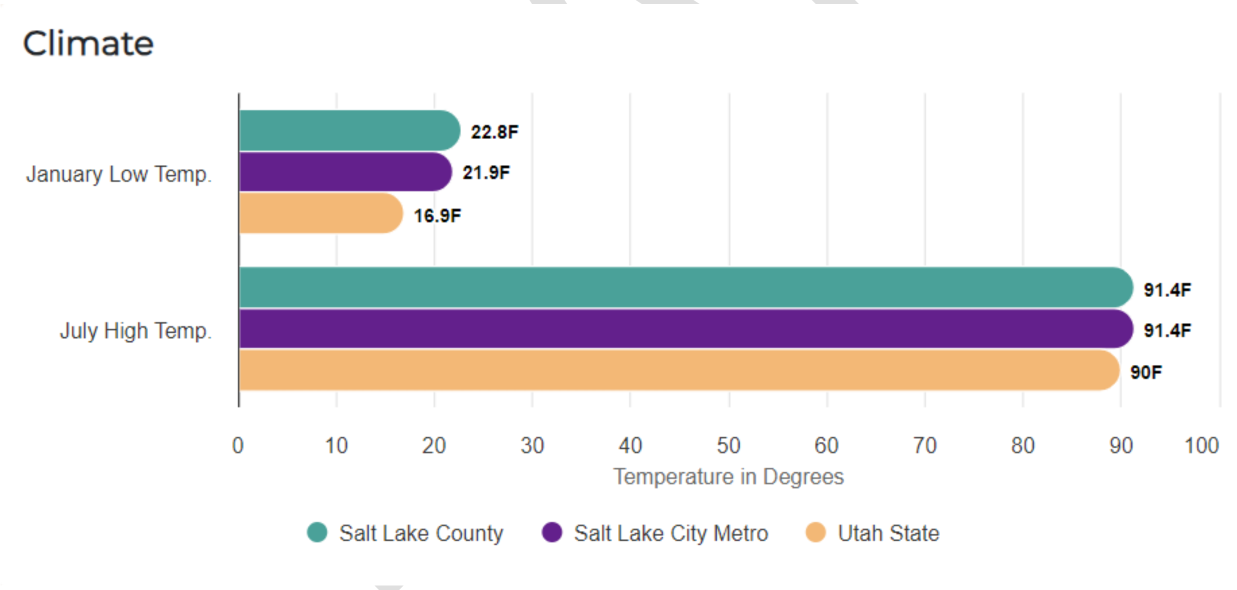


**Figure 4: Climate High and Low Temperature Comparison Chart[2]**

[1] Bestplaces.net. "Salt Lake County Climate Overview." 2024. https://www.bestplaces.net/climate/county/utah/salt_lake
[2] Ibid.

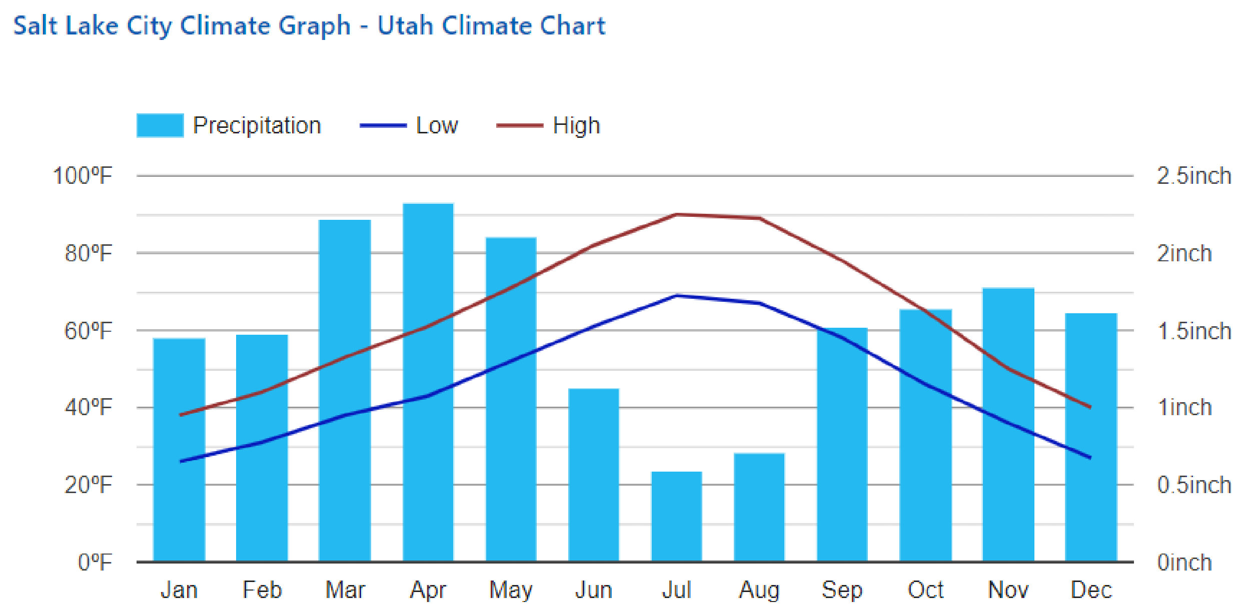


**Figure 5: Salt Lake City Climate Graph-Utah Climate Chart[3]**



# Population

According to the United States Census, Salt Lake County continues to be the most populous county in Utah, with a population of 1,185,813 in 2023. It has grown steadily over the past 13 years (see Table 2).[4] The 2024 estimated population of Salt Lake County is 1,185,057, with a growth rate of -0.06% in the past year, according to the most recent United States census data. The 2010 population was 1,032,997, which has grown by 14.72% since then.[5]

**Table 2: Salt Lake County Utah Population Growth Rates (2010–2023)[6]**

| Year | Population | Growth | Growth Rate |
|---|---|---|---|
| **2023** | 1,185,813 | -756 | -0.06% |
| **2022** | 1,186,569 | 257 | 0.02% |
| **2021** | 1,186,312 | -671 | -0.06% |
| **2020** | 1,186,983 | 28,398 | 2.45% |
| **2019** | 1,158,585 | 9,636 | 0.84% |

[3] The blue line in the figure shows the average low temperature, and the red line shows the average high temperature.
USClimateData.com. "Climate Salt Lake City – Utah." 2024. https://www.usclimatedata.com/climate/salt-lake-city/utah/united-states/usut0225
[4] U.S. Census. "Quick Facts Salt Lake County Utah." 2024. https://www.census.gov/quickfacts/fact/table/saltlakecountyutah/HSG445222
[5] World Population Review.com. "Salt Lake County, Utah Population 2024." 2024. https://worldpopulationreview.com/us-counties/utah/salt-lake-county
[6] Ibid.

| Year | Population | Growth | Growth Rate |
|---|---|---|---|
| **2018** | 1,148,949 | 11,676 | 1.03% |
| **2017** | 1,137,273 | 16,522 | 1.47% |
| **2016** | 1,120,751 | 18,061 | 1.64% |
| **2015** | 1,102,690 | 12,350 | 1.13% |
| **2014** | 1,090,340 | 10,679 | 0.99% |
| **2013** | 1,079,661 | 15,521 | 1.46% |
| **2012** | 1,064,140 | 16,438 | 1.57% |
| **2011** | 1,047,702 | 14,705 | 1.42% |
| **2010** | 1,032,997 | 0 | 0% |

Salt Lake County's population increased in 10 of the 13 years between 2010 and 2023. The largest annual population increase was 2.4% between 2019 and 2020. The county's largest decline in growth was between 2020 and 2021, when the population growth rate saw no increase. Between 2010 and 2022, the county grew by an average of 1.2% per year (see Figure 6).[7]

[7] USA Facts. "Our Changing Population Salt Lake County, Utah." 2024. https://usafacts.org/data/topics/people-society/population-and-demographics/our-changing-population/state/utah/county/salt-lake-county/#:~:text=Salt%20Lake%20County%27s%20population%20increased%2010%20out%20of,grew%20by%20an%20average%20of%201.2%25%20per%20year

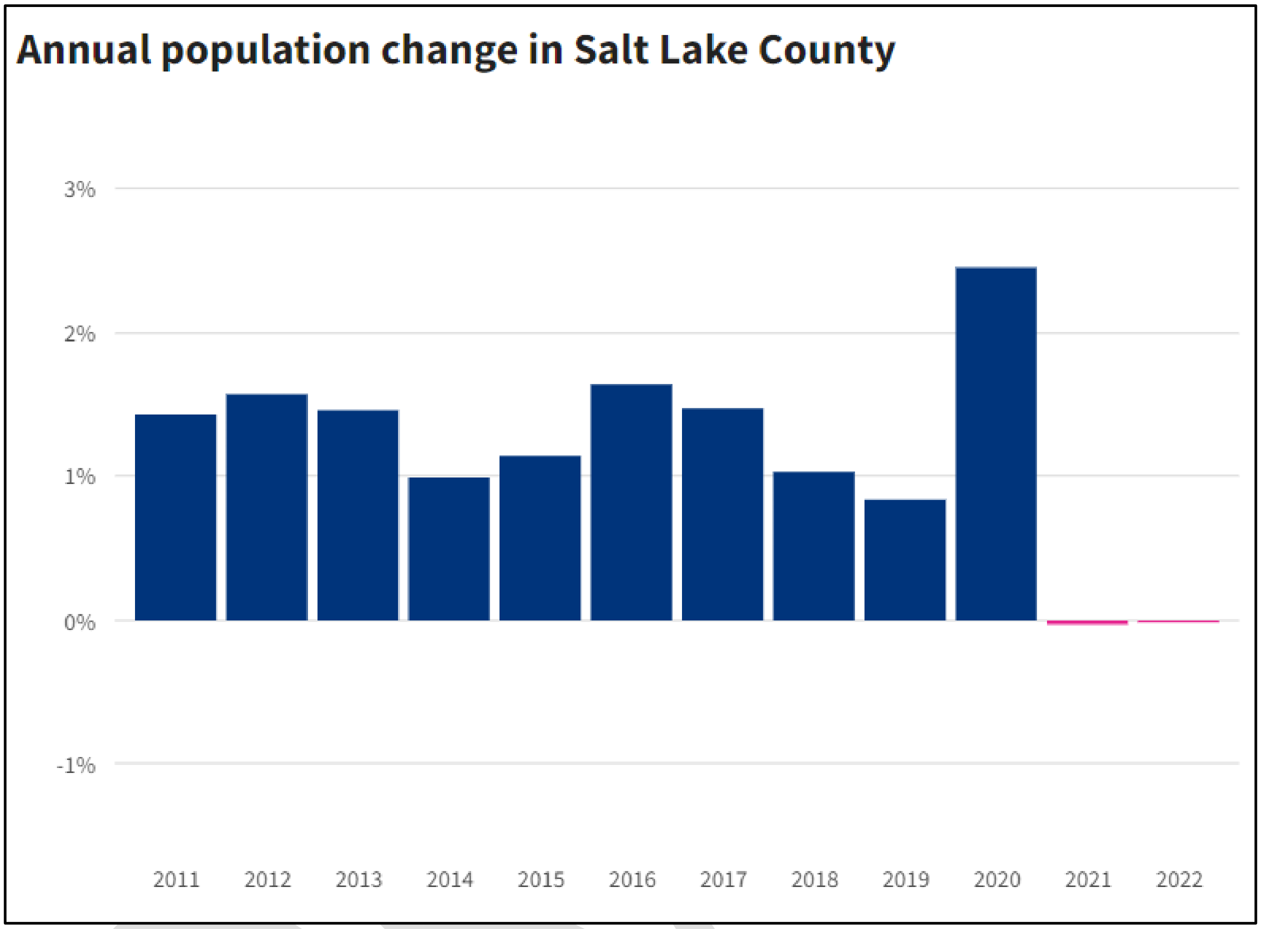


**Figure 6: Salt Lake County Utah Population Growth Rates Graph (2011–2022)[8]**

## City Populations

Salt Lake County contains two of the largest cities in the state: Salt Lake City, which has a population of approximately 209,593 (a 4.9% increase from 2020, when it was 199,723), and West Valley City, which has a population of approximately 134,470 (−4.1% decrease from 2020, when it was 140,238), according to the 2023 census data.[9] Figure 7 shows the current daytime population density throughout the county, followed by the nighttime population in Figure 8 based on LandScan data from Oak Ridge National Laboratory. LandScan data is the community standard for global population data. It is derived through the use of available data and satellite imagery to map geographic areas with superimposed layers of information to represent an “ambient” (24-hour average) population.

[8] USA Facts. “Our Changing Population: Salt Lake County, Utah.” 2024. https://usafacts.org/data/topics/people-society/population-and-demographics/our-changing-population/state/utah/county/salt-lake-county/#:~:text=Salt%20Lake%20County%27s%20population%20increased%2010%20out%20of,grew%20by%20an%20average%20of%201.2%25%20per%20year

[9] U.S. Census. “Quick Facts Salt Lake City and West Valley City Utah.” 2024. https://www.census.gov/quickfacts/fact/table/westvalleycitycityutah,saltlakecitycityutah/HSG445222

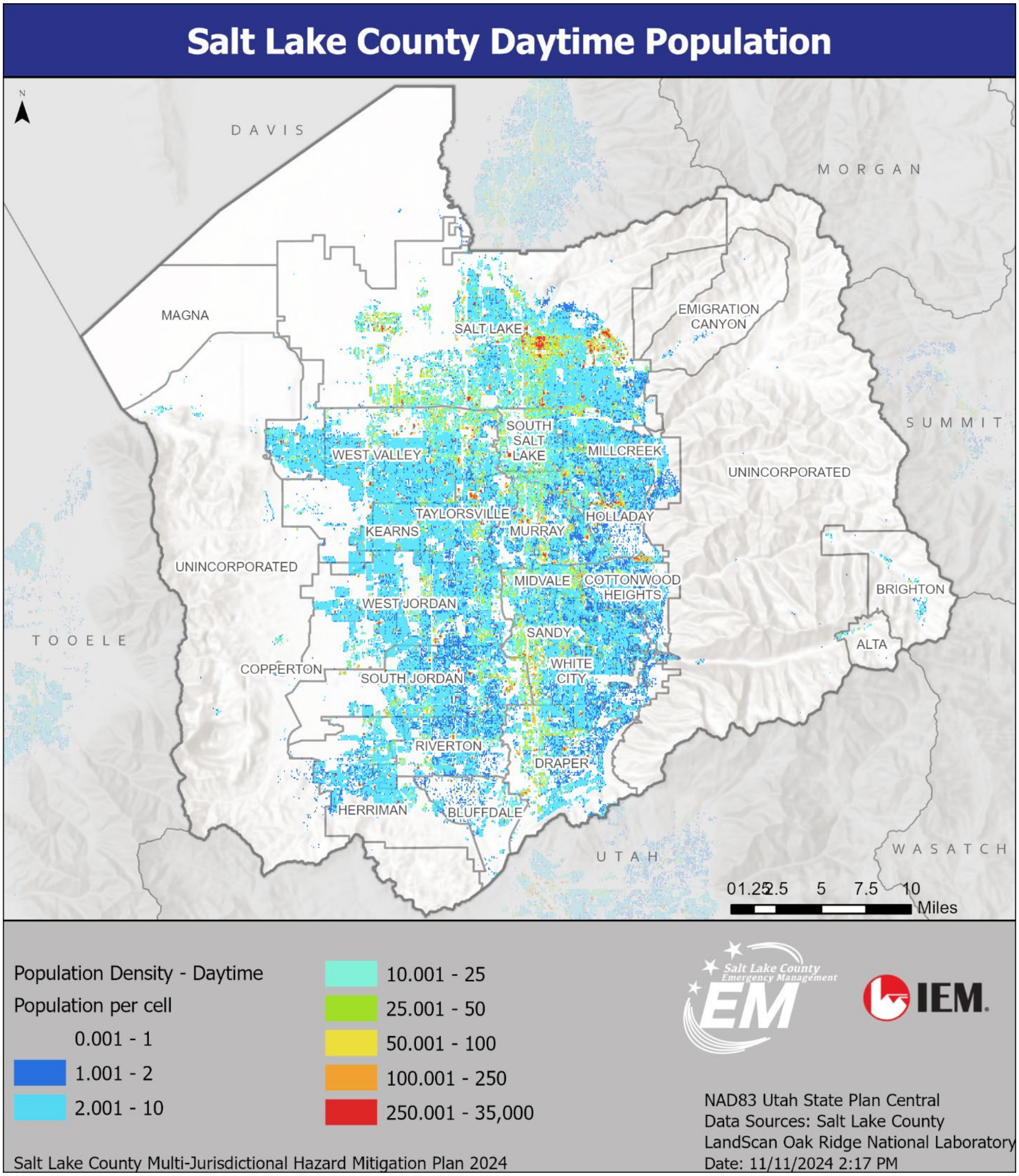


**Figure 7: Salt Lake County Population Density**

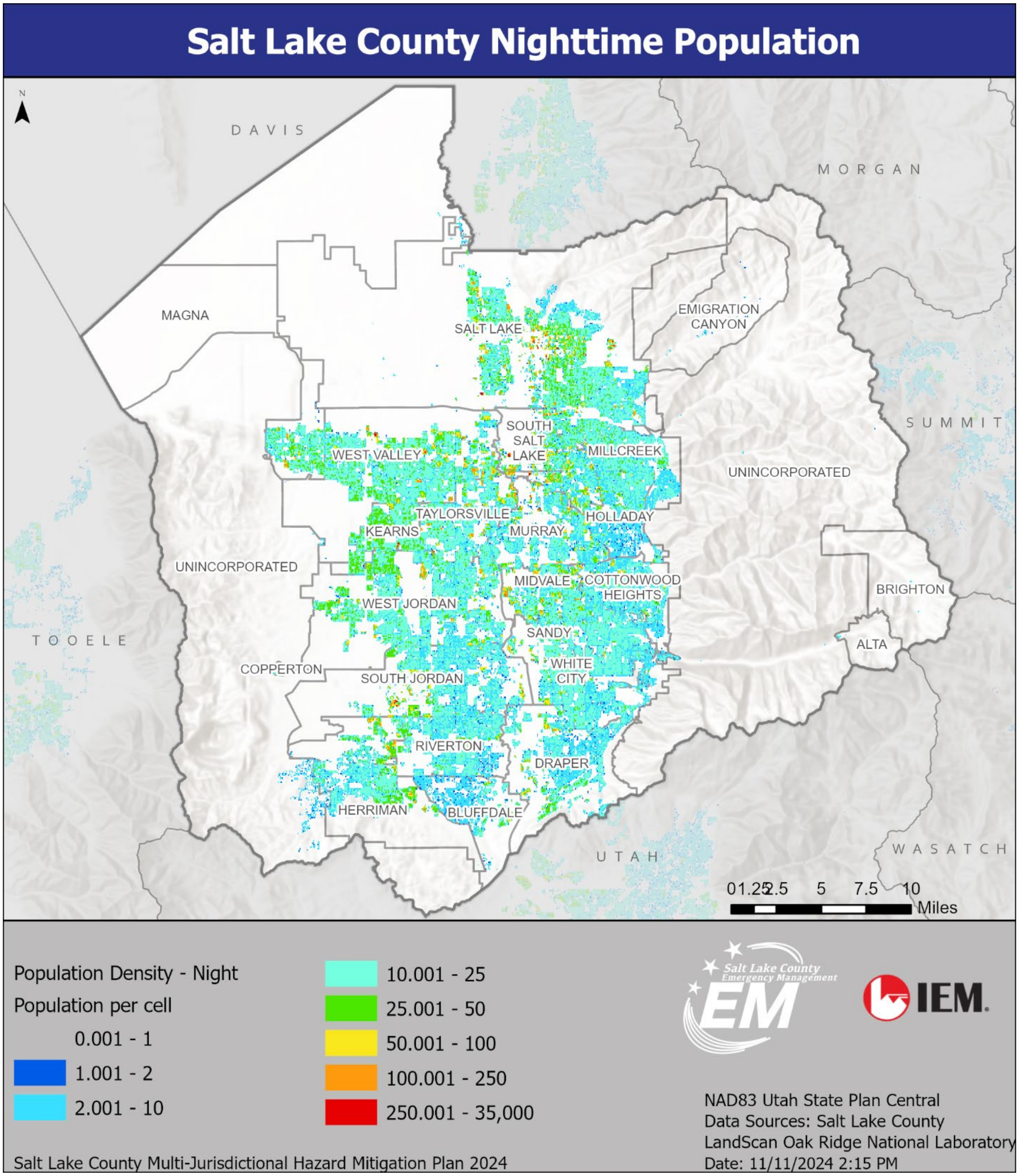


**Figure 8: Salt Lake County Nighttime Population**

Table 3 and Table 4 provide Salt Lake County population and household projections, indicating continued growth of 55% from 2015 to 2065, as determined by The University of Utah's Kem C. Gardner Policy Institute.[10]

## Population Projections

**Table 3: Salt Lake County Population Projections[11]**

| 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% |

**Table 4: Salt Lake County Household Projections[12]**

| 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% |



[10] Hanson, Janelle. "Utah in 2065." The University of Utah, Kem C. Gardner Policy Institute. October 21, 2016. https://attheu.utah.edu/facultystaff/utah-in-2065/
[11] Ibid.
[12] Ibid.

## Population by Age and Gender

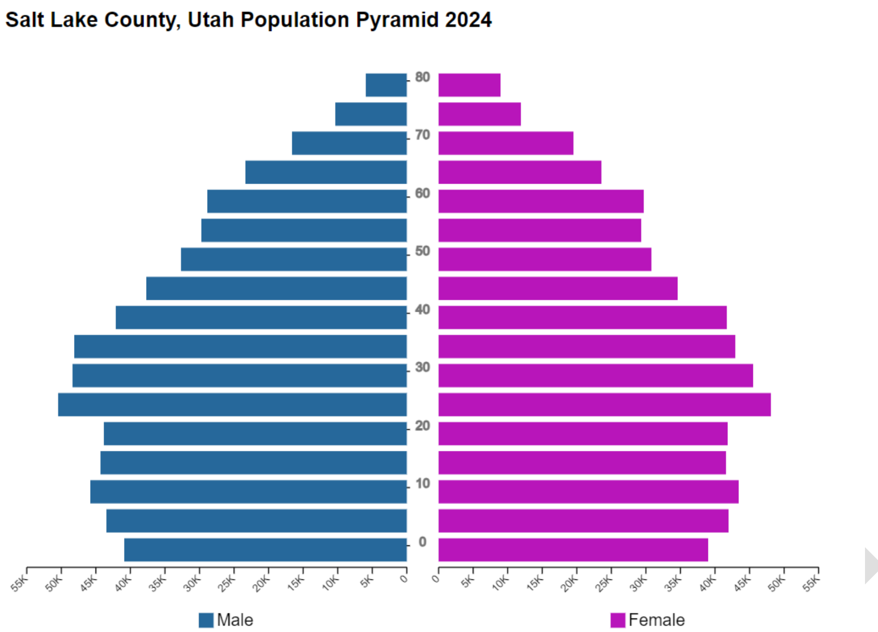


**Figure 9: Salt Lake County Population by Gender and Age[13]**

Figure 9 provides the 2024 statistical population data for Salt Lake County based on age and gender, indicating the median age is 33.4 (33 for males, 33.9 for females). Of the 872,565 adults, 133,703 are seniors. There are 582,943 females (49.38%) and 597,700 males (50.62%).

[13] World Population Review. "Salt Lake County, Utah Population 2024." 2024. https://worldpopulationreview.com/us-counties/utah/salt-lake-county

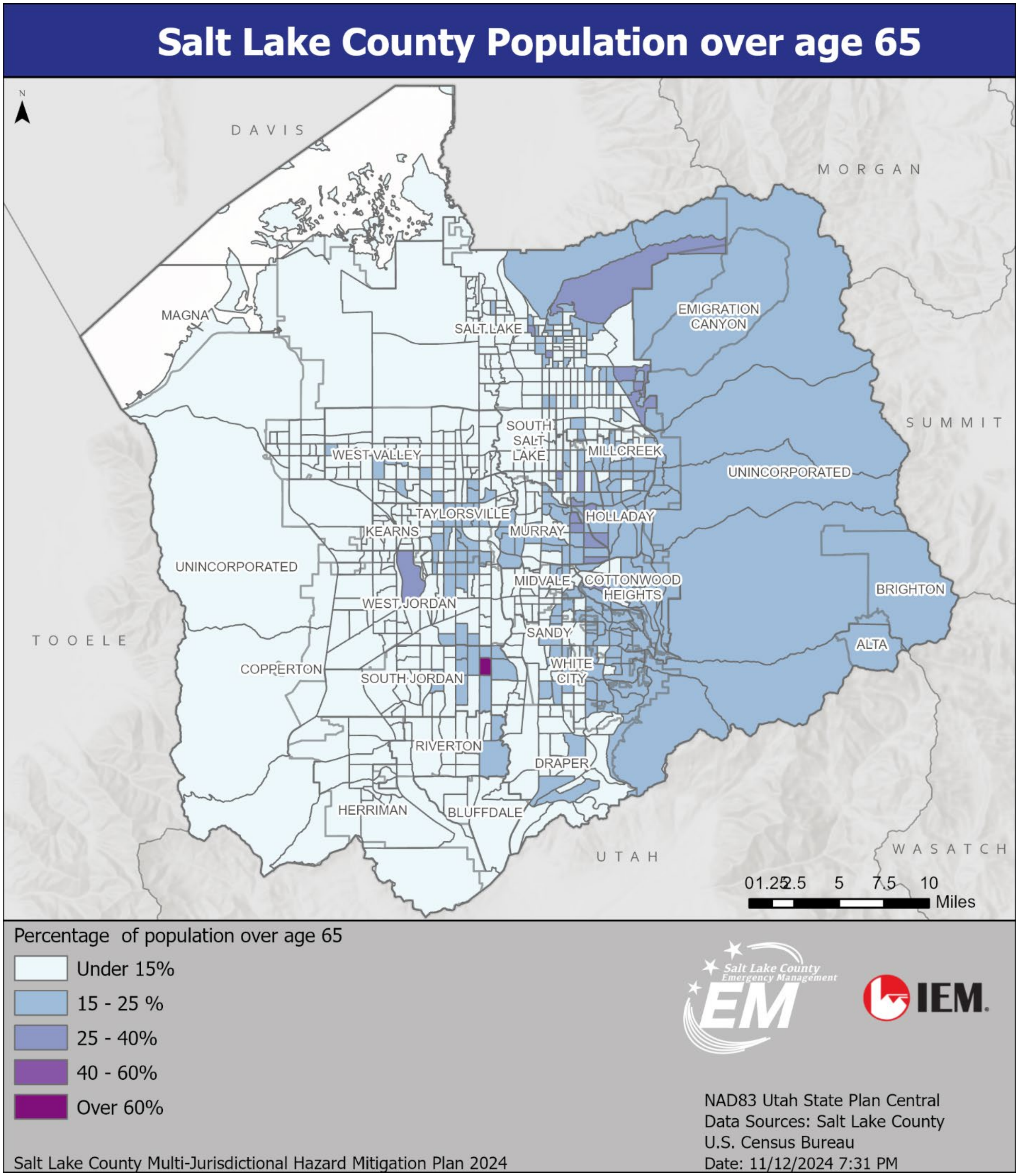


**Figure 10: Salt Lake County Population by Age 65 and Older**

## Population by Race

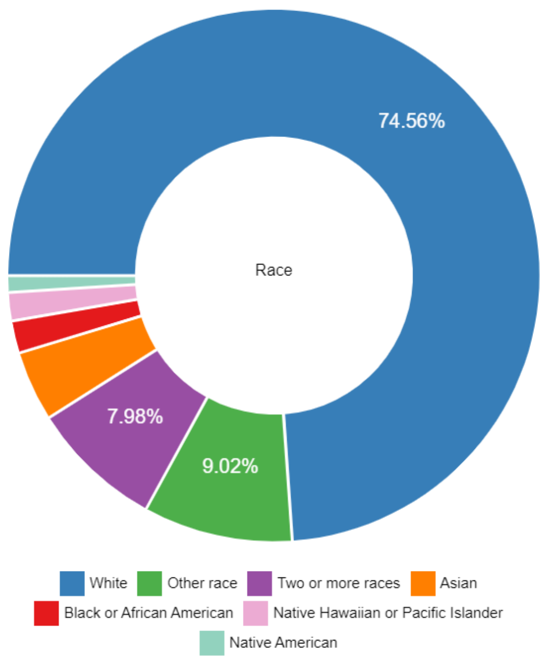


**Figure 11: Salt Lake County Population by Race**[14]

Figure 11 illustrates the Salt Lake County population by race. Of the total population, 880,344, or 74.56%, are white; 106,540, or 9.02%, identify as another race; 94,251, or 7.98%, identify as two or more races; 49,060, or 4.16%, are Asian; 21,531, or 1.82%; are Black or African American; 18,674, or 1.58%, are Native Hawaiian or Pacific Islander; and 10,243, or 0.87%, are Native American.

[14] Ibid.

## Population by Educational Attainment

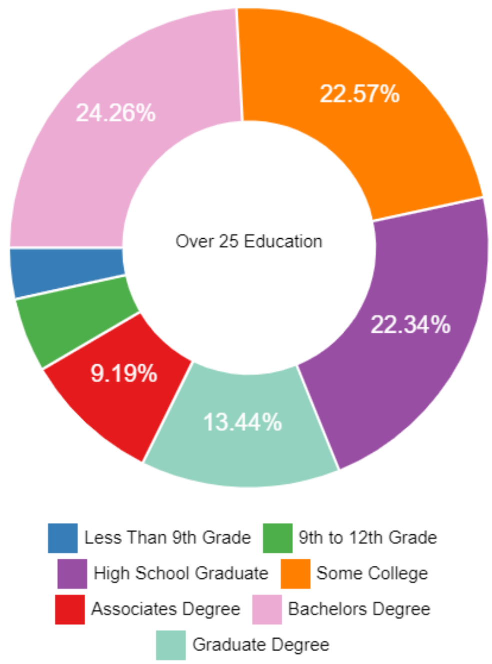


**Figure 12: Salt Lake County Population by Educational Attainment**[15]

Figure 12 illustrates the educational attainment levels of the Salt Lake County population. For residents over 25 years old, 25,107 (or 3.33%) have less than a 9th-grade education, and 36,846 (or 4.88%) attained a 9th- to 12th-grade education. High school graduates make up 22.34% of the population (168,538 individuals). Some college, associate degree, bachelor's degree, and graduate degree attainment totals 523,933, or 69.46%.[16]

# Housing

For 2018–2022, the United States Census Bureau reports an owner-occupied housing unit rate for Salt Lake County of 67.1%, with a total of 458,880 housing units, as of July 1, 2023. The median value of owner-occupied housing units for 2018–2022 was $440,400. The median selected owner costs for a monthly mortgage was $1,939, while the median gross rent was $1,394.[17]

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[15] Ibid.
[16] Ibid.
[17] U.S. Census. "Salt Lake County Utah." 2024. https://www.census.gov/quickfacts/fact/table/saltlakecountyutah/HSG445222

# 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-farming 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 source of employment, followed by government and education, health, and social services. Salt Lake is a regional center for the finance, health care, and high-tech industries. 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 5: Non-Farm Employment Report Salt Lake County (2023–2024[18]**

| July 2023 | June 2024 | July 2024 | % Change Over Year |
|---|---|---|---|
| 798,540 | 817,886 | 815,309 | 2.1% |

**Table 6: Employment Share Within Salt Lake City Area (Non-Farming Jobs)[19]**

| Salt Lake City Area Employment | July 2024 (thousands) | Change from July 2023 to July 2024 (thousands) | Change from July 2023 to July 2024 |
|---|---|---|---|
| Total Non-farm | 841.8 | 24.3 | 3.0% |
| Trade/Transport/Utilities | 161.1 | 1.9 | 1.2% |
| Prof/Business Services | 149.8 | 3.9 | 2.7% |
| Government | 116.4 | 5.3 | 4.8% |
| Education/Health/Social Services | 99.5 | 5.2 | 5.5% |
| Leisure/Hospitality | 72.7 | 2.4 | 3.4% |
| Financial Activities | 64.3 | 0.6 | 0.9% |
| Manufacturing | 66.4 | 2.3 | 3.6% |
| Mining, Logging, and Construction | 63.6 | 3.5 | 5.8% |
| Information | 24.5 | 0.0 | 0.0% |
| Other Services | 22.5 | -0.8 | -3.4% |

The unemployment rate measures those people who reside in a county, are jobless and available to take a job, and have actively sought work in the past four weeks. The unemployment rate is a proxy for the

[18] Utah.gov. Department of Workforce Services. "Non-Farm Employment." 2024. https://jobs.utah.gov/wi/data/library/employment/countyemployment.html
[19] United States Bureau of Labor Statistics. "Salt Lake City Area Economic Summary." August 29, 2024. https://www.bls.gov/regions/mountain-plains/summary/BLSSummary_SaltLakeCity.pdf

availability of labor. An unemployment rate between 4.0% and 4.8% may be considered balanced in terms of excess, balance, and shortage.

According to the United States Bureau of Labor Statistics, the unemployment rate in Salt Lake County in July 2024 was 3.6%, up from July 2023 at 2.6%.[20]

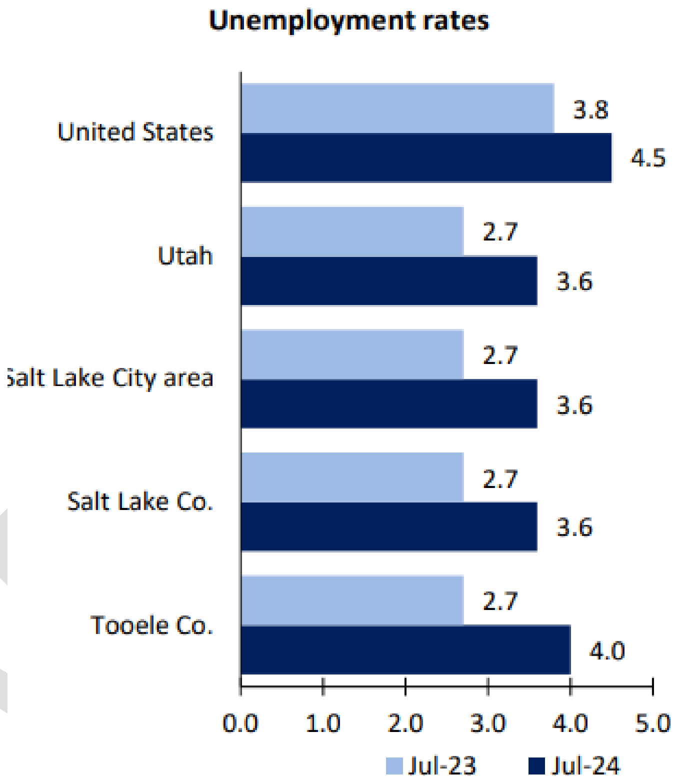



**Figure 13: Comparison of Unemployment Rates in National and Selected Areas[21]**

Looking ahead, Table 7 shows the employed population within the county is projected to increase by 72% from 2015 to 2065.[22]

**Table 7: Salt Lake County Employment Projections[23]**

| 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% |

[20] Utah.gov. Department of Workforce Services. "Seasonal Adjusted Unemployment Rates." 2024. https://jobs.utah.gov/wi/data/library/employment/countyunemployment.html
[21] U.S. Bureau of Labor Statistics. "Salt Lake City Area Economic Summary." August 29, 2024. https://www.bls.gov/regions/mountain-plains/summary/BLSSummary_SaltLakeCity.pdf
[22] Hanson, Janelle. "Utah in 2065." The University of Utah, Kem C. Gardner Policy Institute. October 21, 2016. https://attheu.utah.edu/facultystaff/utah-in-2065/
[23] Ibid.

## Income

According to the Bureau of Labor Statistics, the average weekly wage for all industries within the Salt Lake City area is $1,130.

**Table 8: Average Hourly Wages for Selected Occupations**[24]

| Occupation | Salt Lake City | United States |
|---|---|---|
| **All Occupations** | $31.67 | $31.48 |
| **Software Developers** | $58.13 | $66.40 |
| **General and Operations Manager** | $55.06 | $62.18 |
| **Training and Development Specialists** | $34.79 | $34.60 |
| **Market Research Analysts and Marketing Specialists** | $32.15 | $40.00 |
| **Electricians** | $29.38 | $32.60 |
| **Paralegals and Legal Assistance** | $28.20 | $31.95 |

## Poverty

A measure of poverty takes income and family size into account and has both immediate and long-lasting effects on health. Income assesses the financial resources available to individuals or families for necessities (e.g., food, clothing, and healthcare) to maintain or improve their well-being. Persons living in poverty are worse off than persons in more affluent households for many indicators tracked by the Utah Department of Health and Human Services Public Health Indicator Base Information System (PHIBIS). The Utah Public Health Data Resources reports poverty statistics based on the 2022 Model-based Small Area Income & Poverty Estimates (SAIPE) for school districts, counties, and states. The poverty threshold for a family of four, including two children, was $29,678 in 2022. Poverty thresholds are updated annually using the Consumer Price Index for All Urban Consumers (CPI-U) to allow for changes in the cost of living. They do not vary geographically. PHIBIS reports that the percentage of persons living in poverty in Salt Lake County is 7.7%. In addition, Utah has a lower percentage of children in poverty than the U.S. as a whole, 8.5% vs. 16.3% in 2022.[25]

# 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.

[24] U.S. Bureau of Labor Statistics. "Salt Lake City Area Economic Summary." August 29, 2024. https://www.bls.gov/regions/mountain-plains/summary/BLSSummary_SaltLakeCity.pdf
[25] Utah.gov. "Health Indicator Report of Utah Population Characteristics: Poverty, Children Age 17 and Under." Utah Department of Health and Human Services, Public Health Indicator Based Information System (IBIS). 2022. https://ibis.utah.gov/ibisph-view/indicator/view/ChldPov.html

**Table 9: Count of Critical Facilities by Jurisdiction**

| Name | Emergency Operations Centers | Fire Stations | Hospitals | Police Stations | Schools | County Facilities |
|---|---|---|---|---|---|---|
| Alta | 1 | 0 | 0 | 1 | 0 | 1 |
| Bluffdale | 1 | 2 | 0 | 2 | 7 | 1 |
| Brighton | 0 | 1 | 0 | 0 | 0 | 0 |
| Copperton | 0 | 1 | 0 | 0 | 0 | 1 |
| Cottonwood Heights | 1 | 2 | 0 | 1 | 7 | 10 |
| Draper | 1 | 3 | 1 | 1 | 21 | 7 |
| Emigration Canyon | 0 | 1 | 0 | 0 | 0 | 0 |
| Herriman | 1 | 2 | 0 | 1 | 12 | 6 |
| Holladay | 1 | 1 | 0 | 1 | 16 | 8 |
| Kearns | 0 | 1 | 0 | 1 | 11 | 11 |
| Magna | 0 | 2 | 0 | 1 | 7 | 8 |
| Midvale | 1 | 2 | 0 | 1 | 15 | 10 |
| Millcreek | 0 | 3 | 2 | 1 | 20 | 14 |
| Murray | 1 | 4 | 2 | 2 | 28 | 16 |
| Riverton | 1 | 3 | 1 | 1 | 12 | 10 |
| Salt Lake | 2 | 14 | 5 | 9 | 85 | 32 |
| Sandy | 1 | 5 | 2 | 1 | 35 | 7 |
| South Jordan | 1 | 3 | 0 | 1 | 22 | 9 |
| South Salt Lake | 2 | 3 | 1 | 3 | 24 | 16 |
| Taylorsville | 1 | 2 | 0 | 2 | 17 | 16 |
| Unincorporated | 0 | 1 | 0 | 0 | 3 | 3 |
| West Jordan | 1 | 5 | 1 | 1 | 42 | 15 |
| West Valley | 1 | 6 | 1 | 2 | 37 | 16 |
| White City | 0 | 0 | 0 | 0 | 1 | 1 |

## Transportation

As of 2023, the Salt Lake County International Airport was the 21st busiest airport in the United States, operating as a major hub for Delta Air Lines and SkyWest Airlines. Although not visible in the image below, the South Valley Regional Airport, located in West Jordan, is also available for public use.

Salt Lake County can be traversed on several interstate highways, including I-15, I-80, and I-215. Numerous other freeways, expressways, and significant arterial routes interconnect within the county, including SR-68, SR-201, and SR-154. The county also contains numerous bike paths for active transportation.

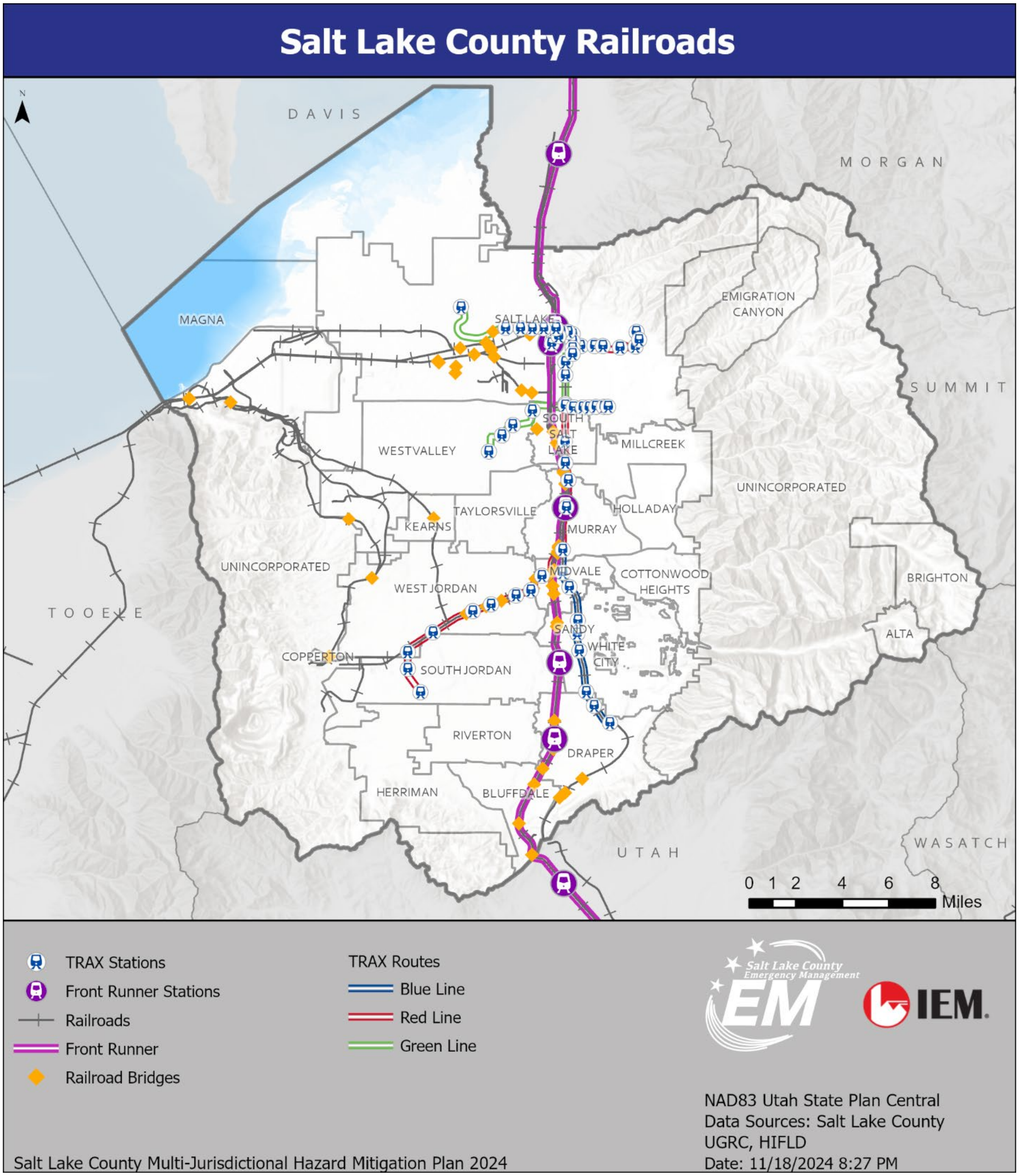



**Figure 14: Salt Lake County Railways**

The county is also heavily networked with bus and commuter rail lines operated by the Utah Transit Authority (UTA) (Figure 14 and Figure 15). The FrontRunner commuter rail line, TRAX light rail system, and numerous bus routes are all used for public transportation throughout Salt Lake County.

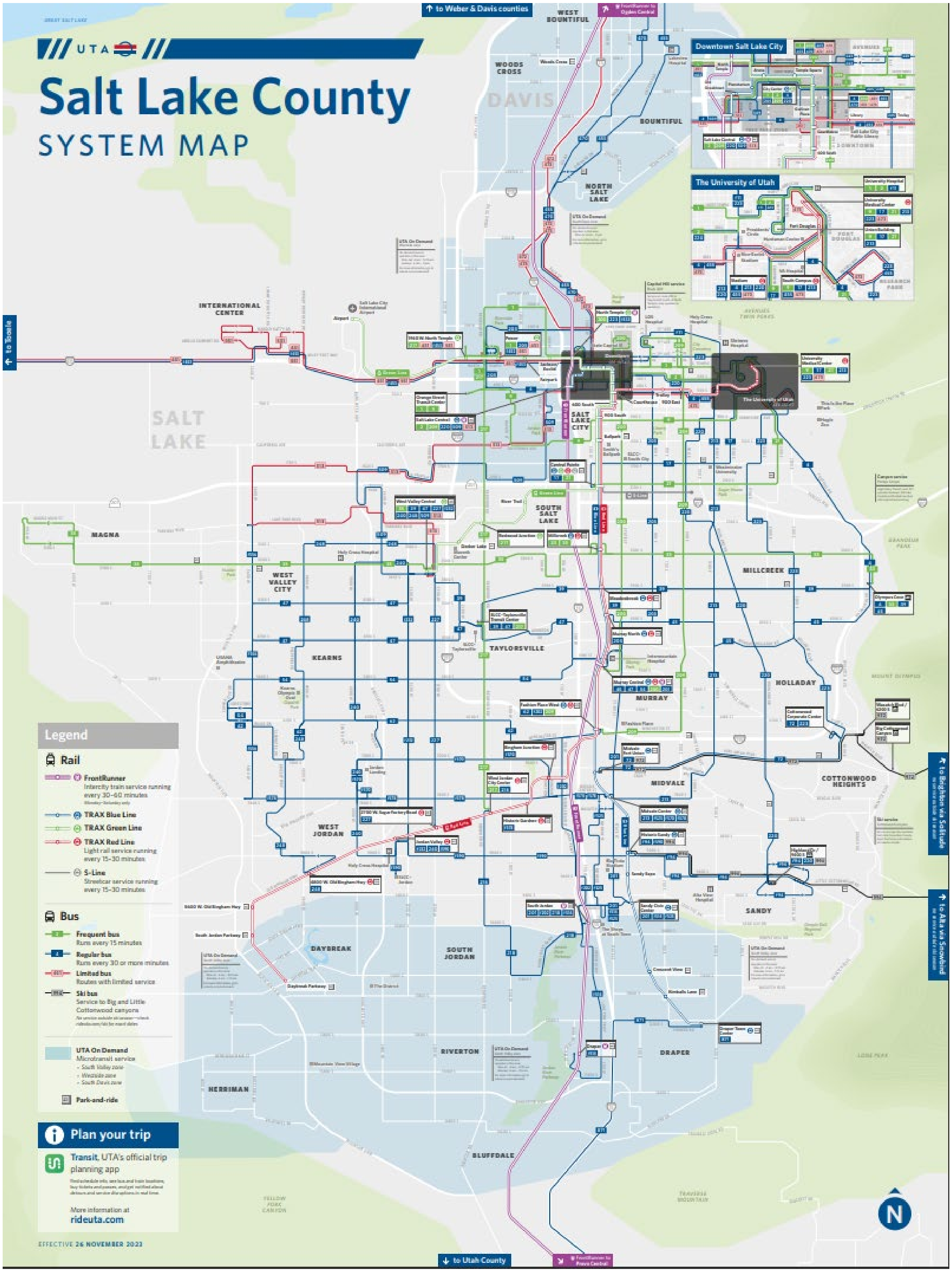


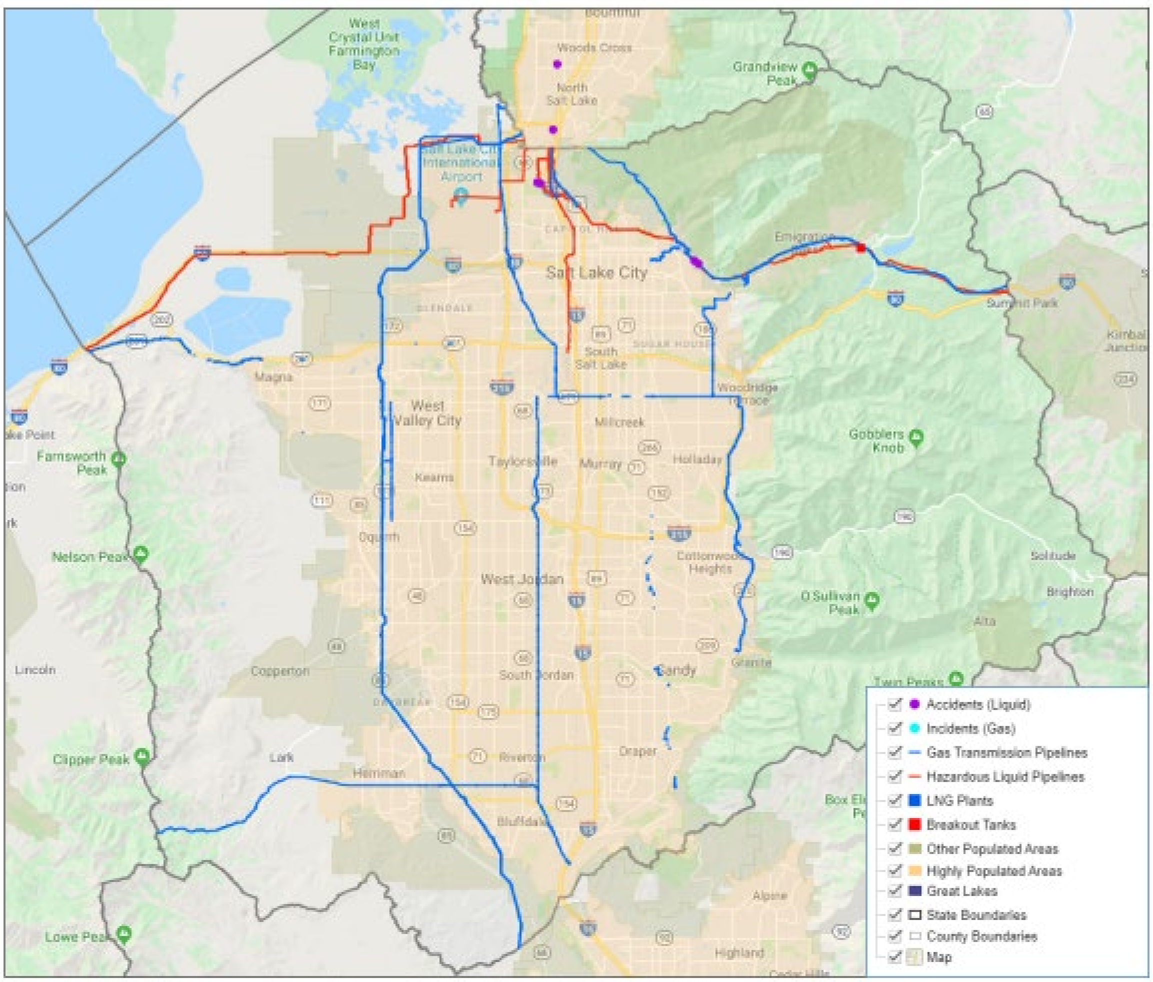

Figure 15: 2023 Salt Lake County Transit System Map

## Water Control Structures

According to the 2024 Utah Enhanced State Hazard Mitigation Plan, there are approximately 282 dam structures within Salt Lake County. The largest concentration of high and significant hazard dams is within the Wasatch Front counties, including the Salt Lake City metropolitan area. The Wasatch Front is a region in north central Utah of mostly contiguous cities and towns along the Wasatch Mountains. It stretches from Santaquin in the south to Pleasant View in the north. The Wasatch Front is the most highly populated region in Utah, with 80% of its residents living in this area. The National Levee Database also maps five 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 gas transmission and hazardous liquid pipelines within Salt Lake County (Figure 16).




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

**Figure 16: Salt Lake County Pipeline Map**

## 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 (Table 10).

**Table 10: Salt Lake County Trunk Radio Systems List [26]**

| System Name | Type | City |
|---|---|---|
| **Snowbird Ski Resort** | DMR Conventional Networked | Alta |
| **South Valley Sewer District** | DMR Motorola Capacity Plus Multi-Site (TRBO) | Bluffdale |
| **Progressive Leasing** | DMR Motorola Capacity Plus Single Site (TRBO) | Draper |
| **Herriman City** | DMR Motorola Capacity Plus Single Site (TRBO) | Herriman |
| **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 II | Magna |
| **Northrop Grumman Systems** | DMR Motorola Capacity Plus Single Site (TRBO) | Magna |
| **Enbridge Gas** | DMR Tier 3 Standard | Multiple |
| **National Security Agency Data Centers** | Project 25 Phase II | Multiple |
| **Peak Wireless Services** | NXDN NEXEDGE 9600 | Multiple |
| **Geneva Rock and Cement** | DMR Motorola Capacity Plus Multi-Site (TRBO) | Orem |
| **Brigham Young University** | DMR Motorola Connect Plus (TRBO) | Provo |
| **Staker Parson Construction** | DMR Motorola Capacity Plus Single Site (TRBO) | Riverton |
| **Alpha Communication** | DMR Motorola Connect Plus (TRBO) | Salt Lake City |
| **Brian Leifson** | Motorola Type II Smartnet | Salt Lake City |
| **Church of Jesus Christ of Latter-Day Saints** | Project 25 Phase II | Salt Lake City |
| **City Creek Center** | DMR Motorola Capacity Plus Single Site (TRBO) | Salt Lake City |
| **Delta Airlines** | DMR Motorola Capacity Plus Single Site (TRBO) | Salt Lake City |
| **Henkel Corporation** | LTR Standard | Salt Lake City |

[26] RadioReference.com. https://www.radioreference.com/

| System Name | Type | City |
|---|---|---|
| **Hogle Zoo** | DMR Motorola Capacity Plus Single Site (TRBO) | Salt Lake City |
| **Hyatt Regency Salt Lake City** | DMR Motorola Capacity Plus Single Site (TRBO) | Salt Lake City |
| **Intel Corporation** | Motorola Type II | Salt Lake City |
| **Intermountain Health Care Hospitals** | NXDN NEXEDGE 4800 | Salt Lake City |
| **Little America** | DMR Motorola Capacity Plus Multi-Site (TRBO) | Salt Lake City |
| **McIntosh Communications (DMR)** | DMR Motorola Capacity Plus Multi-Site (TRBO) | Salt Lake City |
| **McIntosh Communications (Ensign Peak)** | LTR Standard | Salt Lake City |
| **My Patriot Supply** | DMR Motorola Capacity Plus Single Site (TRBO) | Salt Lake City |
| **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 |
| **Salt Palace Convention Center** | DMR Motorola Capacity Plus Single Site (TRBO) | Salt Lake City |
| **Sun Communications** | DMR Motorola Capacity Plus Single Site (TRBO) | Salt Lake City |
| **Tesoro Companies** | DMR Conventional Networked | Salt Lake City |
| **Tesoro Refinery** | DMR Motorola Capacity Plus Single Site (TRBO) | Salt Lake City |
| **UCS Wireless (900)** | DMR Motorola Capacity Plus Multi-Site (TRBO) | Salt Lake City |
| **UCS Wireless (UHF)** | DMR Motorola Capacity Plus Multi-Site (TRBO) | Salt Lake City |
| **Unified Fire Authority** | Project 25 Phase II | Salt Lake City |
| **Unified Fire Authority (BD10)** | Motorola Type II | Salt Lake City |
| **United Parcel Service** | DMR Tier 3 Capacity Max | Salt Lake City |
| **University of Utah Hospitals** | NXDN NEXEDGE 4800 | Salt Lake City |
| **Utah Transit Authority** | MPT-1327 Standard | Salt Lake City |
| **Wasatch Front T-3** | DMR Tier 3 Capacity Max | Salt Lake City |
| **eBay Data Center** | DMR Conventional Networked | South Jordan |
| **Sunroc Construction** | DMR Motorola Capacity Plus Multi-Site (TRBO) | Spanish Fork |
| **Utah Communications Authority (P25)** | Project 25 Phase II | Statewide |
| **Hill Air Force Base** | Project 25 Phase II | Various |

| System Name | Type | City |
|---|---|---|
| **Kilgore Companies** | NXDN Icom IDAS Type C | Various |
| **Peak Wireless Services (DFA)** | NXDN NEXEDGE 4800 | Various |
| **Utah Communications Authority** | Motorola Type II SmartZone Omnilink | Various |
| **Jordan School District** | DMR Motorola Capacity Plus Single Site (TRBO) | West Jordan |
| **South Valley Water Reclamation** | DMR Motorola Capacity Plus Single Site (TRBO) | West Jordan |
| **Discover Cardtronics** | DMR Motorola Capacity Plus Single Site (TRBO) | West Valley City |
| **Frito Lay Plant** | DMR Motorola Capacity Plus Single Site (TRBO) | West Valley City |
| **United Parcel Service Delivery** | DMR Motorola Capacity Plus Single Site (TRBO) | West Valley City |

# Planning for the Future

Salt Lake County anticipates continued population growth over the next 30 years, reaching almost 5 million by 2050. This growth necessitates the 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. The Wasatch Choice 2050 Plan envisions transportation investments and inter-related land and economic development decisions that achieve desired local and regional outcomes.[27]

Four key strategies represent the overarching themes in the Wasatch Choice 2050 Plan and help achieve the regional goals. The key strategies of the Wasatch Choice 2050 Plan are as follows.

- **Provide Transportation Choices:** Help us have real options for getting around and increase the number of easily reached destinations.
- **Support Housing Options:** Support affordable housing types and locations that work best for our lives.
- **Preserve Open Space:** Preserve sufficient and easily accessible open lands that provide 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

[27] Wasatch Choice 2050 Plan. "Goals and Strategies." https://wasatchchoice.org/

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 the Comprehensive Economic Development Strategy, Local Planning, and Regional Transportation Plan (RTP). The maps below from the 2019–2050 RTP show the region's vision for future transportation and land use.

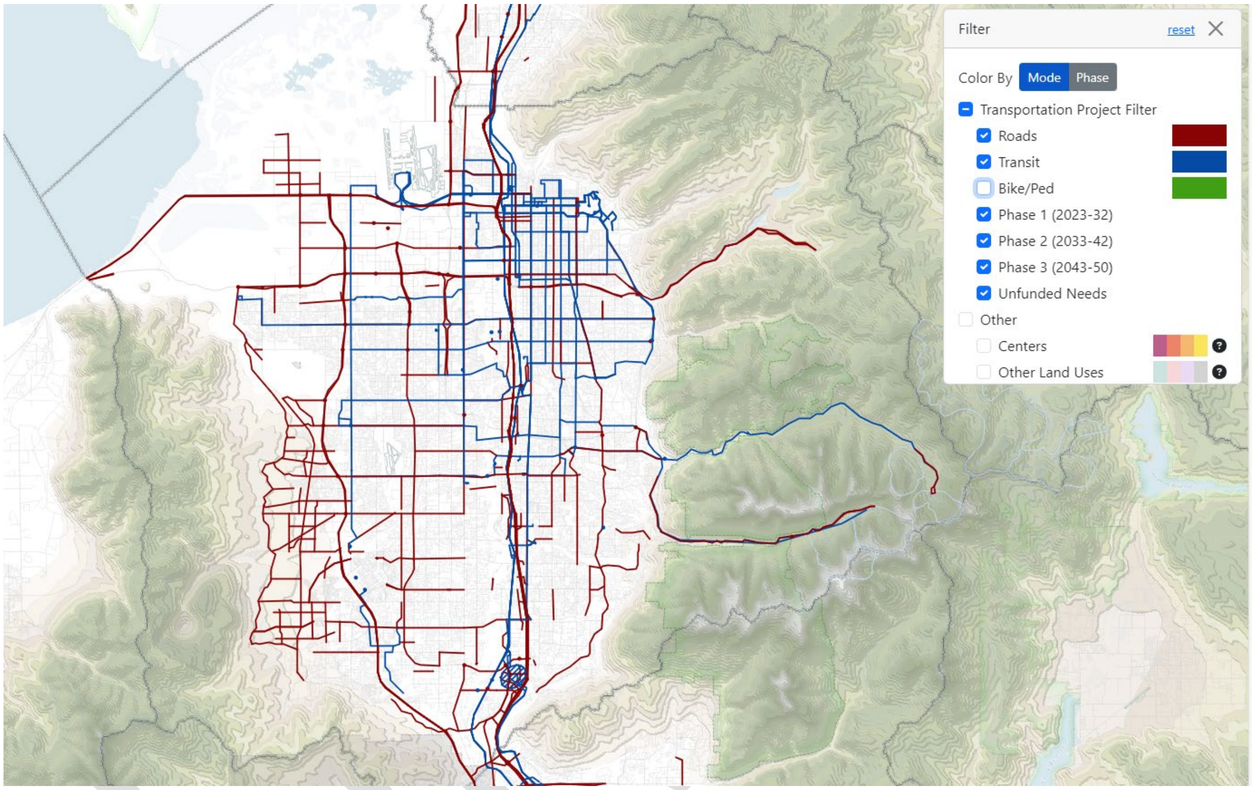



**Figure 17: Wasatch Choice Map – Roads and Transit[28]**

The regionally significant land uses include a hierarchy of centers (Figure 18). Centers are the hearts of a community and are locations where communities anticipate welcoming more buildings, even as they may maintain lower levels of density elsewhere. The locations vary in scale but, in all cases, are denser than their surrounding area, walkable, and offer a mix of uses. Because of these traits, residents within or near centers drive shorter distances and are likelier to walk, bike, and ride transit. Overall, this reduces traffic congestion and air emissions. In addition, they are typically good candidate locations for providing various housing options, including units that impact housing affordability.

[28] Wasatch Choice 2050 Plan. "Transportation Map." https://wasatchchoice.org/vision-map/#mapList=vision.transportation.landuse.econdev.recreation.olympics&selectedMap=vision&sideBarClosed=false&x=-12450274&y=4979018&scale=288895

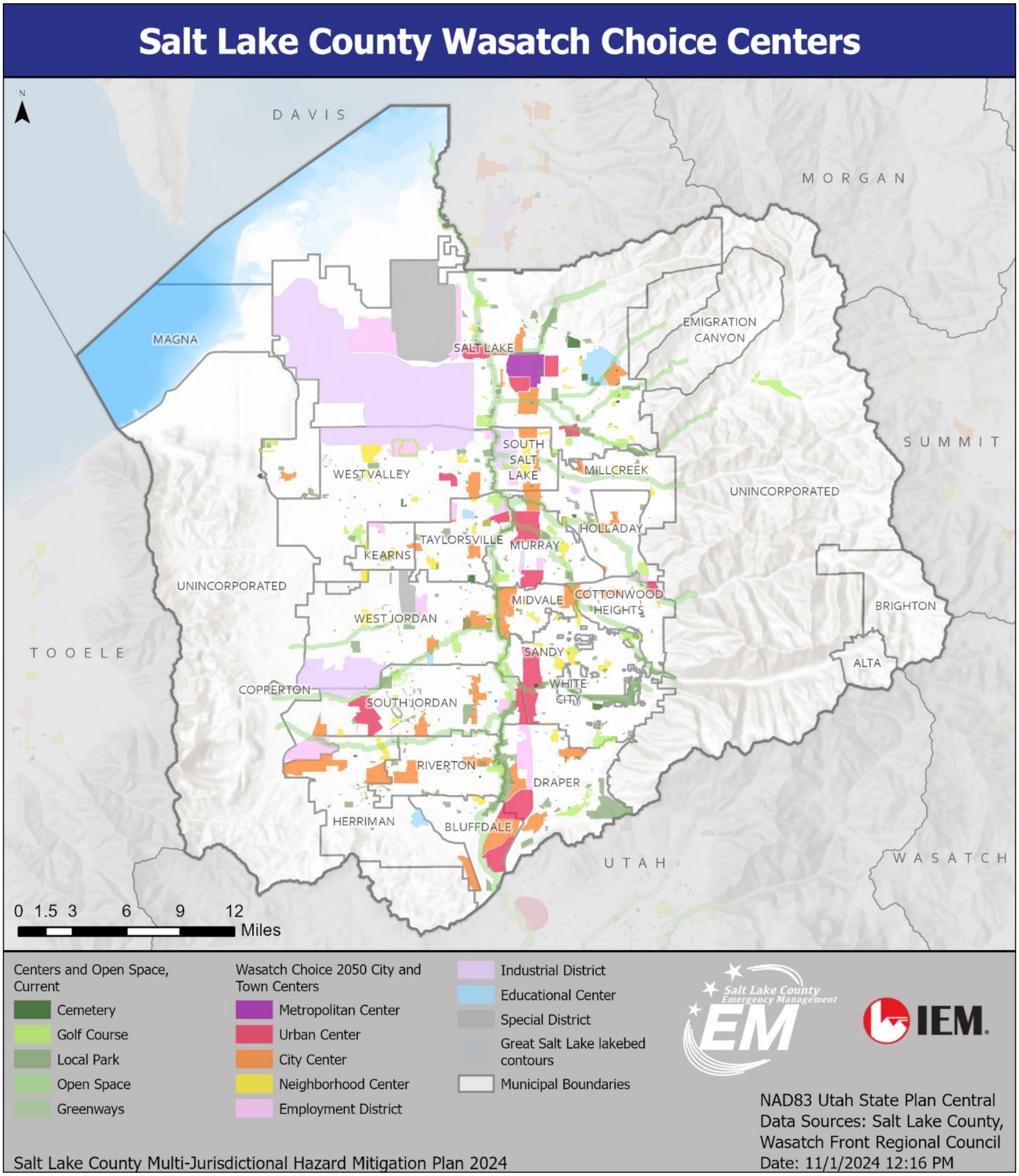



**Figure 18: Wasatch Choice Map – Land Use[29]**

The economic development map (Figure 19) shows several important regional policy and geographic considerations: Utah State Economic Clusters, Opportunity Zones, Community Development Areas

[29] Wasatch Choice 2050 Plan. https://wasatchchoice.org/vision-map/#mapList=vision.transportation.landuse.econdev.recreation.olympics&selectedMap=landuse&sideBarClosed=false&x=-12450274&y=4979018&scale=288895

(CDA) and Regional Development Areas (RDA), and Transit Oriented Developments (TODs). 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 the state and Salt Lake County sustain a competitive business advantage. Opportunity Zones are areas determined by the U.S. census as "low-income communities." Designated Opportunity Zones incentivize private sector investments in housing and economic development in these areas by providing tax incentives. CDAs and Community Reinvestment Areas (CRAs) are public financing tools. They temporarily use the increase in tax revenue spurred by land reinvestment to pay for infrastructure improvements. By doing so, they further encourage land reinvestment. TODs refer to housing, jobs, and commercial developments centered 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. TODs help reduce household transportation costs, congestion, and air pollution.

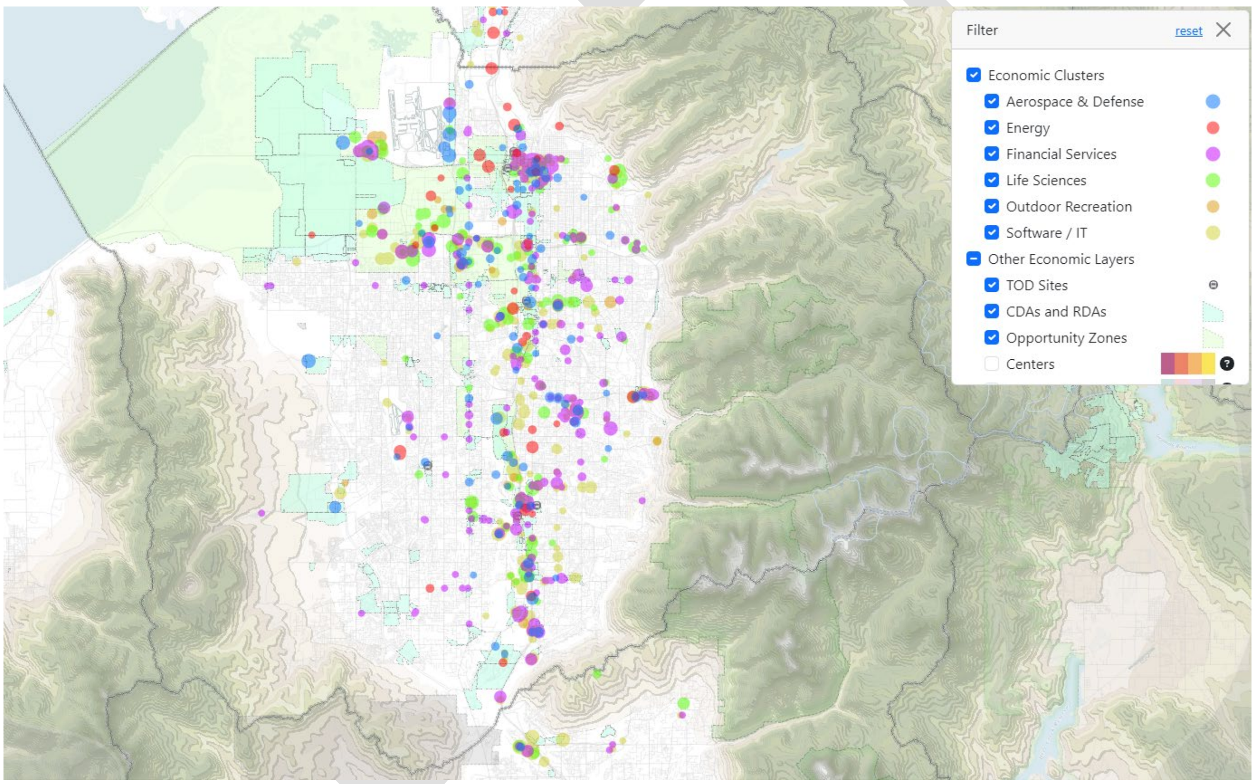



**Figure 19: Wasatch Choice Map-Economic Development[30]**

The Wasatch Front region is a stunning natural setting. As growth continues, one challenge is to ensure residents have sufficient open space and recreational opportunities that are easy to access. Open space can manifest itself in several 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 community gathering places, among many more. In addition to the

[30] Wasatch Choice 2050 Plan. "Economic Opportunities." https://wasatchchoice.org/vision-map/#mapList=vision.transportation.landuse.econdev.recreation.olympics&selectedMap=landuse&sideBarClosed=false&x=-12450274&y=4979018&scale=288895

mental and physical health benefits for people using these spaces, open space is critical green infrastructure.

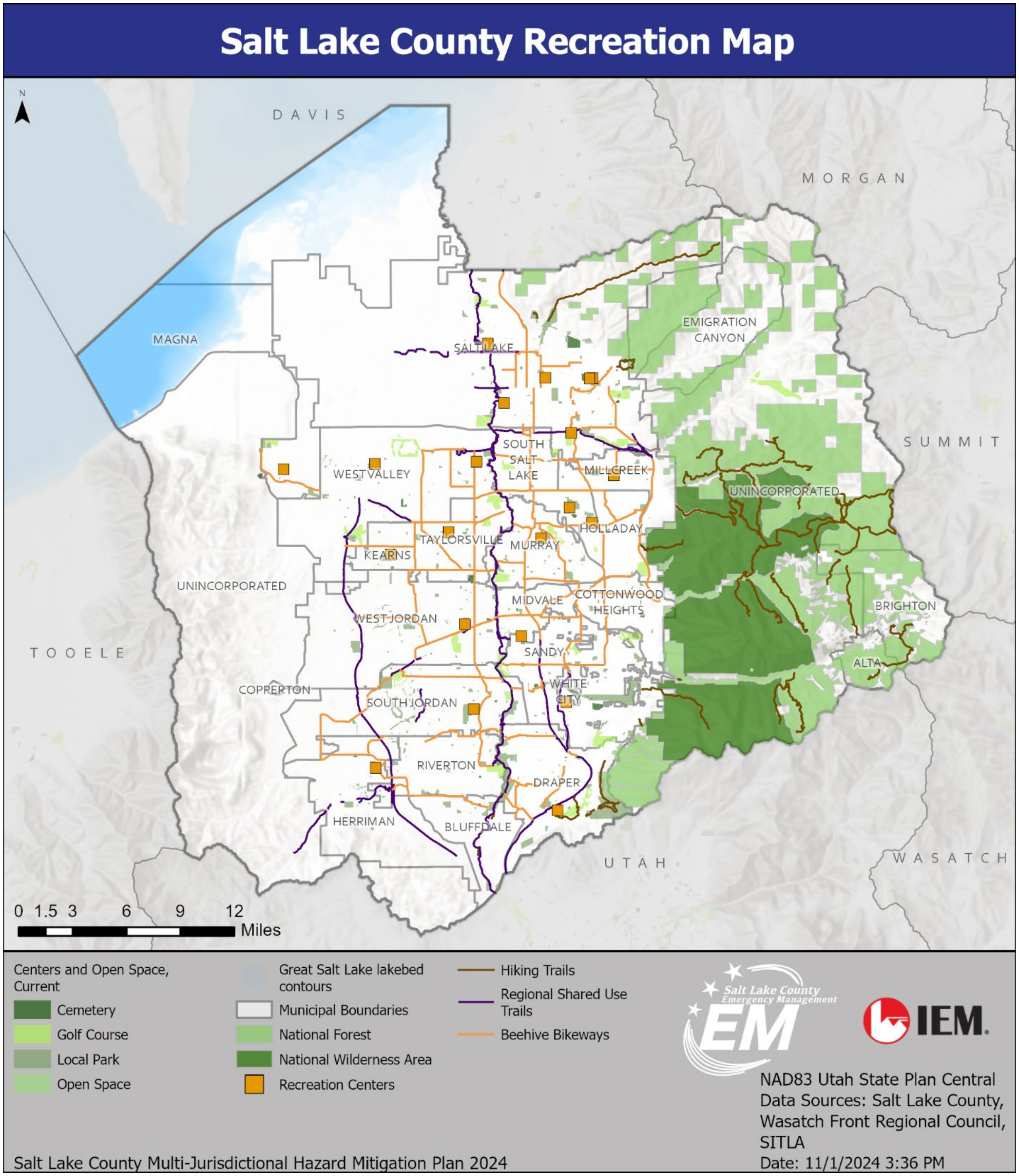



**Figure 20: Recreation in Salt Lake County**

As the region grows, diverse open space and recreation opportunities must be planned to maintain the quality of life that many residents enjoy. Setting local goals for park space per household is one way to focus attention on providing recreational spaces in growth areas. Parks are 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 a 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.

# Planning Process

Hazard mitigation plans serve as the foundation of an effective mitigation program. A robust whole-community planning process is important for gathering vital stakeholder input and building partnerships to implement mitigation actions. An inclusive planning process ensures that local jurisdictions and county-wide participants are involved and can provide meaningful input. By soliciting information from a broad range of stakeholders, the plan update meets the requirements outlined by FEMA in the Local Mitigation Planning Policy Guide. It reflects the plan participants' unique risks, vulnerabilities, goals, and strategies.

This section describes each stage of the planning process used to develop the 2025 Salt Lake County Multi-Jurisdictional Hazard Mitigation Plan (MJHMP). This process provided a framework for document development. It included organizing resources, assessing risk, developing the mitigation plan, drafting it, reviewing and revising it, and adopting and submitting the plan for approval.

## Plan Update Approach

Hazard mitigation planning in the United States is guided by the statutory regulations described in DMA 2000 and implemented through 44 Code of Federal Regulations (CFR) Part 201 and 206. FEMA's guidelines outline a four-step planning process for developing and approving hazard mitigation plans.

To develop the MJHMP, a planning process was created based on the various federal guidance documents and regulations, including FEMA's Local Mitigation Planning Handbook, which shows that the MJHMP planning process includes four core components: organizing resources, assessing risk, developing the mitigation action strategy, and adopting and implementing the plan.

Salt Lake County Emergency Management (SLCo EM) gathered letters of commitment from the participating jurisdictions during the summer of 2024. Once participating jurisdictions were identified, IEM facilitated the Kickoff Meeting with SLCo EM staff and jurisdictional planning partners to address the purpose of the mitigation plan and the planning process, establish a schedule for future meetings, and explain the importance of public and stakeholder involvement. In addition, they identified project objectives and data needs, refined plan boundaries, collected background information, identified project issues and challenges, discussed networking with essential partners, and facilitated discussion of the public outreach strategy and project management. This meeting also emphasized the need for public outreach, particularly to vulnerable populations.

Following the Kickoff meeting, the SLCo EM staff facilitated two presentations with executive leaders of participating jurisdictions, one with the Salt Lake County Council on October 15 and another with the Council of Mayors on October 17. These meetings were an opportunity to introduce the purpose of the mitigation plan and the planning process and explain the importance of public and stakeholder involvement.

**Figure 21: Salt Lake County Government Center Mitigation Plan Announcement**

The Risk Assessment Review Meeting provided plan participants with an opportunity to provide input about past and potential hazard impacts to each jurisdiction. The Mitigation Strategy Meeting provided plan participants with the opportunity to discuss the approach to mitigation across the planning area and included a brainstorming session to propose measures to reduce the current and future vulnerabilities described in the risk assessment stage of the plan. Plan participants were also invited to attend the Final Review and Plan Adoption Meetings, as well as an Executive Leadership Meeting to conduct the closeout proceedings.

**Figure 22: Salt Lake County HMP Kickoff Meeting**

## Local Jurisdiction Plan Participation

The 2025 Salt Lake County MJHMP update was developed with support from many agencies, organizations, and individuals. The Unified Fire Authority provided funding for this plan update. SLCo EM hired IEM International, Inc. (IEM) to update the 2019 plan. IEM provided technical and outreach assistance throughout the planning process, including updating the base plan, facilitating meetings, and developing and incorporating forms to garner stakeholder input. Salt Lake County was joined by the Cities, Towns, and Special Districts listed in Table 11.

The IEM team worked with each participating jurisdiction throughout the planning process to identify hazards of concern and mitigation actions specific to each jurisdiction. The county representatives worked with available county staff, as appropriate, outside of meetings to obtain feedback and provide input about specific concerns, capabilities, and actions for each jurisdiction.

The County also supported smaller, previously unincorporated jurisdictions that were not full participants in the prior plan, assigning the Salt Lake County Emergency Management Municipal Planner to oversee the planning process for the newly incorporated Cities of Magna, Copperton, and Kearns. Table 11 outlines the schedule of activities for plan participation, detailing the levels of involvement from all participating jurisdictions. It indicates which jurisdictions aim to meet the optional High-Hazard Potential Dams (HHPD) element. Those jurisdictions marked as pursuing this element are in areas designated as HHPDs. Special districts are labeled as N/A since they are encompassed within a specific city, and that city will fulfill the requirements for the HHPD element.[31]

**Table 11: Participating Jurisdictions**

| Jurisdiction | Participating Jurisdiction in 2019 Plan | Participating Jurisdiction in 2025 Plan | Seeking to Meet Optional HHPD Element |
|---|---|---|---|
| Town of Alta | Yes | Yes | No |
| City of Bluffdale | Yes | Yes | Yes |
| Brighton | Yes | Yes | Yes |
| Copperton | Yes | Yes | No |
| Cottonwood Heights | Yes | Yes | No |
| Draper City | Yes | Yes | Yes |
| Emigration Canyon | Yes | Yes | No |
| Herriman City | Yes | Yes | Yes |
| City of Holladay | Yes | Yes | Yes |
| City of Kearns | Yes | Yes | No |
| Magna City | Yes | Yes | No |
| Midvale City | Yes | Yes | Yes |

[31] National Inventory of Dams, "Salt Lake County." https://nid.sec.usace.army.mil/#/dams/search/sy=@countyState:salt%20lake%20@hazardId:(4)&viewType=map&resultsType=dams&advanced=false&hideList=false&eventSystem=false

| Jurisdiction | Participating Jurisdiction in 2019 Plan | Participating Jurisdiction in 2025 Plan | Seeking to Meet Optional HHPD Element |
|---|---|---|---|
| City of Millcreek | Yes | Yes | No |
| City of Murray | Yes | Yes | No |
| Riverton City | Yes | Yes | Yes |
| Salt Lake City | Yes | Yes | Yes |
| City of Sandy | Yes | Yes | Yes |
| City of South Jordan | Yes | Yes | Yes |
| City of South Salt Lake | Yes | Yes | Yes |
| City of Taylorsville | Yes | Yes | No |
| West Jordan City | Yes | Yes | No |
| West Valley City | Yes | Yes | No |
| White City | Yes | Yes | No |
| Salt Lake Community College | Yes | Yes | N/A |
| Salt Lake County | Yes | Yes | Yes |
| Jordan School District | No | Yes | N/A |
| Canyons School District | No | Yes | N/A |

## Organizing Resources

As part of this step, the IEM team reviewed and incorporated, as appropriate, various existing plans, studies, reports, and other technical data/information into the MJHMP update. Suggestions for important data to include were collected from the participating jurisdictions and stakeholders. Relevant information from the following documents and other sources has been incorporated in the MJHMP update, especially in the hazard profiles (Table 12).

**Table 12: Organizing Resources**

| Existing Resource | Used in Plan |
|---|---|
| **UTAH 2024 State Hazard Mitigation Plan** | Climate Change sections of Hazard Profiles, maps, and figures relevant to sections |
| **Salt Lake County 2019 Pre-Disaster Mitigation Plan** | To update all sections of the plan |
| **Federal Emergency Management Agency** | How-to Guidelines for each section of the plan |
| **National Weather Service (NOAA/NCEI)** | Each natural hazard profile includes statistical data related to previous occurrences of disasters in the jurisdictions that were reported. |
| **National Climate Data Center** | Statistics and research information for each jurisdiction relating to drought and severe weather conditions as part of the hazard profiles' previous occurrence sections |

| Existing Resource | Used in Plan |
|---|---|
| **Utah Division of Emergency Management** | Geographical Information Systems (GIS) data, flood data, Hazus data for floods, and earthquake data added to various sections of the hazard profiles |
| **Utah Geologic Survey** | GIS data, geologic information added to various sections of the hazard profiles |
| **Utah Division of Forestry Fire and State Lands** | State Wildfire information and statistical data added to various sections of the hazard profiles. |
| **Utah Avalanche Center** | Snow and Avalanches and statistical data added to various sections of the hazard profiles |
| **Utah Department of Transportation** | Traffic, accidents, and hazardous materials transportation information and statistical data added to various sections of the hazard profiles |
| **Utah Geospatial Resource Center** | GIS data and statistical data added to various sections of the hazard profiles |
| **University of Utah Seismic Station** | Earthquake data and statistical data added to various sections of the hazard profiles |
| **Utah State University** | Climate data and statistical data added to various sections of the hazard profiles |
| **Salt Lake County and Municipalities Emergency Operations Plan** | Histories, mitigation actions, public input; GIS, assessor, transportation, property, and infrastructure data |
| **Earthquake Safety in Utah** | Identification of potential earthquake mitigation actions and statistical data added to various sections of the hazard profiles |
| **Utah Natural Hazards Handbook** | Identification of natural hazard risks for Salt Lake County and statistical data added to various sections of the hazard profiles |
| **Utah Statewide Fire Risk Assessment Project** | Evaluation of fire risk assessment for Salt Lake County and potential mitigation actions and statistical data added to various sections of the hazard profiles |
| **A Strategic Plan for Earthquake Safety in Utah** | Identification of potential earthquake mitigation actions and statistical data added to various sections of the hazard profiles |
| **State of Utah Wildfire Plan 2008** | Prior wildfire mitigation action review |
| **State of Utah Drought Plan 2007** | Prior wildfire mitigation action review |

## Identifying the Hazards

Hazard identification was initiated through an extensive process that utilized the following multi-disciplinary cross-sector representation:

- Salt Lake County Emergency Management
- Consulting Planning Team
- Local Emergency Managers
- Local Emergency Planning Committee
- Public Works Staff
- Community Stakeholders
- Public individuals
- Elected officials
- Special Service Districts
- Utah Division of Emergency Management
- Utah Geological Survey
- Utah Geospatial Resource Center

The hazard identification process was aided by FEMA's how-to guidance documents, FEMA 386-1,2,3,7, FEMA Post Disaster Hazard Mitigation Planning Guidance DAP-12, the Disaster Mitigation Act of 2000, 44 CFR Parts 201 and 206, the Interim Final Rule, and the Local Mitigation Plan Review Tool. The risk assessment process also drew on assistance from local Geographical Information Systems (GIS) departments using the best available data.

The identification process for each participating jurisdiction encompassed natural hazards that consistently affected each area before and during the planning process based on the history of occurrences, future probability, and risk. These specific hazards were identified based on a hazard identification risk assessment that identified the natural hazards listed below as being the most prevalent and posing the most potential risk to the County. While it is recognized that dam failure is not a natural hazard, the potential impact to Salt Lake County from a catastrophic dam failure would likely be so severe that inclusion into the Plan was warranted. Municipal jurisdictions contributed to the risk assessment analyses performed for the County when located within an identified hazard boundary. Upon initial review of this plan, specific hazards associated with severe weather were renamed and split into separate hazards to identify better and address their unique considerations per DEM and FEMA recommendations.

The 2025 MJHMP addresses the 19 natural and man-made hazards most applicable to Salt Lake County and includes the following:

### NATURAL HAZARDS

- Avalanche
- Earthquake
- Lightning
- Extreme Heat
- Extreme Cold
- Flood
- Landslide/Slope Failure
- Tornadoes
- High Wind
- Radon
- Heavy Rain
- Wildfire
- Drought
- Heavy Snow/Blizzard
- Public Health Epidemic-Pandemic

### MAN-MADE HAZARDS

- Dam Failure
- Hazardous Materials
- Terrorism and Cyberterrorism
- Civil Disturbance

## Assessing Risk and Vulnerabilities

Each hazard identified was profiled with the most current available information and data, including the occurrence and probability ranking of future hazard events and a summary of each jurisdiction's vulnerability to each hazard. In profiling hazards, IEM researched hazards with the plan participants to review all-natural and community-identified hazards and occurrences. All possible resources for information and data were considered, such as the current MJHMP, Master/General/Comprehensive Plans, Community Wildfire Plans, Strategic Plans, and other similar sources. IEM provided Hazus models for the risk assessment.

IEM developed hazard profiles of each jurisdiction's vulnerability to specific hazards based on hazard assessments. This assessment identifies critical facilities and infrastructure by type and hazard area, describes land use and development trends to inform future land use policy and decisions, and explains how potential climate variation may impact the jurisdiction's current and future vulnerability for each hazard.

## Evaluating Participant Capabilities

This update documents the effectiveness of the county's efforts to integrate mitigation into other planning efforts since the previously approved plan. IEM conducted a capability assessment to inventory existing plans, policies, procedures, programs, and other initiatives that are currently in place to support hazard mitigation. Jurisdictional participation in the NFIP was analyzed by working with local and state floodplain managers and NFIP administrators to collect information. Collecting and assessing this information identifies high-risk areas, properties, and populations and allows jurisdictions to determine mitigation actions that will most efficiently and effectively protect the community. The Plan Participants formulated and wrote a community description for the plan, utilizing past plans, current and past studies, and the institutional knowledge of stakeholders, municipalities, and the public.

## Developing Mitigation Goals and Actions

The Mitigation Strategy was evaluated, and updated goals and objectives were outlined in existing mitigation plans. This step is particularly important as Salt Lake County has experienced changes in risk severity and increased frequency of hazard events.

## Maintaining the Plan

The plan implementation section identifies ways to incorporate mitigation strategies into existing planning practices, policies, and programs to institutionalize hazard mitigation in Salt Lake County's program. The plan maintenance process will also clearly indicate the method and schedule to be used over the next five years to monitor, evaluate, and update the plan, including timelines and responsibilities.

**Table 13: Plan Participation Schedule of Activities**

| Meetings and Assignments | Salt Lake County | Town of Alta | City of Bluffdale | Brighton | Copperton | Cottonwood Heights | Draper City | Emigration Canyon | Herriman City | City of Holladay | City of Kearns | Magna City | Midvale City | City of Millcreek | City of Murray | Riverton City | Salt Lake City | City of Sandy | City of South Jordan | City of South Salt Lake | City of Taylorsville | West Jordan City | West Valley City | White City | Salt Lake Community College | Jordan School District | Canyons School District |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 9/5/2024 HMP Kickoff Meeting | X | - | - | X | X | X | X | X | - | X | X | X | X | X | X | X | X | X | X | X | X | X | X | - | X | X | X |
| 9/30/2024 Public Information Officer HMP Information Meeting | X | - | - | - | - | X | - | - | X | X | X | - | - | X | - | - | X | - | - | X | - | - | - | - | - | - | - |
| 10/2/2024 Risk Assessment Meeting | X | X | - | X | X | X | - | X | - | X | X | X | X | X | - | - | X | - | X | X | X | X | - | - | X | X | - |
| 10/21/2024 Mitigation Strategy Meeting | X | X | - | X | x | - | - | X | X | X | X | X | X | - | - | X | X | - | - | X | X | X | - | - | - | X | X |
| Letter of Intent Submitted | X | X | X | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| Public Outreach Activities | X | X | | | | X | X | | X | X | | | X | X | X | X | X | X | X | X | X | X | X | | | X | |
| Completed Planning Process Form | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | | |
| Submitted Mitigation Actions Status Update | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | | |
| Submitted Risk Assessment Form | X | X | X | X | X | | X | X | | X | X | X | X | X | | X | X | X | X | X | X | X | | | X | X | |

| Meetings and Assignments | Salt Lake County | Town of Alta | City of Bluffdale | Brighton | Copperton | Cottonwood Heights | Draper City | Emigration Canyon | Herriman City | City of Holladay | City of Kearns | Magna City | Midvale City | City of Millcreek | City of Murray | Riverton City | Salt Lake City | City of Sandy | City of South Jordan | City of South Salt Lake | City of Taylorsville | West Jordan City | West Valley City | White City | Salt Lake Community College | Jordan School District | Canyons School District |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Submitted Mitigation Strategy and 2024 Mitigation Actions** | X | X | | X | X | | | X | X | X | X | X | X | X | | | | X | X | X | X | | X | x | | | |
| **Submitted Capabilities Assessment Form/NFIP Assessment Form** | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | | | |
| **Participated in Draft Plan Review** | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Completed Plan Adoption** | | | | | | | | | | | | | | | | | | | | | | | | | | | |

# Stakeholder Engagement

One of the first steps in the planning process was to identify and invite key agencies and stakeholders to participate in the plan update. Per the Local Mitigation Planning Policy Guide, stakeholders were categorized in the following ways:

1. Local and regional agencies involved in hazard mitigation activities.

   *Examples include public works, emergency management, local floodplain administration, and GIS departments.*

2. Agencies that have the authority to regulate development.

   *Examples include zoning, planning, community, and economic development departments, building officials, planning commissions, or other elected officials.*

3. Neighboring communities

   *Examples include adjacent local governments, including special districts, such as those affected by similar hazard events or that may share a mitigation action or project that crosses boundaries. Neighboring communities may be partners in hazard mitigation and response activities or where critical assets, such as dams, are located.*

4. Representatives of businesses, academia, and other private organizations.

   *Examples include private utilities or major employers that sustain community lifelines.*

5. Representatives of nonprofit organizations, including community-based organizations, that work directly with and/or support underserved communities and socially vulnerable populations.

   *Examples include housing, healthcare, and social service agencies.*

Another factor that was considered while developing the list of participants to engage in this plan update was community lifelines. Community lifelines are the most fundamental services in the community that, when stabilized, enable all other aspects of society to function (Figure 23). A thorough understanding of lifelines allows decision-makers to identify key priorities, understand the root causes of the issues, and implement effective measures to reduce risk and respond to a catastrophic incident.


**Figure 23: FEMA Community Lifelines**[32]

For this plan update, each jurisdiction was asked to identify internal and external stakeholders who could support the plan update. The IEM team also helped identify stakeholders, including those representing underserved and vulnerable populations. These stakeholders were provided multiple opportunities to participate through meetings, a dedicated stakeholder digital survey, phone calls, and reviewing the draft plan. Finally, IEM conducted meetings directly with the participating jurisdictions to ensure that all information included in the plan was identified. A list of stakeholders provided the opportunity to participate is included in Table 14. The stakeholder types have been adapted to preserve space and/or improve clarity.

**Table 14: Stakeholders Given the Opportunity to Participate**

| Jurisdiction/Agency/ Organization | Type of Stakeholder | Description |
|---|---|---|
| **Greater Salt Lake Municipal Services** | Floodplain/Stormwater Management, Municipal Administrative Services for newly incorporated cities and towns | Local and regional agencies involved in hazard mitigation activities. |
| **Utah Division of Emergency Management** | State Emergency Management | Local and regional agencies involved in hazard mitigation activities. |
| **Salt Lake County Emergency Management** | County Emergency Management | Local and regional agencies involved in hazard mitigation activities. |
| **Utah Division of Water Rights Dam Safety Section** | State Dam Safety Agency | Agencies that have the authority to regulate development. |
| **Millcreek Emergency Management** | Local Emergency Management | Local and regional agencies involved in hazard mitigation activities. |
| **Taylorsville - Bennion Improvement District** | Water Utility Company | Representatives of businesses, academia, and other private organizations. |

[32] FEMA. "Community Lifelines." https://www.fema.gov/emergency-managers/practitioners/lifelines

| Jurisdiction/Agency/ Organization | Type of Stakeholder | Description |
|---|---|---|
| **Jordan Basin Improvement District** | Public Sanitary Sewer Service | Representatives of businesses, academia, and other private organizations. |
| **City of Riverton Emergency Management** | Local Emergency Management | Local and regional agencies involved in hazard mitigation activities. |
| **City of Taylorsville Emergency Management** | Local Emergency Management | Local and regional agencies involved in hazard mitigation activities. |
| **Murray City Fire Department** | Local Fire Department | Local and regional agencies involved in hazard mitigation activities. |
| **West Jordan City Emergency Management** | Local Emergency Management | Local and regional agencies involved in hazard mitigation activities. |
| **Utah Department of Transportation** | State Transportation Agency | Agencies that have the authority to regulate development. |
| **Summit County Emergency Management** | Local Emergency Management | Neighboring Community. |
| **National Weather Service Weather Forecast Office Salt Lake City** | Warning Coordination Meteorology | Representatives of businesses, academia, and other private organizations. |
| **Tooele County** | County Government | Neighboring Community. |
| **Utah County** | Local Emergency Management | Neighboring Community. |
| **Salvation Army** | Disaster Non-Governmental Organization | Nonprofit Organization serving underserved populations. |
| **American Red Cross** | Disaster Non-Governmental Organization | Nonprofit Organization serving underserved populations. |
| **Salt Lake Valley Emergency Communication Center** | Unified Emergency Communication System | Representatives of businesses, academia, and other private organizations. |
| **Salt Lake County Health Department** | Public Health Agency | Local and regional agencies involved in hazard mitigation activities. |
| **Salt Lake County Human Services** | Human Services Department | Local and regional agencies involved in hazard mitigation activities. |
| **Murray City Emergency Management** | Local Emergency Management | Local and regional agencies involved in hazard mitigation activities. |
| **Murray City Department of Public Works** | Public works Department | Local and regional agencies involved in hazard mitigation activities. |

| Jurisdiction/Agency/ Organization | Type of Stakeholder | Description |
|---|---|---|
| **Salt Lake County Animal Services** | County Animal Shelter | Local and regional agencies involved in hazard mitigation activities. |
| **Salt Lake County Facilities Management** | County Buildings and Facilities | Local and regional agencies involved in hazard mitigation activities. |
| **Draper City Fire Department and Emergency Management** | Local Fire Department and Emergency Management | Local and regional agencies involved in hazard mitigation activities. |
| **Salt Lake County Information Technology Department** | County Information Technology | Local and regional agencies involved in hazard mitigation activities. |
| **Salt Lake County Geospatial Information Systems** | County GIS | Local and regional agencies involved in hazard mitigation activities. |
| **Salt Lake County Office of Regional Development** | County Development | Local and regional agencies involved in hazard mitigation activities. |
| **Salt Lake County Public Works** | Public Works Department | Local and regional agencies involved in hazard mitigation activities. |
| **Salt Lake County Flood Control** | Public Works Department | Local and regional agencies involved in hazard mitigation activities. |
| **Utah Transit Authority** | Public Transportation | Agencies that have the authority to regulate development. |
| **Salt Lake County Aging and Adult Services** | Social Service Agency | Nonprofit Organization serving underserved populations. |
| **Granger Hunter Improvement District** | Water Utility Company | Representatives of businesses, academia, and other private organizations. |
| **Rocky Mountain Power/Pacific Corporation** | Electric Utility Company | Representatives of businesses, academia, and other private organizations. |
| **Herriman City Emergency Management** | Local Emergency Management | Local and regional agencies involved in hazard mitigation activities. |
| **South Salt Lake Emergency Management** | Local Emergency Management | Local and regional agencies involved in hazard mitigation activities. |
| **West Valley City Emergency Management** | Local Emergency Management | Local and regional agencies involved in hazard mitigation activities. |

| Jurisdiction/Agency/ Organization | Type of Stakeholder | Description |
|---|---|---|
| **Utah Earthquake Program/Division of Emergency Management** | State Emergency Management | Local and regional agencies involved in hazard mitigation activities. |
| **Utah State Floodplain Management** | State Flood Management | Agencies that have the authority to regulate development. |
| **Davis County Emergency Management** | Local Emergency Management | Neighboring Community. |
| **Utah Department of Health and Human Services** | Social Services Agency | Agencies that have the authority to regulate development. |
| **Salt Lake County Deputy Mayor of Regional Operations** | Local County Government | Local and regional agencies involved in hazard mitigation activities. |
| **White City Water Improvement District** | Water Utility Company | Representatives of businesses, academia, and other private organizations. |
| **Copperton Improvement District** | Water Utility Company | Representatives of businesses, academia, and other private organizations. |
| **Big Cottonwood Canyon Improvement District** | Water Utility Company | Representatives of businesses, academia, and other private organizations. |
| **Cottonwood Improvement District** | Water Utility Company | Representatives of businesses, academia, and other private organizations. |
| **Metropolitan Water District of Salt Lake & Sandy** | Water Utility Company | Representatives of businesses, academia, and other private organizations. |
| **Emigration Improvement District** | Water Utility Company | Representatives of businesses, academia, and other private organizations. |
| **Magna Water Co. (an improvement dist.)** | Water Utility Company | Representatives of businesses, academia, and other private organizations. |
| **Jordan Valley Water Conservancy District** | Water Utility Company | Representatives of businesses, academia, and other private organizations. |
| **Murray Power** | Electrical Power Utility Company | Representatives of businesses, academia, and other private organizations. |
| **Murray Wastewater** | Wastewater Treatment Plan | Representatives of businesses, academia, and other private organizations. |

| Jurisdiction/Agency/ Organization | Type of Stakeholder | Description |
|---|---|---|
| **Murray Water** | Water Utility Company | Representatives of businesses, academia, and other private organizations. |
| **Salt Lake City Corporation** | Local Government Utility and Dam Owner | Agencies that have the authority to regulate development. |
| **University of Utah, Information Technology** | State University System | Representatives of businesses, academia, and other private organizations. |
| **Salt Lake City Public Utilities** | Local Government Utility and Dam Owner | Agencies that have the authority to regulate development. |
| **Sandy City Dam** | Local Government Utility and Dam Owner | Agencies that have the authority to regulate development. |
| **South Despain Ditch Company** | Private Dam Owner | Representatives of businesses, academia, and other private organizations. |
| **Draper Irrigation Company** | Private Dam Owner | Representatives of businesses, academia, and other private organizations. |
| **Kennecott Utah Copper LLC** | Private Dam Owner | Representatives of businesses, academia, and other private organizations. |
| **Daybreak Community Association** | Private Dam Owner | Representatives of businesses, academia, and other private organizations. |
| **Herriman City Dam** | Local Government Public Dam Owner | Agencies that have the authority to regulate development. |
| **Riverton City Dam** | Local Government Public Dam Owner | Agencies that have the authority to regulate development. |
| **Salt Lake City Urban Forestry** | Local Government Forestry Service | Local and regional agencies involved in hazard mitigation activities. |

Further, IEM and Salt Lake County met with Amy Van Horn, the Bureau of Reclamation's (BOR) emergency management coordinator, to discuss the dam failure hazard profile. Data sources and current draft maps were evaluated, and BOR's feedback was considered when determining how best to profile this hazard.

## Coordination with Other Agencies, Partners, and Stakeholders

A main priority was updating the plan to meet the mitigation planning requirements outlined in FEMA's Local Mitigation Planning Policy Guide. This included an increased emphasis on stakeholder engagement, evaluating the impacts and potential mitigation measures for community lifelines, addressing climate change, and expanding mitigation actions to address all hazards profiled in the plan.

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

- American Red Cross (vulnerable population engagement)
- VOAD, Salvation Army Region 2 (disadvantaged and underserved population engagement)
- Federal Emergency Management Agency (How-to Guides)
- National Weather Service (hazard profile)
- National Centers for Environment Information (hazard profile)
- Sewer Districts
- Utah Division of Emergency Management (GIS data, flood data, Hazus data for floods and earthquakes)
- 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 Valley Emergency Communications Center (Emergency Alert Systems)
- Salt Lake County Departments and municipalities (Emergency Operations Plans, histories, mitigation actions, public input, GIS, assessor, transportation, property and infrastructure)

While a multitude of stakeholders were given the opportunity to participate, not all were able to. The stakeholders listed in Table 15 participated directly in the plan by attending meetings, completing the digital stakeholder survey, and/or reviewing the draft plan. This stakeholder outreach was considered a success because of the broad range of stakeholders that participated and their active engagement and participation in the planning process.

**Table 15: Stakeholders That Participated in the Planning Update**

| Name | Title | Agency/Jurisdiction | Type of Stakeholder |
|---|---|---|---|
| **Dan Blanchard** | Safety and Emergency Manager | Utah Department of Corrections | Local and regional agencies involved in hazard mitigation activities |
| **Kevin Barjenbruch** | Warning Coordination Meteorologist | NOAA/National Weather Service Salt Lake City | Local and regional agencies involved in hazard mitigation activities |
| **Mason Kemp** | Mitigation Planning Lead | Utah Division of Emergency Management | Local and regional agencies involved in hazard mitigation activities |
| **Tal Ehlers** | Emergency Management Program Manager | Utah Transit Authority | Agencies that have the authority to regulate development |
| **Tina Brown** | Public Information Officer | Unified Fire Authority | Agencies that have the authority to regulate development |
| **Martin Webb** | Emergency Manager | Salt Lake Valley Emergency Communication Center (SLVECC) | Local and regional agencies involved in hazard mitigation activities |
| **Tim Tomer** | Facilities/Safety Program Manager | Salt Lake County Aging and Adult Services | Nonprofit Organization serving underserved population |
| **Carly Sands** | Community Support Liaison | Utah Division of Emergency Management | Local and regional agencies involved in hazard mitigation activities |
| **Brian Buckhout** | Emergency Management Municipal Planner | Salt Lake County Emergency Management (SLCo EM) | Local and regional agencies involved in hazard mitigation activities |
| **Alex Rudowski** | Grading, Floodplain, and Stormwater Manager | Greater Salt Lake Municipal Services District | Local and regional agencies involved in hazard mitigation activities |
| **Jamie Petersen** | Region 1 Liaison | Utah Division of Emergency Management | Local and regional agencies involved in hazard mitigation activities |
| **Stephanie Rennick** | Emergency Manager | Salt Lake County Health Department | Local and regional agencies involved in hazard mitigation activities |

| Name | Title | Agency/Jurisdiction | Type of Stakeholder |
|---|---|---|---|
| **Dan McDougal** | Director of Risk and Asset Management | Taylorsville-Bennion Improvement District | Local and regional agencies involved in hazard mitigation activities |
| **Jason Draper** | Chief Engineer Floodplain Administrator | Salt Lake City Public Utilities | Local and regional agencies involved in hazard mitigation activities |
| **David Bullock** | Facilities Manager | Jordan School District | Local and regional agencies involved in hazard mitigation activities |
| **Jay Ziolkowski** | Emergency Manager | City of Taylorsville | Local and regional agencies involved in hazard mitigation activities |
| **Jeffory Mulcahy** | Emergency Manager | City of West Jordan | Local and regional agencies involved in hazard mitigation activities |
| **Jason Jones** | Emergency Manager/Police Department | Riverton City | Local and regional agencies involved in hazard mitigation activities |
| **Leon Berrett** | Operations Associate Director | Salt Lake County Public Works | Local and regional agencies involved in hazard mitigation activities |
| **Michael Yei** | Internal Emergency Management Manager | Salt Lake County | Local and regional agencies involved in hazard mitigation activities |
| **Captain Gary Carter** | Planning Section Chief | Salt Lake City Fire Department | Local and regional agencies involved in hazard mitigation activities |
| **Kelly Colopy** | Director | Salt Lake County Human Services | Local and regional agencies involved in hazard mitigation activities |
| **Ryan Jakeman** | Facility Coordinator | Canyons School District | Local and regional agencies involved in hazard mitigation activities |
| **Ty Shepherd** | Division Chief/Emergency Manager | Salt Lake City | Local and regional agencies involved in hazard mitigation activities |

| Name | Title | Agency/Jurisdiction | Type of Stakeholder |
|---|---|---|---|
| **Ember Herrick** | Emergency Manager | Davis County | Local and regional agencies involved in hazard mitigation activities |
| **William Reyes** | Emergency Management Planning Coordinator | Herriman City | Local and regional agencies involved in hazard mitigation activities |
| **Chet Ellis** | Division Chief/Deputy Director | SLCo EM | Local and regional agencies involved in hazard mitigation activities |
| **Robert Lambert** | Battalion Chief | Draper City | Local and regional agencies involved in hazard mitigation activities |
| **Mike Barker** | City Manager | Draper City | Local and regional agencies involved in hazard mitigation activities |
| **Kellie Challburg** | Assistant City Manager | Draper City | Local and regional agencies involved in hazard mitigation activities |
| **Karen Burnett** | Geographic Information Systems (GIS) Director | Draper City | Local and regional agencies involved in hazard mitigation activities |
| **Steve Pearson** | Deputy Fire Chief | Draper City | Local and regional agencies involved in hazard mitigation activities |
| **Rich Ferguson** | Police Chief | Draper City | Local and regional agencies involved in hazard mitigation activities |
| **Scott Cooley** | Public Works Director | Draper City | Local and regional agencies involved in hazard mitigation activities |
| **Dustin Willie** | Police Lieutenant | Draper City | Local and regional agencies involved in hazard mitigation activities |
| **Robert Markle** | Deputy Public Works Director | Draper City | Local and regional agencies involved in hazard mitigation activities |

| Name | Title | Agency/Jurisdiction | Type of Stakeholder |
|---|---|---|---|
| **Jared Bunch** | City Engineer | City of Holladay | Local and regional agencies involved in hazard mitigation activities |
| **Leon Barrett** | Associate Director of Public Works | Salt Lake County | Local and regional agencies involved in hazard mitigation activities |
| **Jon Teerlink** | Director of Community and Economic Development | City of Holladay | Agencies that have the authority to regulate development |
| **Ann Garcia** | Economic Development and Housing Manager | City of Holladay | Representatives of businesses, academia, and other private organizations |
| **Darren Shepherd** | Manager | Holliday Water Company | Neighboring communities; Representatives of businesses, academia, and other private organizations |
| **Dean Ayala** | | Mt. Olympus Improvement District | Neighboring communities; Representatives of businesses, academia, and other private organizations |
| **Wade Skinner** | Emergency Manager Program Manager | Rocky Mountain Power/Pacificorp | Representatives of businesses, academia, and other private organizations |
| **Jeff King** | Emergency Manager Coordinator | Jordan Valley Water Conservation District | Neighboring communities; Representatives of businesses, academia, and other private organizations |
| **Roger Brooks** | Emergency Manager | Granite School District | Representatives of nonprofit organizations, including community-based organizations, that work directly with and/or provide support to underserved communities and socially vulnerable populations |

| Name | Title | Agency/Jurisdiction | Type of Stakeholder |
|---|---|---|---|
| **Randy Porter** | Police Chief | Granite School District Police | Representatives of nonprofit organizations, including community-based organizations, that work directly with and/or provide support to underserved communities and socially vulnerable populations |
| **Greg Anderson** | Manager | Kearns Improvement District | Local and regional agencies involved in hazard mitigation activities |
| **Levi Hughes** | Chief | Unified Police Department Kearns Precinct | Local and regional agencies involved in hazard mitigation activities |
| **Colin Hilton** | Director | Olympic Oval | Local and regional agencies involved in hazard mitigation activities |
| **Kevin Schmidt** | Director | Kearns Oquirrh Park | Agencies that have the authority to regulate development |
| **Roger Snow** | Chair | Kearns Community Council | Neighboring communities |
| **Matt Dahl** | City Manager | City of Midvale | Local and regional agencies involved in hazard mitigation activities |
| **John Miller** | Director of Public Works | Millcreek City | Local and regional agencies involved in hazard mitigation activities |
| **Cheri Jackson** | Council Member | Millcreek City | Representatives of nonprofit organizations, including community-based organizations, that work directly with and/or provide support to underserved communities and socially vulnerable populations |

| Name | Title | Agency/Jurisdiction | Type of Stakeholder |
|---|---|---|---|
| **Michael Lasko** | Community Member | Millcreek City | Representatives of nonprofit organizations, including community-based organizations, that work directly with and/or provide support to underserved communities and socially vulnerable populations |
| **Tim Bachman** | Community Emergency Response Team Coordinator | Millcreek City | Representatives of nonprofit organizations, including community-based organizations, that work directly with and/or provide support to underserved communities and socially vulnerable populations |
| **Ty Shepherd** | Emergency Management (EM) Division Chief | Salt Lake City | Local and regional agencies involved in hazard mitigation activities |
| **Gary Carter** | EM Preparedness Captain | Salt Lake City | Local and regional agencies involved in hazard mitigation activities |
| **Tom Simons** | EM Ops Captain | Salt Lake City | Local and regional agencies involved in hazard mitigation activities |
| **Tess Alexander** | EM Community Preparedness | Salt Lake City | Representatives of nonprofit organizations, including community-based organizations, that work directly with and/or provide support to underserved communities and socially vulnerable populations |
| **Matt Wilson** | EM Planning Coordinator | Salt Lake City | Local and regional agencies involved in hazard mitigation activities |
| **Eric Witt** | EM Training Specialist | Salt Lake City | Local and regional agencies involved in hazard mitigation activities |

| Name | Title | Agency/Jurisdiction | Type of Stakeholder |
|---|---|---|---|
| **Audrey Pierce** | EM Critical Infrastructure | Salt Lake City | Local and regional agencies involved in hazard mitigation activities |
| **Jason Draper** | Chief Engineer – Public Works | Salt Lake City | Local and regional agencies involved in hazard mitigation activities; Agencies that have the authority to regulate development |
| **Carmen Bailey** | Deputy Director – Public Lands | Salt Lake City | Local and regional agencies involved in hazard mitigation activities; Agencies that have the authority to regulate development |
| **Chad Korb** | Deputy Director – Information Management Services | Salt Lake City | Local and regional agencies involved in hazard mitigation activities |
| **Debbie Lyons** | Director – Sustainability | Salt Lake City | Local and regional agencies involved in hazard mitigation activities |
| **Chris Bell** | Deputy Director – Sustainability | Salt Lake City | Local and regional agencies involved in hazard mitigation activities |
| **Steve Wooldridge** | Police Lieutenant | Salt Lake City | Local and regional agencies involved in hazard mitigation activities |
| **Julie Crookston** | Deputy Director – Public Services | Salt Lake City | Agencies that have the authority to regulate development |
| **Robert Stafford** | Fire Department Assistant Chief | Salt Lake City | Local and regional agencies involved in hazard mitigation activities |
| **Aaron Sainsbury** | Emergency Manager | South Jordan City | Local and regional agencies involved in hazard mitigation activities |
| **Tereza Bagdasarova** | Board of Directors | South Salt Lake Chamber of Commerce | Representatives of businesses, academia, and other private organizations |

| Name | Title | Agency/Jurisdiction | Type of Stakeholder |
|---|---|---|---|
| **Zach Stevens** | | Mount Olympus | Representatives of businesses, academia, and other private organizations |
| **Isaac Talbot** | Emergency Manager | Central Valley | Representatives of businesses, academia, and other private organizations |
| **Shazelle Terry** | General Manager | Jordan Valley | Representatives of businesses, academia, and other private organizations |
| **Tom Holstrom** | Assistant Manager | Central Valley Water | Representatives of businesses, academia, and other private organizations |
| **Ben White** | City Engineer | Taylorsville | Local and regional agencies involved in hazard mitigation activities |
| **Mark McGrath** | Long-range Planner | Taylorsville | Local and regional agencies involved in hazard mitigation activities |
| **Richard Bell** | Deputy Chief | West Jordan Police | Local and regional agencies involved in hazard mitigation activities |
| **Chris Trevino** | Deputy Chief | West Jordan Fire | Local and regional agencies involved in hazard mitigation activities |
| **Brian Clegg** | Director | West Jordan Public Works | Local and regional agencies involved in hazard mitigation activities |
| **Greg Davenport** | Director | West Jordan Public Utilities | Local and regional agencies involved in hazard mitigation activities |
| **Cory Fralick** | Director | West Jordan Public Services | Local and regional agencies involved in hazard mitigation activities |
| **Scott Langford** | Director | West Jordan Community Development | Agencies that have the authority to regulate development |

| Name | Title | Agency/Jurisdiction | Type of Stakeholder |
|---|---|---|---|
| **Marie Magers** | Public Information Officer | West Jordan Public Affairs | Local and regional agencies involved in hazard mitigation activities |
| **Korban Lee** | Chief Administrative Officer | West Jordan Administration | Agencies that have the authority to regulate development |
| **Paul Jerome** | Assistant Chief Administrative Officer | West Jordan Administration | Agencies that have the authority to regulate development |
| **Jeffory Mulcahy** | Emergency Manager | West Jordan Emergency Management | Local and regional agencies involved in hazard mitigation activities |
| **Scott Thomas** | ASB Director | Jordan School District | Neighboring communities |
| **Dave Rostrom** | Facility Services Director | Jordan School District | Neighboring communities |
| **Ian Roberts** | Capital Outlay Manager | Jordan School District | Neighboring communities |
| **David Bullock** | Inspector | Jordan School District | Neighboring communities |

Neighboring counties (Davis County, Utah County, Tooele County, and Summit County) were granted access to the Plan for review and feedback. An additional e-mail with a link to the draft plan was sent to the designated emergency manager for each county. Additionally, hazard mitigation plans for the adjacent counties (specifically Davis County and Tooele County and the Mountainland Pre-Disaster Hazard Mitigation Plan) and the planning for all other nearby counties were reviewed to determine region-wide risks and mitigation opportunities. Public input from those who reside in surrounding counties but indicated they commute and work in the County was also analyzed and compared to residents who indicated they live in Salt Lake County.

# Public Outreach

Public participation is a vital planning requirement for a FEMA-approved hazard mitigation plan. The public outreach strategy engaged the whole community throughout the planning process. It gave decision-makers access to diverse perspectives, knowledge, and individual lived experiences to incorporate into the final MJ-MHMP. IEM developed and shared the public outreach strategy with the county planning working groups that engaged the public and assessed their understanding of the identified risks and their interest in mitigation opportunities. Specifically, the public outreach strategy provided opportunities for vulnerable populations and underserved communities to be involved in the plan's development. For example, the County Office for New Americans shared the survey with immigrant and refugee communities.

The IEM planning team drafted and shared a public survey in English and Spanish. Each participating jurisdiction reviewed and shared the survey on multiple occasions in different venues and in-person and online formats (see Figure 24). In addition to posting links to the survey on county and city websites and sharing via social media, the survey was also announced via a radio announcement on KUER on October 19, 2024. A news article was published by KSL.com on October 30 that also announced the mitigation plan to the public and provided a link to the survey.[33] A half-page announcement about the plan update and a link to the survey were also included in the City Journal Community Newspaper, which was mailed to residents in 13 participating cities.


The Salt Lake County Multi-Jurisdictional Hazard Mitigation Plan is being updated.

El Plan de Mitigación de Riesgos del Condado de Salt Lake está actualizadose.

**Figure 24: Social Media Graphic for Public Outreach Survey**

The public survey asked the public about their hazards of concern, assessed their understanding of the assets at risk, solicited information on what areas or community assets are more vulnerable, what they are doing in terms of mitigation, what mitigation actions they would support the community undertaking and any specific suggestions for mitigation actions. Engaging socially vulnerable populations and disadvantaged communities was an important component of the public survey process. Each plan participant selected the population they wanted to focus on, but in general, non-English speaking populations, the elderly, youth, and low-income individuals were engaged.

Salt Lake County and IEM facilitated a meeting with the participating jurisdictions' Public Information Officers (PIOs) to help engage them in the public outreach efforts. The PIOs helped post the survey on city social media pages, which significantly boosted community engagement with the survey. More details on outreach can be found in the jurisdictional annexes.

SLCo EM participated in the Salt Lake County Senior Expo on October 11. This was a key opportunity to engage with one of the county's vulnerable populations. SLCo EM staff discussed the planning process

[33] KSL.com. "Utah residents need to prepare for these 5 kinds of emergencies." October 30, 2024. https://www.ksl.com/article/51160262/utah-residents-need-to-prepare-for-these-5-kinds-of-emergencies

and hazard concerns with attendees, and they also had reference materials and access to the public. Information was also shared at a community event in Copperton.


Figure 25: Salt Lake County Senior Expo and Copperton Public Outreach

**Table 16: Public Outreach Conducted by Jurisdiction**

| Jurisdiction | Description of Outreach Efforts |
|---|---|
| Salt Lake County | Posted notification of Hazard Mitigation Plan update and access to survey on County website and social media page |
| Cottonwood Heights City | Posted notification of Hazard Mitigation Plan update and access to survey on city social media page |
| Draper City | Reposted Salt Lake County Emergency Management social media post of Hazard Mitigation Plan update and access to survey |
| Midvale City | Posted notification of Hazard Mitigation Plan update and access to survey on city social media page |
| Salt Lake City | Reposted Salt Lake County Emergency Management social media post of Hazard Mitigation Plan update and access to survey |
| South Salt Lake City | Posted notification of Hazard Mitigation Plan update and access to survey on city social media page |
| West Valley City | Posted notification of Hazard Mitigation Plan update and access to survey on city social media page |

## Feedback from the Public Survey

After several months of public outreach in Salt Lake County, approximately 564 community members responded to the Salt Lake County MJHMP Public Survey. The following summarizes the responses and comments received.

### LEVEL OF CONCERN ABOUT SPECIFIC HAZARDS

When participants were asked about specific natural hazards that may impact Salt Lake County, they were most often very concerned about earthquakes and drought.

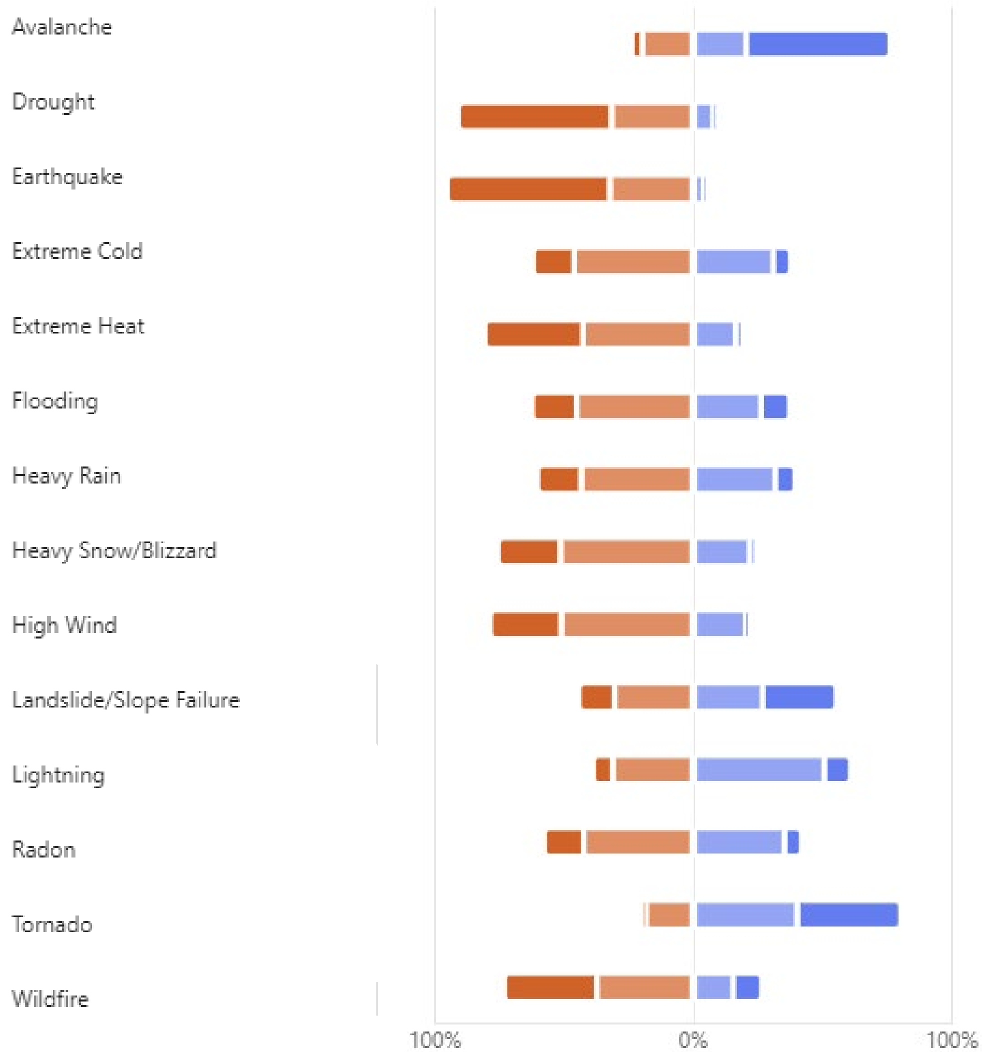



**Figure 26: Concerns About Specific Hazards, Survey Results**

Among the technical and human-made hazards identified, 327 respondents were somewhat or very concerned about radon, 156 were somewhat or very concerned about dam failure, 346 were somewhat or very concerned about terrorism, 478 were somewhat or very concerned about cyberterrorism, and 424 were somewhat or very concerned about a potential hazardous materials incident.

## HAZARD INSURANCE COVERAGE

Question #10 asked respondents what residential insurance coverage they currently have for natural hazards; 286 stated they have fire insurance, 131 have windstorm insurance, 173 have earthquake insurance, 89 have flood insurance, and 20 have landslide insurance.

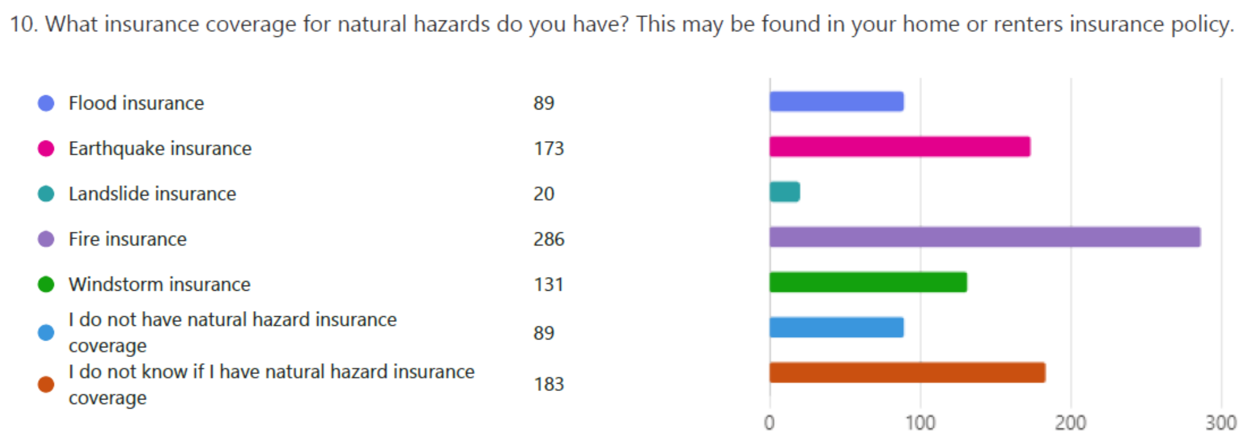



**Figure 27: Hazard Insurance Coverage, Survey Results**

## WHERE DO RESPONDENTS LIVE OR WORK?

Question #14 asked where respondents lived or worked at the time of the survey. Results can be sorted to determine if there are geographic trends in responses to the other questions.

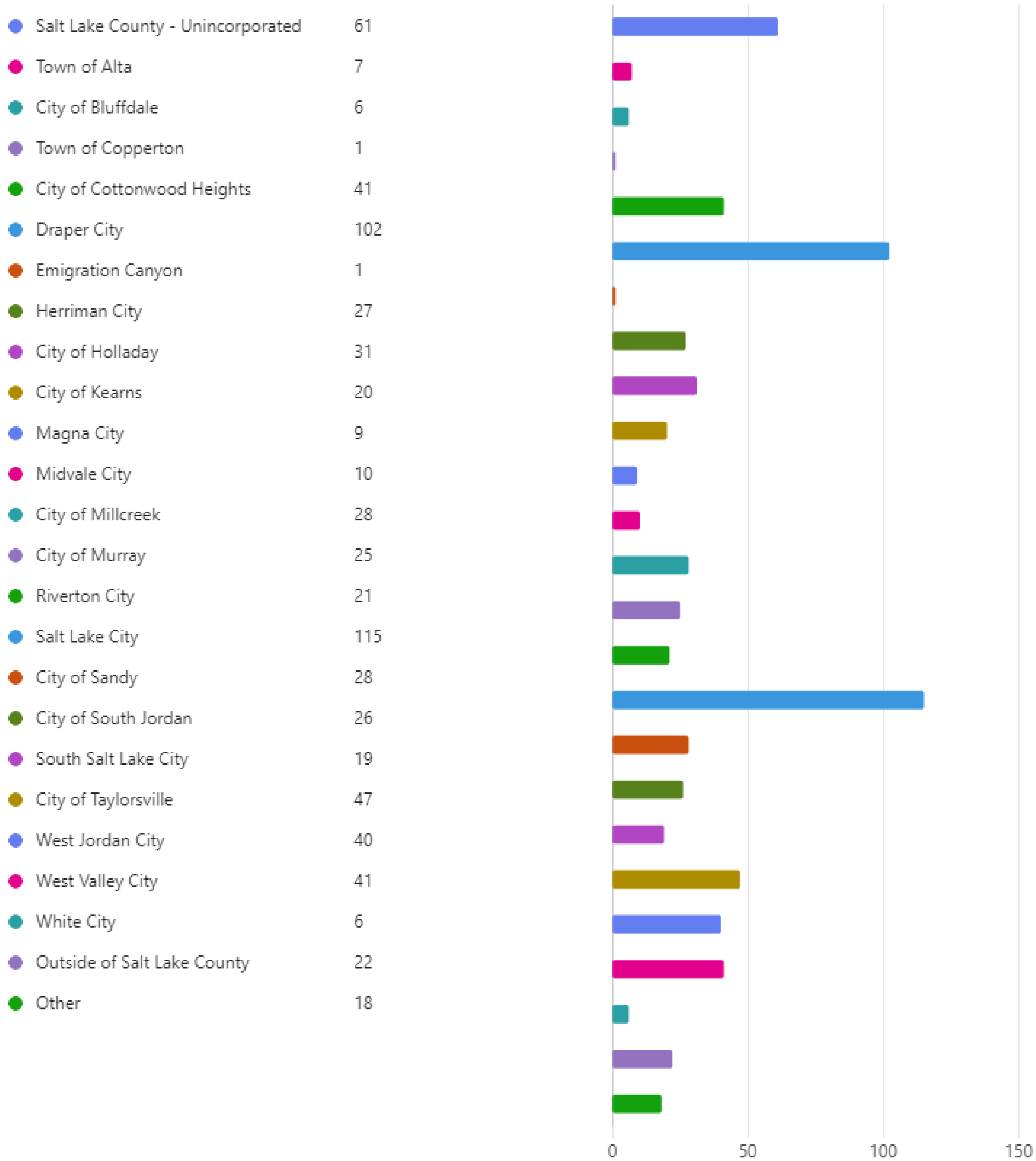



**Figure 28: Where Respondents Live and Work**

## VULNERABLE POPULATIONS

Question 13 invited respondents to identify if they belonged to one or more vulnerable population categories. The intent of this question was to determine whether vulnerable populations were reached by the survey and had an opportunity to voice their unique concerns about natural hazards.

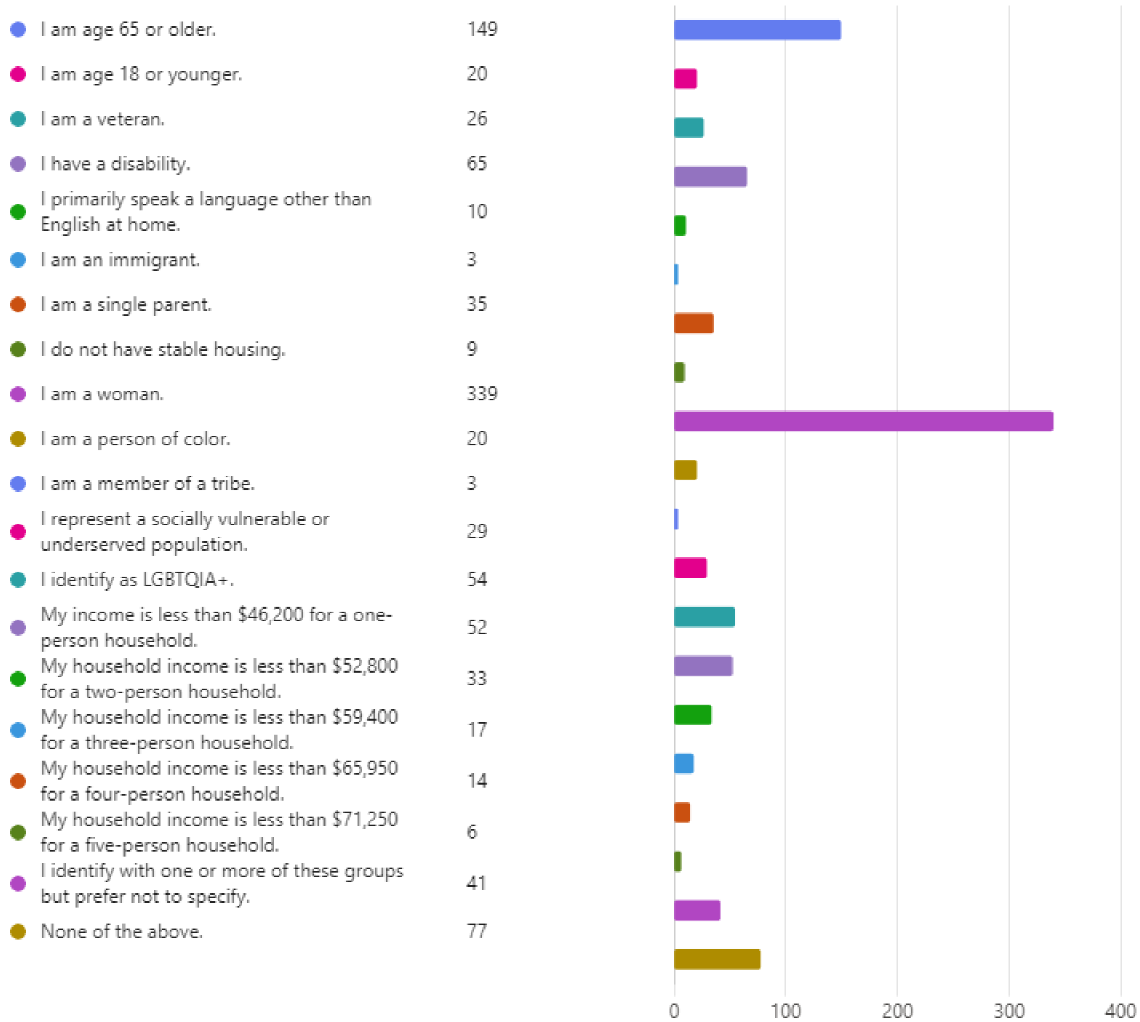



**Figure 29: Vulnerable Populations**

## PARTS OF THE COMMUNITY MOST AT RISK

Question #4 asked, "What parts of your community (including buildings, people, economic activities and events, and natural areas) are most at risk of these hazards?" Of the 563 respondents, 101 identified "people" as most at risk, with buildings and homes also frequently selected.

## MITIGATION IDEAS

Question #8 asked, “What other types of hazard mitigation activities would you support your community in taking? Be specific if you know an area or structure that needs mitigating.” Of the 558 respondents, 43 said they would support “community activities” and water and earthquake mitigation activities.

## PROTECTION FROM FUTURE DISASTERS

Question # 5 asked, “What at-risk areas (including structures, infrastructures, and natural areas) or people in your community would you like to see protected from future disasters? Be specific, if known.” Of the 560 response respondents, 78 answered protecting natural areas from future disasters and homes and buildings.

# Risk Assessment

The Hazard Identification and Risk Assessment (HIRA) measures the potential impact on life, property, and economic impacts of natural hazards. It intends to identify, as much as practicable, given the existing or available data, a community's qualitative and quantitative vulnerabilities. The risk assessment results provide a clearer understanding of the impacts of natural hazards on the community. They also serve as a foundation for developing and prioritizing mitigation actions see Section 6: Mitigation Strategy aimed at reducing damage from natural disasters. This includes increased preparedness, faster response times, and improved allocation of resources to the most vulnerable areas.

This risk assessment followed the methodology described in the FEMA Local Mitigation Planning Handbook 2023, which outlines a five-step process:

1. **Identify Hazards:** This step helps clarify the potential hazards that may occur in the planning area.
2. **Describe Hazards:** This step includes gathering more information about the hazards, including where they can happen, the impact of past occurrences, and the potential frequency and intensity of future occurrences.
3. **Identify Community Assets:** This step evaluates which assets are most vulnerable to loss during a disaster, considering any development changes since the previous plan was created.
4. **Analyze Impacts:** This step describes how each hazard could affect the assets of each community.
5. **Summarize Vulnerability:** This step synthesizes all the analyses and uses the risk assessment to draw conclusions. Based on these conclusions, the planning team can develop a strategy to increase the resilience of residents, businesses, the economy, and other vital assets.

## Methodology

The information gathered during the Multi-Jurisdictional Hazard Mitigation Plan (MJHMP) planning process related to the above five steps has been incorporated into the following discussions in this chapter:

- **Hazard Identification:** This involves identifying and prioritizing the natural hazards that threaten Salt Lake County, including assets in other jurisdictions, such as levees and upstream dams, that can also affect yours. The reasoning for omitting some hazards from further consideration is also provided in this discussion.
- **Hazard Profiles:** each natural hazard that threatens Salt Lake County has a separate hazard profile that includes its location, extent/magnitude/severity, previous occurrences, and likelihood of future events. The previous plan identified severe weather as a hazard. This plan has broken this category into separate hazards—heavy rain, high wind, extreme heat, and lightning—to provide more detail on each and additional information on events since the last plan update. Extreme cold has been

separated from severe winter weather and is now presented as a stand-alone hazard profile. No other new hazards have been added since the last plan.

- **Identify Assets:** Identify the assets in Glenn County, Willows, and Orland at risk of hazards. Information includes people, structures, community lifelines, and other critical facilities; natural, historic, and cultural resources; and the economy and other activities that have value to the community.
- **Analyze Impacts:** Overlaps between Identifying where hazards overlap with and assets are identified, including descriptions of the asset vulnerabilities and describing potential impacts.
- **Summarize Vulnerability:** Information from hazard profiles, vulnerability assets, changes in development, potential impacts, and losses are summarized to help Glenn County, Willows, and Orland understand the most significant risks and vulnerabilities.

## Identifying Hazards

According to FEMA guidance, identifying hazards is the first step in developing a risk assessment. Salt Lake County plan participants reviewed previously prepared hazard mitigation plans and relevant documents to determine potential natural hazards that could affect the county. Based on a review of the prior plan and consideration of recent events, 19 different hazards were identified.

**Table 17: Hazards Identified for 2024 Hazard Mitigation Plan**

| | | | |
|---|---|---|---|
| Avalanche | Flooding | Public Health Epidemic/Pandemic | Dam Failure |
| Drought | Heavy Rain | Radon | Civil Disturbance |
| Earthquake | High Wind | Severe Winter Storm | Hazardous Materials Incident |
| Extreme Cold | Landslide/Slope Failure | Tornadoes | Terrorism/ Cyberterrorism |
| Extreme Heat | Lightning | Wildfire | |

The following information is provided for each hazard:

- **Hazard Description:** A brief introduction of the mechanisms behind the hazard.
- **Location:** An indication of geographic areas most likely to experience the hazard.
- **Magnitude/Extent:** A description of the potential magnitude and extent of the hazard, accompanied by the likelihood of the hazard occurring (or a time frame of recurrence, if available).
- **Historical Events:** Similar to location, a chronological summary of recent hazard occurrences, including extent or damage cost, if available.
- **Probability of future occurrences:** Likelihood of this event occurring in Salt Lake County, based on return intervals or past annual frequency.

- **Climate Change Considerations:** When applicable, a brief overview indicating how the hazard profile may change over time due to climate changes.
- **Secondary Hazards/Cascading Impacts:** A brief overview of secondary hazards often associated with the hazards.
- **Vulnerability Analysis:** A description of which assets—including structures, systems, populations, and other assets as defined by the plan participant—are at risk from each hazard. Vulnerability may be expressed in quantitative terms, such as replacement cost, or qualitatively, such as type of structure value, depending on available data. This section also discusses the impacts of hazards, which are the potential consequences of a hazard event, including land use and development changes. These impacts can include the following:
  - Modeled estimates of potential structural and economic losses, including values of community assets exposed to the hazard
  - Impacts on vulnerable populations
  - Changes in development and whether these changes represent a change in vulnerability since the 2019 plan
  - Effects on FEMA Community Lifelines

Hazard descriptions were based on information from local, state, and federal agencies that study these hazards. These sources were also used to identify the locations and extent of hazards that could impact people, structures, or other assets in Salt Lake County. These sources were identified in Section 2, Planning Process.

For each hazard profiled, a review of past events was conducted. This involved examining historical records of hazards that have previously affected the county and/or cities and towns, such as the National Centers for Environmental Information (NCEI) Storm Events Database. Potential hazards that may affect the county in the future were identified by gathering information from local, state, and federal agencies; accounts from newspapers or local media; state and regional weather records; conversations with the public and local officials; surveys; and meetings with personnel in the planning area. Information about federal Disaster Declarations in Salt Lake County was updated and compiled into Table 18, which provides a baseline for consideration in the hazard prioritization process.

Each participating jurisdiction considered these 19 hazards and evaluated which consistently affected its area based on the history of occurrences and probability. The jurisdictions used forms to identify the hazards they wished to include in their risk assessment and briefly explained any that they decided not to include. They also identified community assets, critical facilities, or infrastructure in the community that are at risk from each hazard. Participants also described changes in development, such as changes in population or land use, that could affect their vulnerability to hazards. Details regarding these jurisdiction-specific hazards and an analysis of the vulnerabilities and potential impacts of each are described in Volume 2 of this plan.

## Past Declarations

**Table 18: Past Disaster Declarations**

| Disaster Declaration Code | Incident Period | Date Declared | Description |
|---|---|---|---|
| **FM-5408-UT** | 8/14/2021–8/18/2021 | 8/14/2021 | Parleys Canyon fire |
| **4578-DR-UT** | 9/7/2020–9/8/2020 | 1/12/2021 | Severe storm, straight-line winds |
| **DR-4548-UT** | 3/18/2020–4/17/2020 | 7/9/2020 | Earthquake and aftershocks |
| **DR-4525-UT** | 1/20/2020–5/11/2023 | 4/4/2020 | COVID-19 pandemic |
| **EM-3478-UT** | 1/20/2020–5/11/2023 | 3/13/2020 | COVID-19 |
| **FM-2991-UT** | 6/29/2012–6/30/2012 | 6/29/2012 | Rose Crest fire |
| **DR-4011-UT** | 4/18/2011–7/16/2011 | 8/8/2011 | Flooding |
| **FM-2859-UT** | 9/19/2010 | 9/19/2010 | Machine Gun fire |
| **EM-3223-UT** | 8/29/2005–10/1/2005 | 9/5/2005 | Hurricane Katrina evacuation |
| **DR-1285-UT** | 8/11/1999 | 8/16/1999 | Tornado, severe thunderstorms, hail |
| **DR-720-UT** | 8/17/1974 | 8/17/1984 | Severe storms, mudslides, landslides, flooding |
| **DR-680-UT** | 4/13/1983 | 4/30/1983 | Severe storms, landslides, flooding |

## Prioritization of Hazards

Each plan participant completed a Calculated Priority Risk Index (CPRI) based on the following criteria to identify how each plan participant is uniquely at risk for the hazards profiled.

**Table 19: Calculated Priority Risk Criteria**

| Risk Index Factor | Degree of Risk Level | | Criteria | Factor Weight for Degree of Risk Level |
|---|---|---|---|---|
| **Probability of Future Events** | 1 | Unlikely | Less than 1% probability of occurrence within the next year or a recurrence interval of greater than every 100 years | 30% |
| | 2 | Occasional | 1%–10% probability of occurrence within the next year or a recurrence interval of 11–100 years | |

| Risk Index Factor | Degree of Risk Level | | Criteria | Factor Weight for Degree of Risk Level |
|---|---|---|---|---|
| | 3 | Likely | 11%–90% probability of occurrence within the next year or a recurrence interval of 1–10 years | |
| | 4 | Highly Likely | 91%–100% percent probability of occurrence within the next year or a recurrence interval of less than 1 year | |
| **Spatial Extent** (Geographic coverage, i.e., how large of an area could be affected by the specific hazard?) | 1 | Limited | Less than 10% of the planning area could be impacted | 10% |
| | 2 | Small | 10%–25% of the planning area could be impacted | |
| | 3 | Significant | 25%–50% of the planning area could be impacted | |
| | 4 | Extensive | 50%–100% of the planning area could be impacted | |
| **Severity of Life/Property Impact** | 1 | Negligible | Less than 5% of the affected area's critical and noncritical facilities and structures are damaged/destroyed. Only minor property damage and minimal disruption of life. Temporary shutdown of critical facilities. | 30% |
| | 2 | Limited | Between 5% and 25% of property in the affected area is damaged/destroyed. Complete shutdown of critical facilities for more than 1 day but less than 1 week. | |
| | 3 | Critical | Between 25% and 50% of property in the affected area was damaged/destroyed. Complete shutdown of critical facilities for over 1 week but less than 1 month. | |
| | 4 | Catastrophic | Over 50% of critical and noncritical facilities and infrastructures in the affected area are damaged/destroyed. Complete shutdown of critical facilities for more than one month | |

| Risk Index Factor | Degree of Risk Level | | Criteria | Factor Weight for Degree of Risk Level |
|---|---|---|---|---|
| **Warning Time** (Warning time refers to the duration between the moment a warning is issued for an impending threat or disaster and when the threat or disaster occurs. Having more warning time allows for better emergency preparations and public information dissemination.) | 1 | Self-defined | More than 24 hours | 10% |
| | 2 | Self-defined | 12–24 hours | |
| | 3 | Self-defined | 6–12 hours | |
| | 4 | Self-defined | Less than 6 hours | |
| **Duration** (The duration for which local, state, and/or federal assistance will be necessary to prepare, respond, and recover from a potential disaster event) | 1 | Brief | Up to 6 hours | 10% |
| | 2 | Intermediate | Up to 1 day | |
| | 3 | Extended | Up to 1 week | |
| | 4 | Prolonged | More than 1 week | |
| **Response Capacity** (The local resources and capability to respond to this type of event) | 1 | High | Significant resources and capability to respond to this type of event; staff are trained, experienced, and ready | 10% |
| | 2 | Medium | Some resources and capability to respond to this type of event; some staff may be trained, experienced, and ready while others may need additional support | |
| | 3 | Low | Limited resources and capability to respond to this type of event; additional staff or staff training needed | |
| | 4 | None | No resources and capability to respond to this type of event; additional outside support would be required | |

## RISK FACTOR EQUATION

RF Value = [(Probability x .30) + (Spatial Extent x .10) + (Severity of Life/Property Impact x .30) + (Warning Time x .10) + (Duration x .10) + (Response Capacity x .10)]

## County CPRI

The following represents the overall risk for each hazard in Salt Lake County. Those with a risk factor value greater than or equal to 2.5 are considered high risk. Risk factors ranging from 2.0 to 2.4 are considered moderate risk, and those below 2.0 are considered low risk. The highest possible risk factor value is 4.

**Table 20: Salt Lake County Calculated Priority Risk Index**

| Type of Hazard Event | Probability of Future Events | Spatial Extent | Severity of Life/Property Impact | Warning Time | Duration | Response Capacity | Risk Factor Value |
|---|---|---|---|---|---|---|---|
| Avalanche | 4 | 1 | 2 | 4 | 2 | 1 | 2.6 |
| Drought | 4 | 4 | 2 | 1 | 4 | 1 | 2.8 |
| Earthquake | 3 | 4 | 4 | 4 | 3 | 2 | 3.4 |
| Extreme Heat | 4 | 4 | 3 | 1 | 3 | 1 | 3 |
| Extreme Cold | 3 | 4 | 2 | 1 | 3 | 1 | 2.4 |
| Flooding | 4 | 3 | 3 | 3 | 3 | 1 | 3.1 |
| Landslide/Slope Failure | 2 | 1 | 2 | 4 | 1 | 2 | 2 |
| Radon | 4 | 4 | 2 | 1 | 4 | 2 | 2.9 |
| Heavy Rain | 4 | 3 | 2 | 3 | 1 | 1 | 2.6 |
| High Wind | 4 | 3 | 3 | 3 | 2 | 1 | 3 |
| Lightning | 4 | 2 | 2 | 4 | 1 | 1 | 2.6 |
| Heavy Snow/Blizzard | 4 | 3 | 2 | 2 | 2 | 1 | 2.6 |
| Tornado | 2 | 2 | 3 | 4 | 1 | 2 | 2.4 |
| Wildfire | 4 | 3 | 3 | 4 | 3 | 1 | 3.2 |
| Dam Failure | 2 | 2 | 3 | 2 | 2 | 3 | 2.4 |
| Civil Disturbance | 2 | 1 | 2 | 4 | 2 | 2 | 2.1 |
| Cyber Attack | 2 | 3 | 3 | 4 | 3 | 2 | 2.7 |
| Hazardous Materials Incident (Transportation & Fixed Facility) | 3 | 1 | 2 | 4 | 1 | 1 | 2.2 |
| Public Health Epidemic/ Pandemic | 3 | 4 | 3 | 1 | 4 | 1 | 2.8 |
| Terrorism | 2 | 1 | 3 | 4 | 2 | 1 | 2.3 |

# Vulnerability Assessment

A vulnerability assessment evaluates the assets potentially at risk from the identified hazards, including structures, populations, infrastructure, and other assets within hazard-prone areas. Impacts are the consequences or effects of each hazard on each community's assets and the losses a community may incur in the event of a disaster. Evaluating the assets at risk and potential impacts provides the foundation for determining where hazard mitigation resources are most needed. The FEMA Local Mitigation Planning Handbook[34] provides a framework for conducting a vulnerability assessment.

## ASSET IDENTIFICATION

The vulnerability assessment relied on asset data from the county to provide a measure of the potential impacts of hazards on community assets. Assets refer to people, critical facilities, infrastructure, or other resources of value in the county and cities. When local data was unavailable, state or federal sources were consulted. Geospatial data are indispensable in determining which assets are potentially exposed to specific hazards. Geospatial analysis can be conducted by overlaying the community's assets on a map of the spatial extent of a natural hazard to determine areas of exposure and potential losses. For hazards without a defined spatial extent, maps of past occurrences can provide a reference for general risk in the county.

## LOSS ESTIMATES

Hazus is a standardized risk modeling tool that estimates potential damage, economic losses, and other impacts from earthquakes, floods, tsunamis, and hurricanes. Hazus software relies on Esri ArcGIS for Desktop technology. It includes nationwide datasets for general building stock, critical facilities, transportation, and other infrastructure data. The models estimate the potential damage to various assets based on a defined hazard scenario.

For this plan update, Hazus 6.1 was used to model 100-year and 500-year flood scenarios and an earthquake scenario based on a USGS ShakeMap scenario of a 6.2 magnitude earthquake on the Warm Springs Fault. Salt Lake County Office of Emergency Management (SLCOEM) provided GIS data for critical facilities, including 68 fire stations, 36 police stations, 16 hospitals, 18 emergency operations centers (EOCs), 218 county facilities, and 422 schools. These locations are shown in Figure 30–Figure 36. For the Hazus models of earthquake and flood scenarios, the county critical facility data was used to augment the default Hazus facility data. Other economic, transportation, utility, and building loss estimates were based on the default inventory data from Hazus 6.1.

[34] FEMA. "Local Mitigation Planning Handbook." May 2023. https://www.fema.gov/sites/default/files/documents/fema_local-mitigation-planning-handbook_052023.pdf

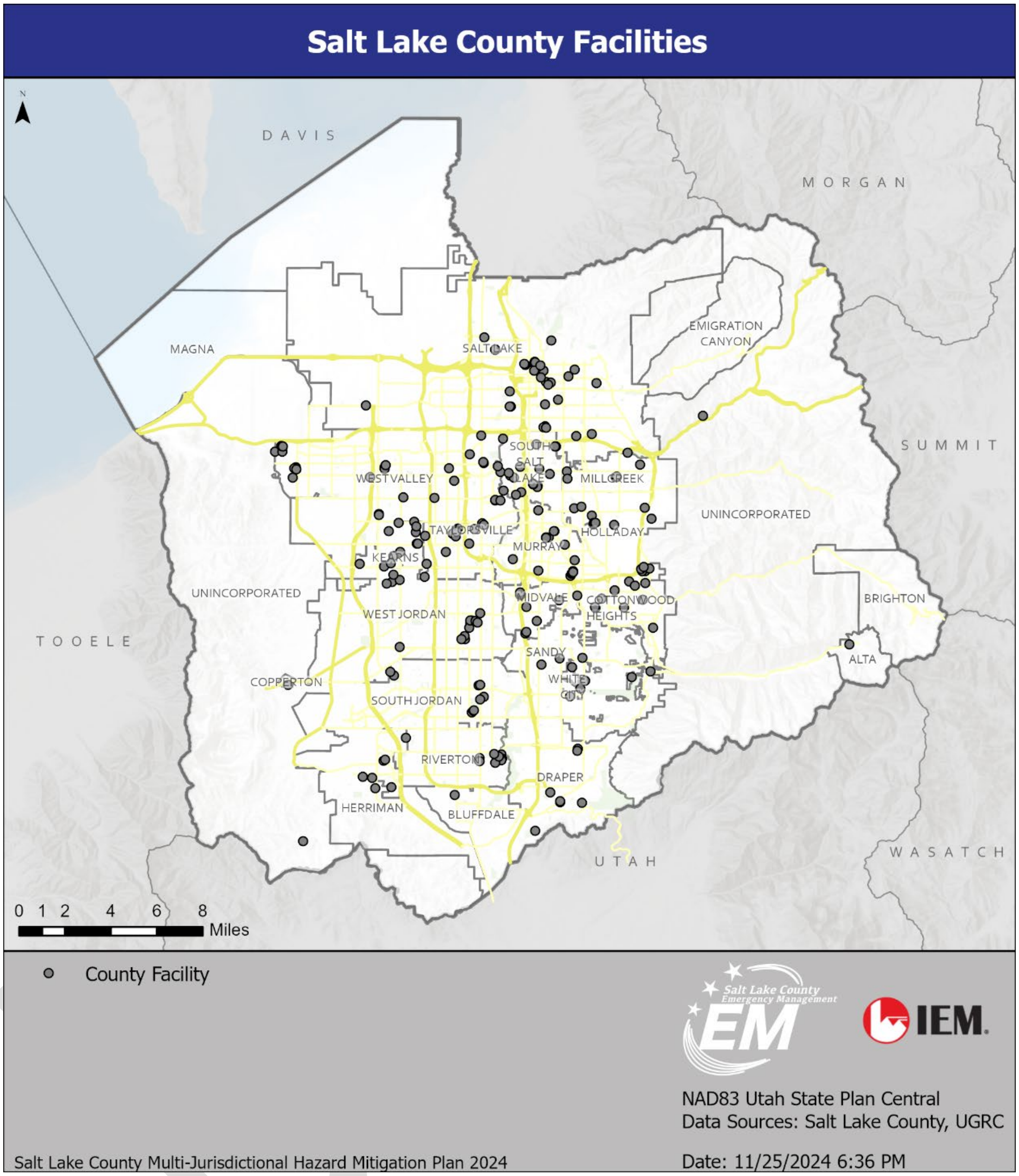



**Figure 30: Salt Lake County Facilities**

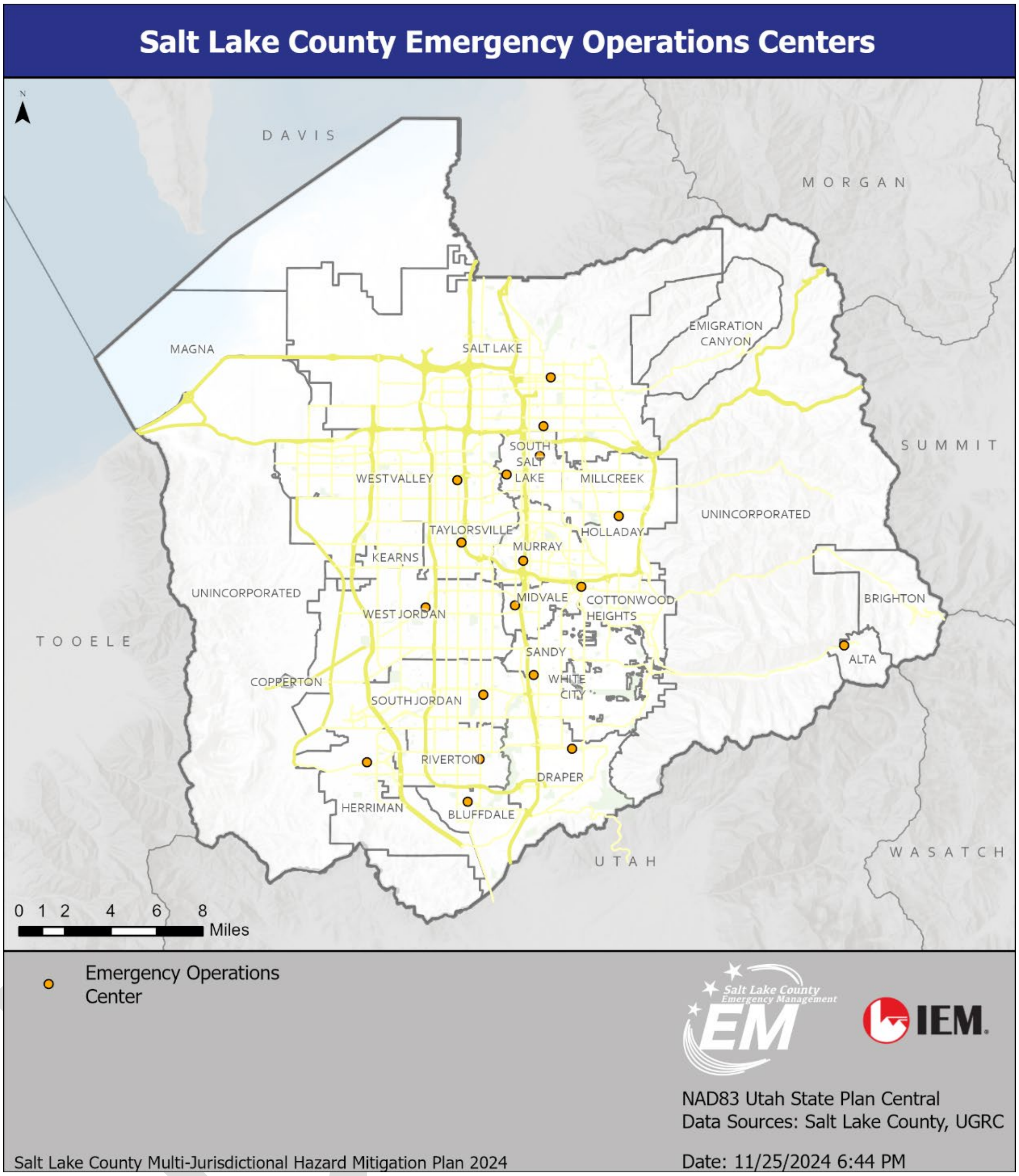



**Figure 31: Emergency Operations Centers in Salt Lake County**

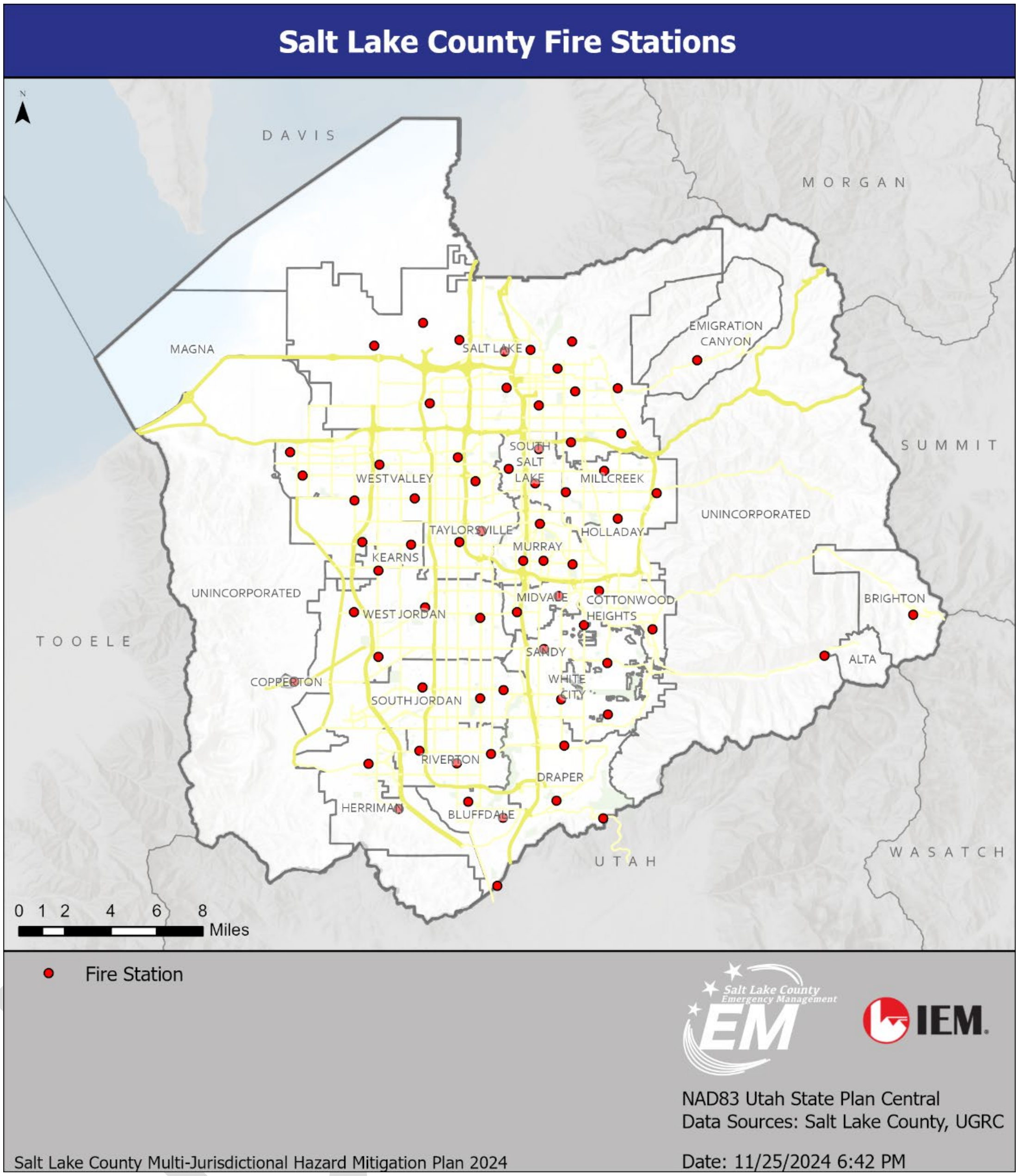



**Figure 32: Fire Stations in Salt Lake County**

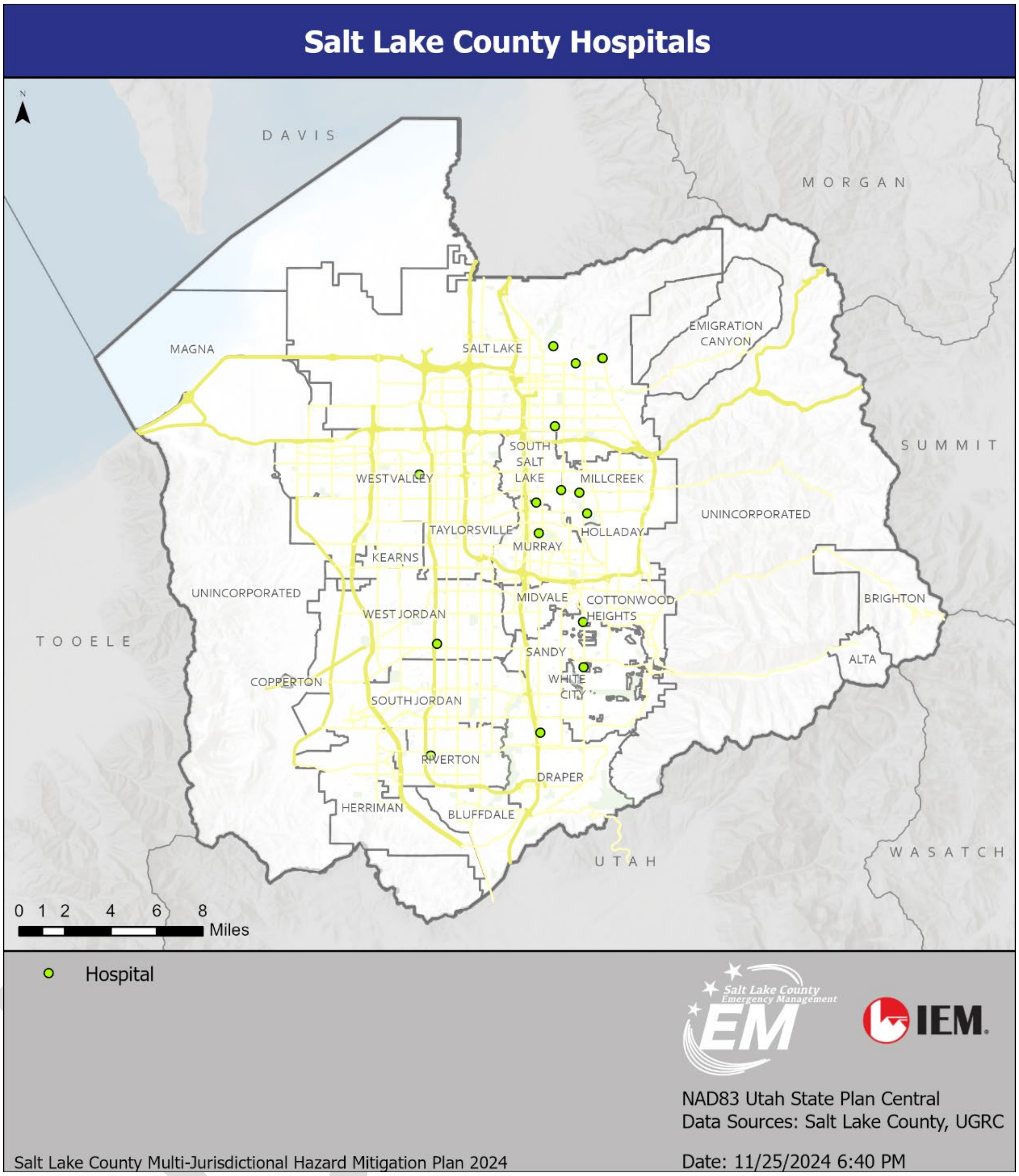



Figure 33: Hospitals in Salt Lake County

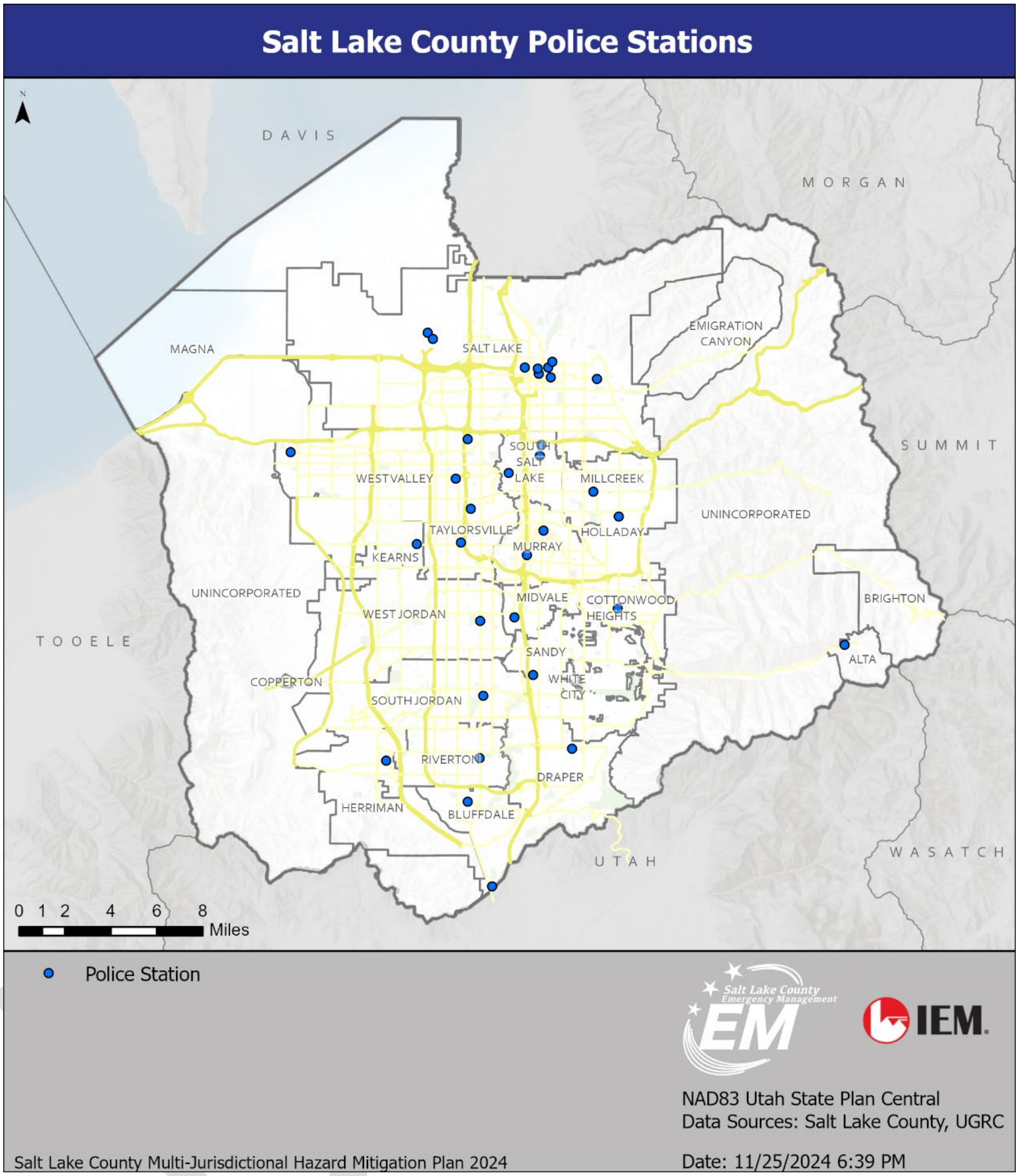



**Figure 34: Police Stations in Salt Lake County**

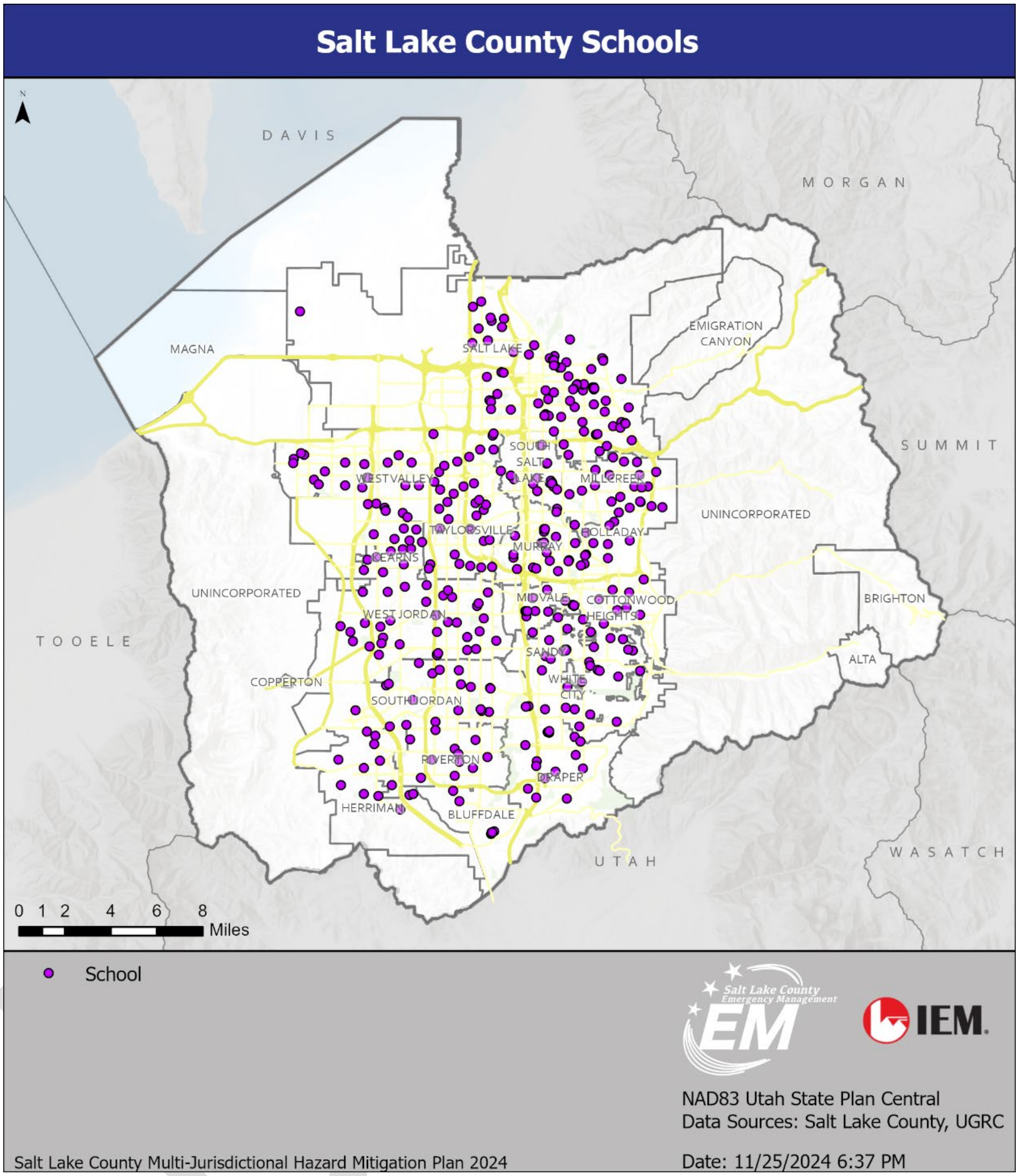



**Figure 35: Schools in Salt Lake County**

## NATIONAL RISK INDEX

The National Risk Index (NRI) is an online dataset developed by FEMA and its partners that defines a baseline understanding of risk for all communities across the United States. This interactive online tool can compare risks across the countywide planning area with the rest of the United States regarding expected annual loss, social vulnerability, and community resilience. Figure 36 illustrates how these three factors contribute to a composite score. The data for each hazard are pulled from different datasets. Dollars are in terms of 2022 dollars. Images in each hazard profile are screen captures taken directly from the NRI.

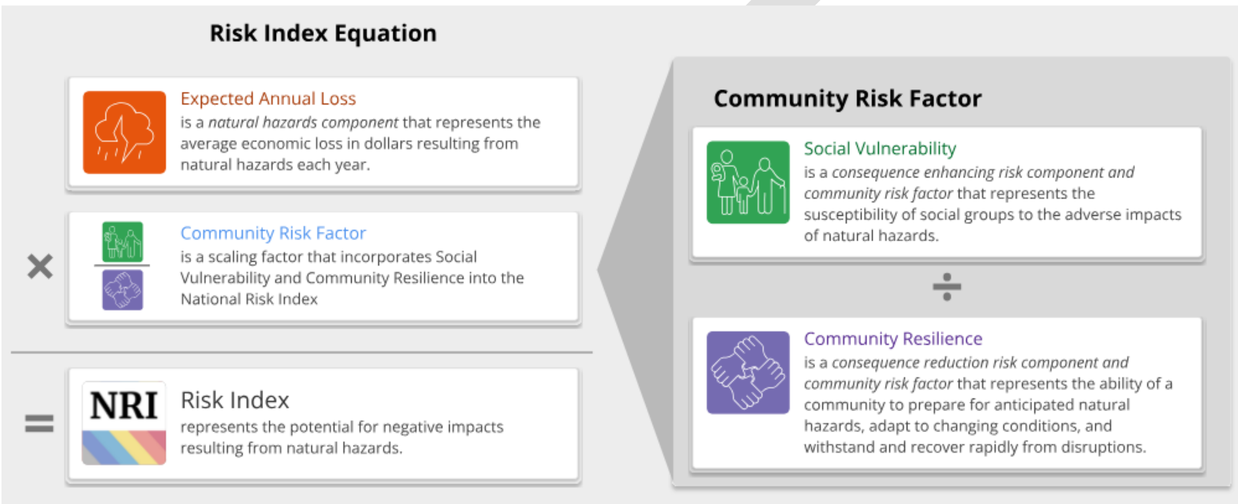



**Figure 36: FEMA National Risk Index Equation**

Ratings are described using qualitative terms ranging from "Very Low" to "Very High." No specific numeric values determine the rating, as scores are relative.[35] The following defines the NRI categories at a national level:

- **Very High:** 80th to 100th percentiles
- **Relatively High:** 60th to 80th percentiles
- **Relatively Moderate:** 40th to 60th percentiles
- **Relatively Low:** 20th to 40th percentiles
- **Very Low:** 0 to 20th percentiles

Ratings do not always reflect the local experience, including Salt Lake County. However, this tool can serve as a baseline to understand risk and see how risks in Salt Lake County differ from those in the rest of the United States.

[35] FEMA, National Risk Index. "Determining Risk." https://hazards.fema.gov/nri/determining-risk

## Vulnerable Populations

Some social groups are more susceptible to the impacts of natural hazards, which affects their capacity to prepare for, respond to, and recover from hazard events. Historically, people in these groups have experienced disproportionate losses or economic impacts, disruption of livelihood, injuries, or death. Characteristics of socially vulnerable groups might include age, gender, income, race, ethnicity, language, or disabilities. For each hazard, care was given to identify populations that might be more susceptible to the effects of that hazard.

Several tools were referenced to help identify socially vulnerable populations in Salt Lake County. Social vulnerability is included in the NRI overall risk rating equation. This is based on the CDC's Social Vulnerability Index (SVI). The SVI is a place-based index, database, and mapping application that provides a reference for understanding which areas are most likely to experience social vulnerability. It uses 16 variables from the U.S. Census 5-year American Community Survey to identify communities needing additional support. These are grouped into four themes and also combined into a single measure of overall vulnerability, as shown in Figure 37.[36] The maps in Figure 38–Figure 42 show the areas in Salt Lake County with high percentages of socially vulnerable populations based on the four themes.

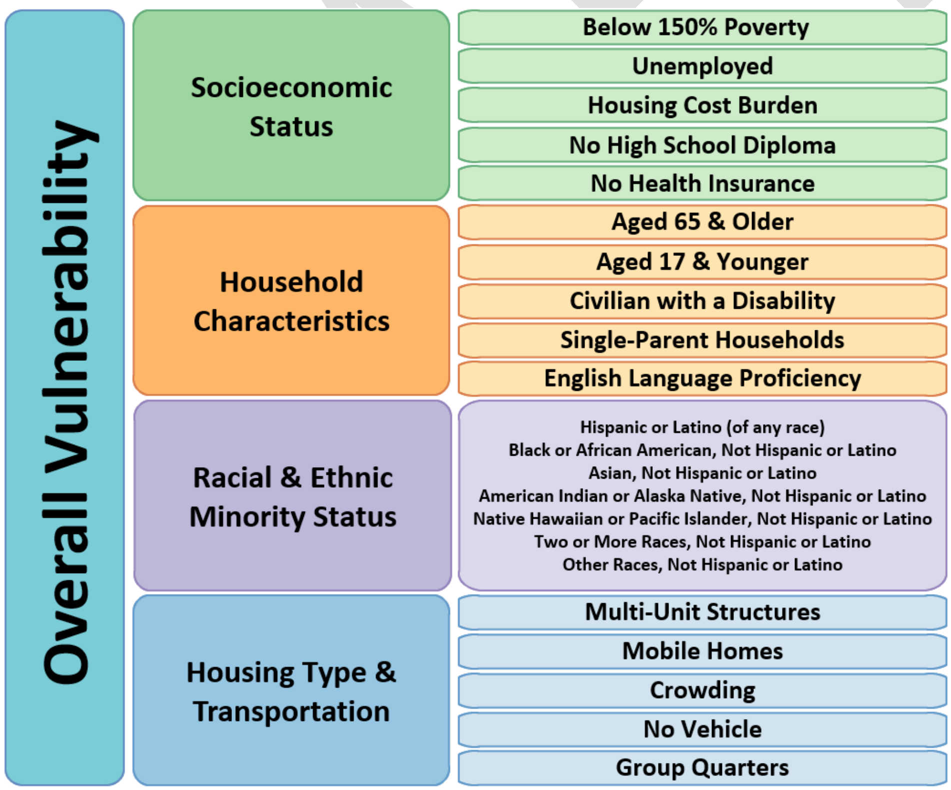



**Figure 37: Social Vulnerability Index Themes and Variables**

[36] CDC/ATSDR. "Social Vulnerability Index." 2022. https://www.atsdr.cdc.gov/place-health/php/svi/index.html

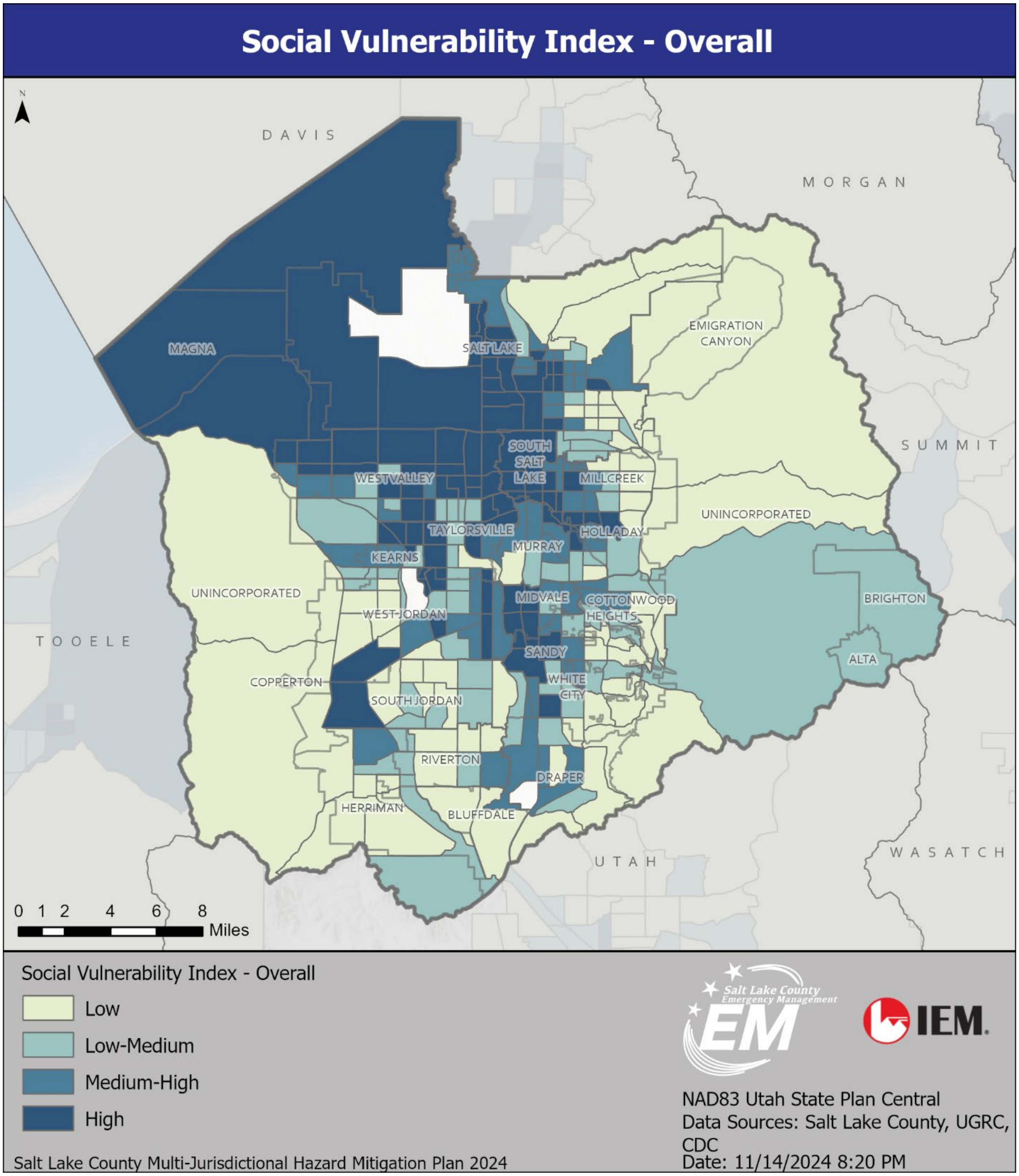



**Figure 38: SVI – Overall Vulnerability Score**

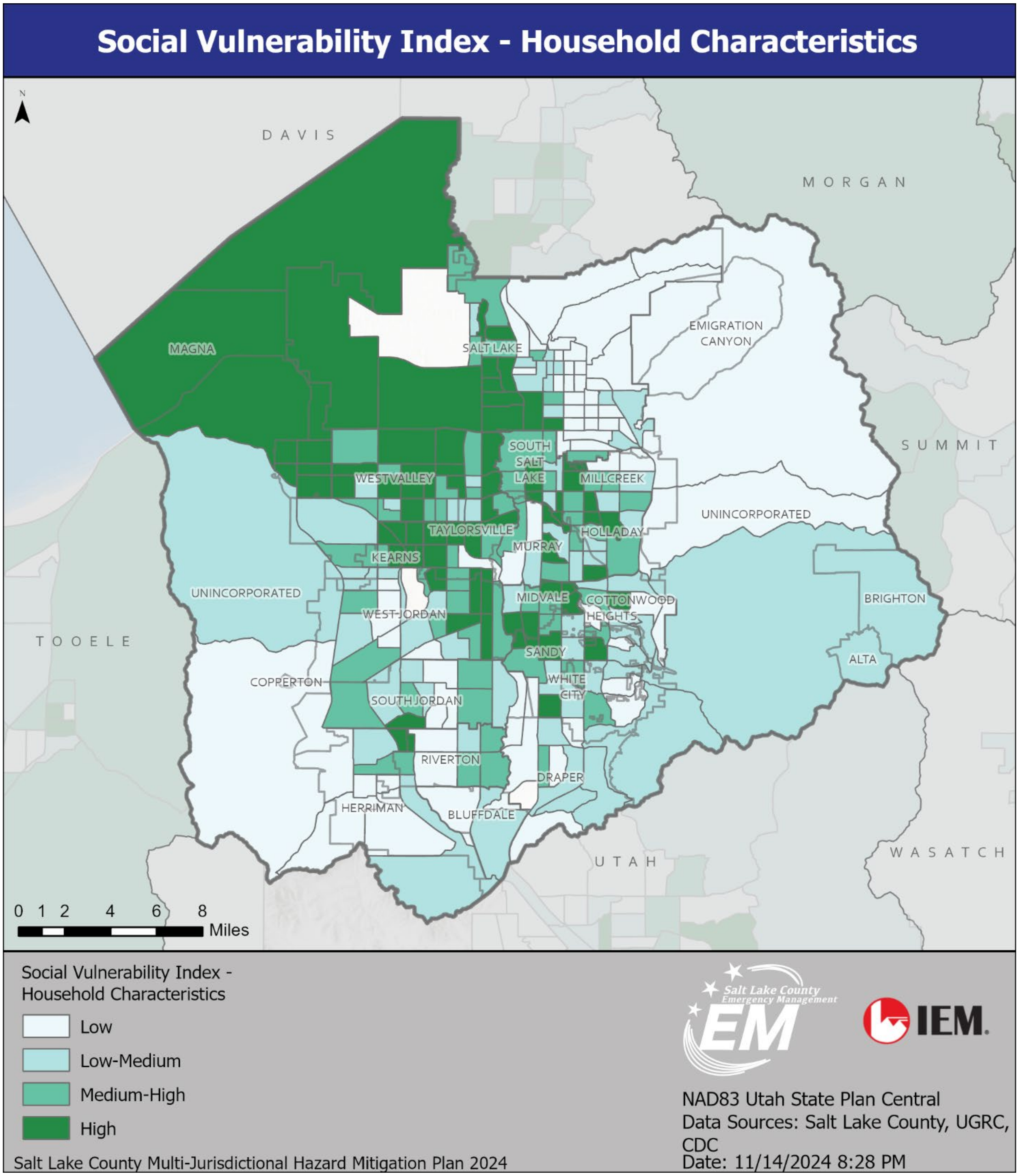



**Figure 39: SVI – Household Characteristics**

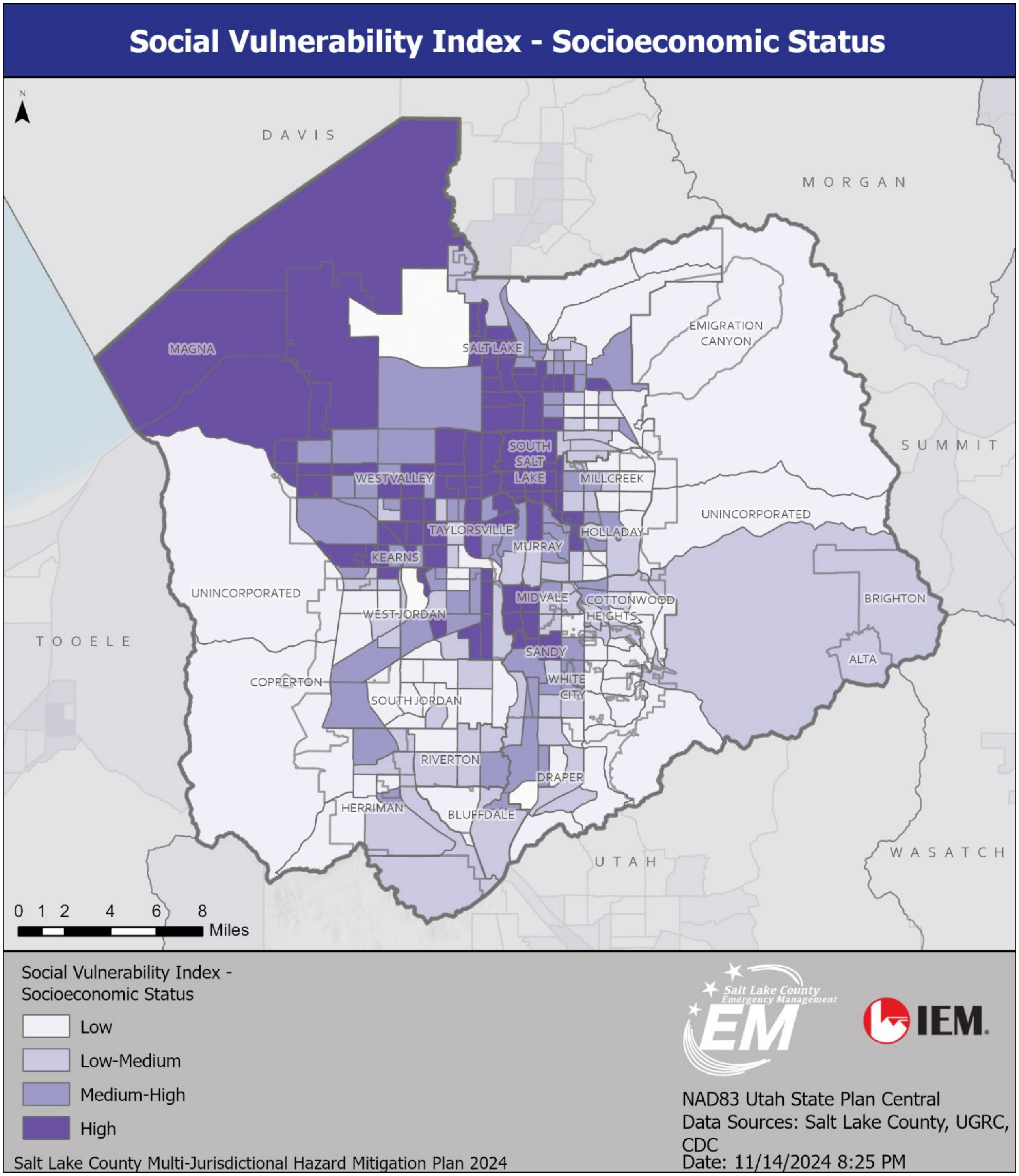



Figure 40: SVI – Socioeconomic Status

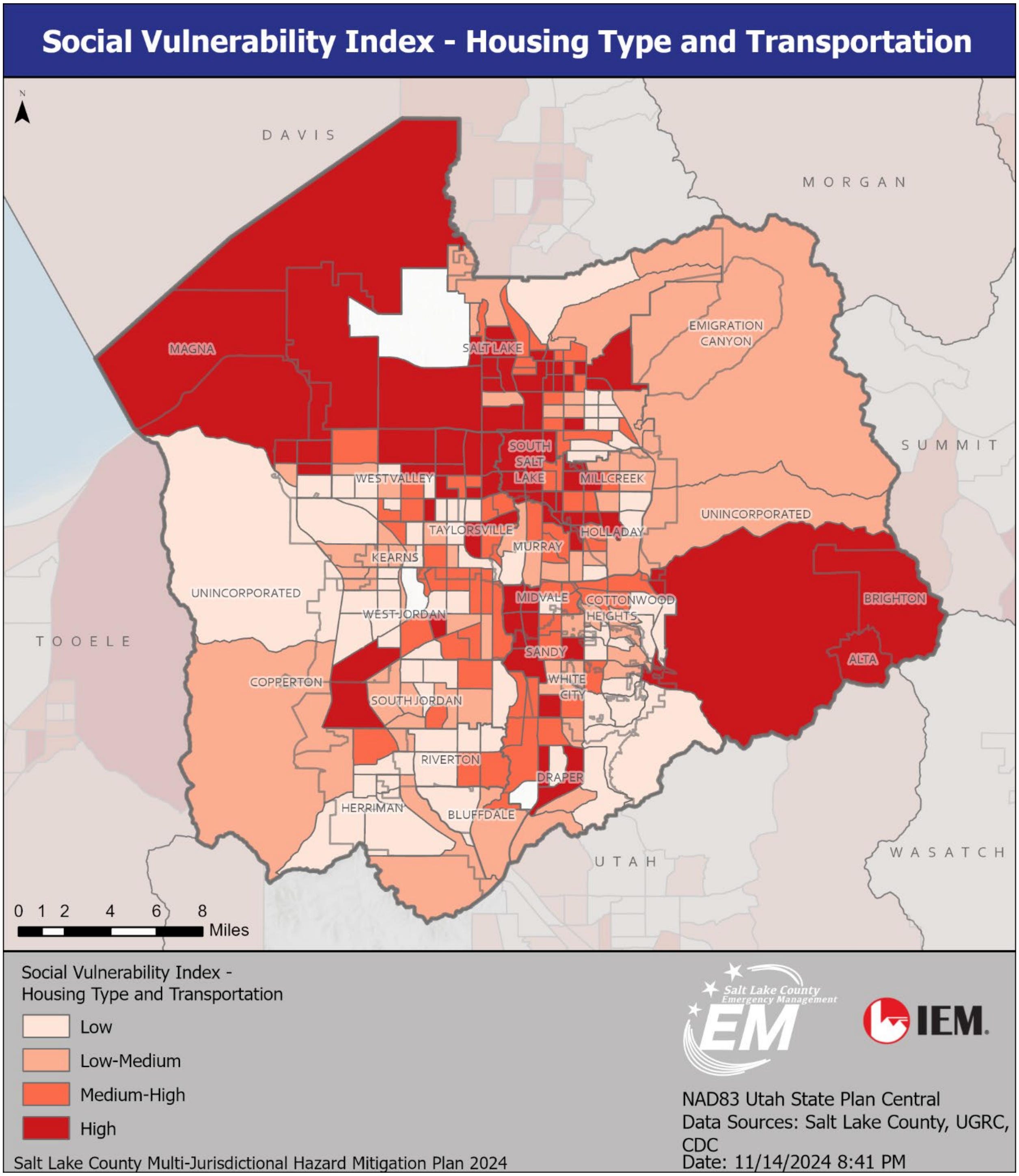



**Figure 41: SVI – Housing Type and Transportation**

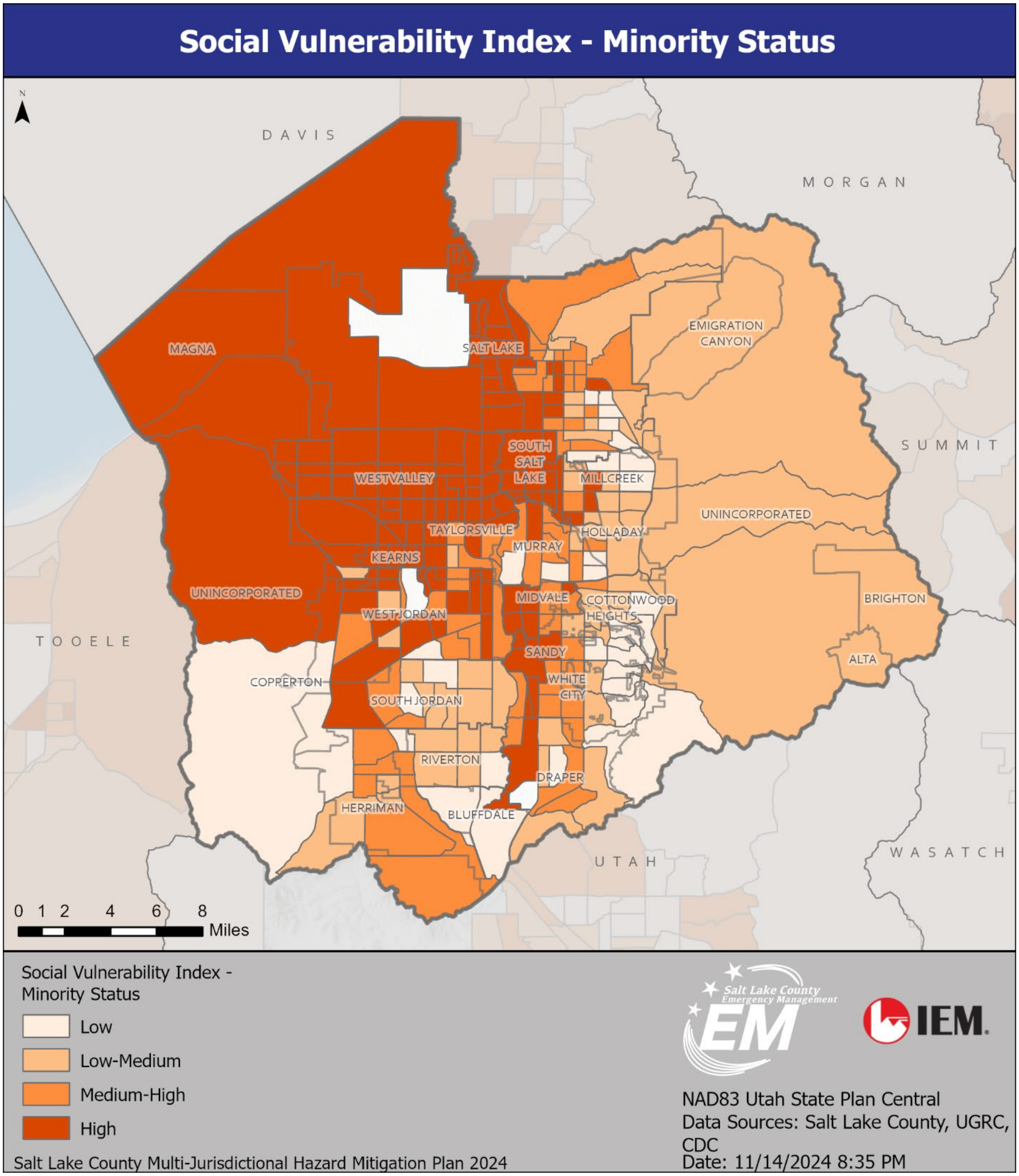



**Figure 42: SVI – Minority Status**

The Climate and Economic Justice Screening Tool is another method for identifying vulnerable populations. This interactive mapping tool identifies overburdened and underserved census tracts that are considered disadvantaged. Tracts that meet one or more categories of burden and the associated socioeconomic threshold are identified as disadvantaged. Figure 43, shows disadvantaged tracts in Salt Lake County.

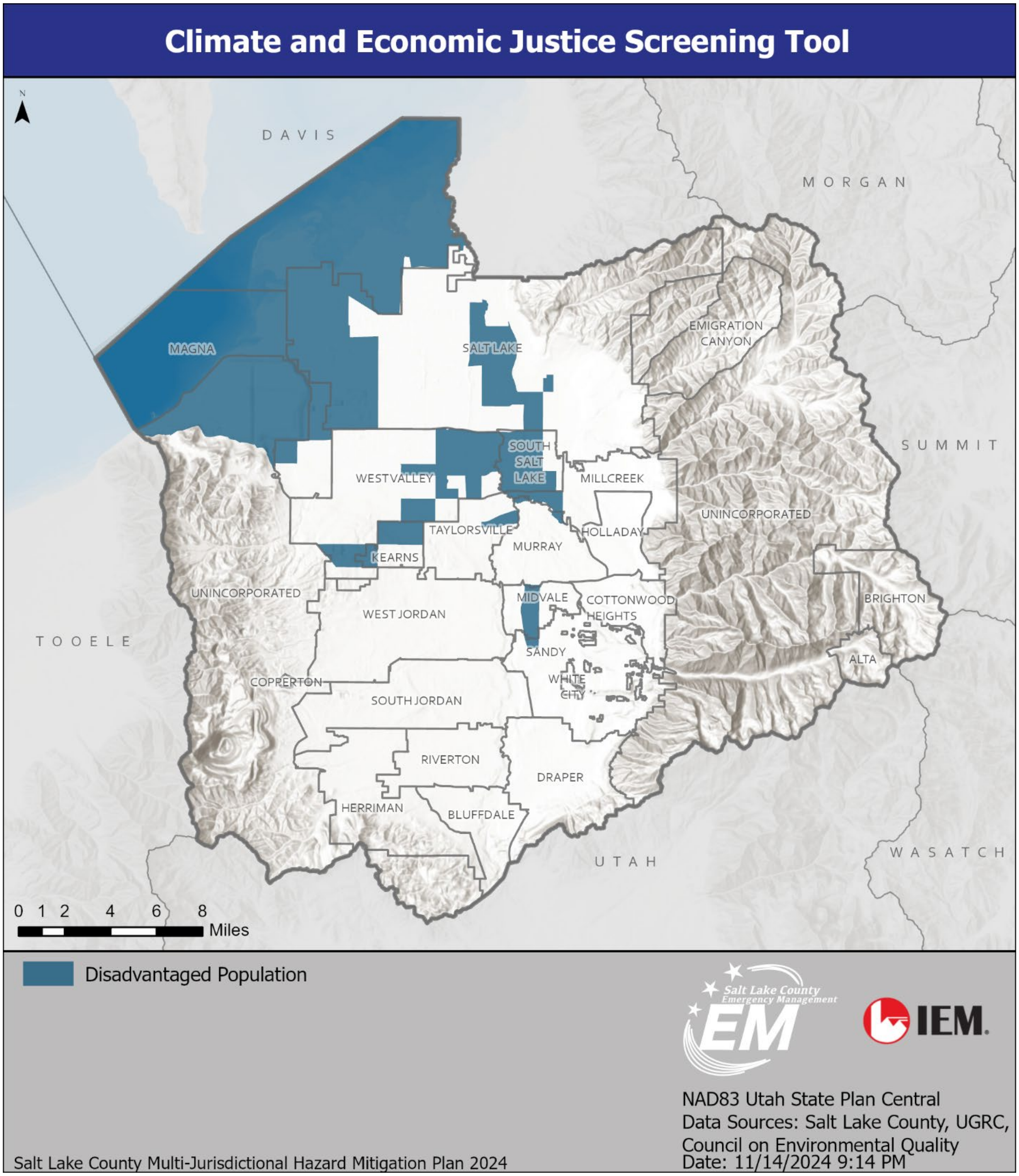



**Figure 43: Salt Lake County CEJST Disadvantaged Census Tracts**

Indicators that contribute to disadvantaged status in one or more census tracts in Salt Lake County include the following:

- Projected wildfire risk
- Projected flood risk
- Expected population loss rate from natural hazards
- Asthma
- Low life expectancy
- Formerly used defense sites
- Proximity to hazardous waste facilities
- Proximity to risk management plan facilities
- Proximity to Superfund sites
- Underground storage tanks and releases
- Toxic concentrations in wastewater discharge
- Diesel particulate matter exposure
- Traffic proximity and volume
- Historic underinvestment in home loans
- Housing cost
- Lack of green space
- Homes containing lead paint
- Linguistic isolation
- Percentage of people with less than a high school diploma
- Low median income (comparison of median income in the tract to median incomes in the area)
- Low income (household income is less than or equal to twice the federal poverty level)

# Avalanche

## Hazard Description

A snow avalanche is the rapid downslope movement of a mass of snow, ice, and debris. Snow avalanches occur in the mountains of Utah during the winter and spring due to snow accumulation and unstable snowpack conditions. Avalanches can be extremely destructive due to the forceful energy of rapidly moving snow and debris and the resulting burial of areas in run-out zones. Avalanches can cause damage to property, interruption of communications, and blockage of transportation routes and streams. They often result in injury and death, causing more fatalities than any other natural hazard in Utah. On average, over the past 25 years, four people have been killed by avalanches in the state each year.

Although most avalanches occur in undeveloped areas, recreational endeavors—hiking, hunting, mountain climbing, skiing, snowboarding, snowmobiling, and other wintertime activities—bring the population into avalanche-prone areas. Due to the immense popularity of these activities, avalanches are actively mitigated within well-traveled areas. People venturing into the backcountry are at higher risk. Homes and businesses along the foothills and in mountain areas have been damaged by avalanches. Avalanches can occur naturally or be triggered artificially by explosives or people such as snowmobilers, backcountry skiers, or other outdoor recreationists. The weather and terrain are two main natural factors that affect avalanche activity.

Weather events create a layered snowpack. When strong layers or slabs of snow form on top of weak layers, the snowpack can become unstable. The amount of snow, accumulation rate, wind speed, direction, moisture content, and snow crystal type all contribute to snowpack stability conditions. Most natural avalanches occur during or within the 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. The slope angle is the primary factor influencing avalanche probability, with most occurring between 30 and 45 degrees (the optimum angles). The elevation and aspect dictate the depth, temperature, and moisture characteristics of the snowpack. The 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 roughness of the slope and provide some stability.

Types of avalanches include wet and dry slab. Wet-slab avalanches occur most often on south-facing slopes in warming conditions. Dry-slab avalanches occur mostly on north-facing slopes in mid-winter. Wind can accelerate snow deposition, leading to larger or more frequent avalanches. The two primary factors impacting avalanche activity are weather and terrain. Large, frequent storms deposit snow on steep slopes, creating avalanche hazards. Additional factors that contribute to slope stability are the amount of snow, accumulation rate, moisture content, wind speed and direction, and type of snow crystals.

Avalanche paths may not experience a serious avalanche for years or even decades, but the potential remains, especially during above-average snowfall years. In Utah, 100 avalanche deaths occurred from 1958 to 2022. By comparison, there have been 61 deaths from lightning since 1950.

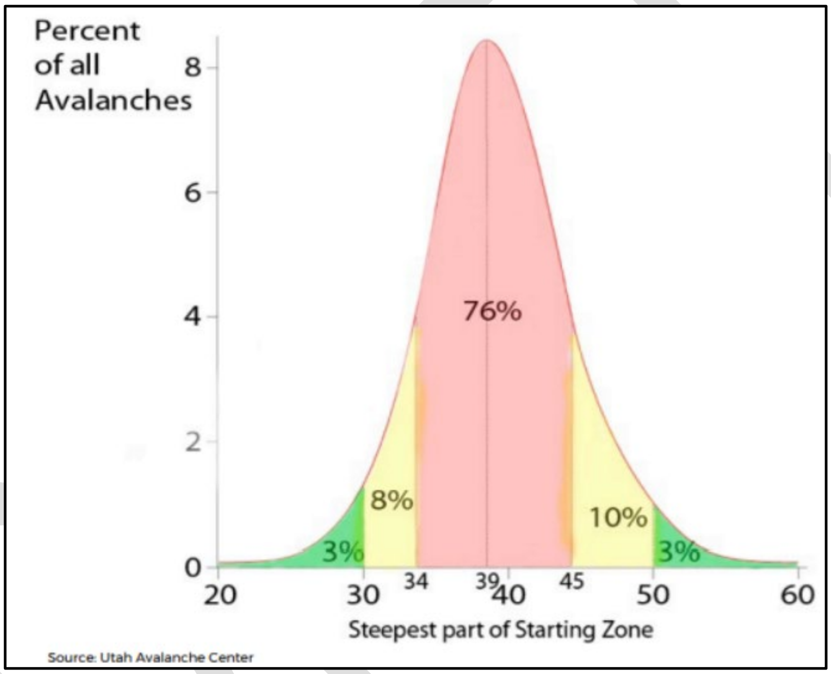



**Figure 44: Utah Avalanche Center Diagram of Factors Impacting Avalanche Activity**[37]

Topography also plays a vital role in avalanche dynamics. As shown in Figure 44 and as reported by the Utah Avalanche Center (UAC), slope angles between 30 and 45 degrees are optimal for avalanches. The risk of avalanches decreases on slope angles below 30 degrees. At 50 or more degrees, they tend to produce sluff or loose snow avalanches that account for only a small percentage of avalanche deaths and property damage annually.[38]

[37] Utah Hazard Mitigation Plan. "Avalanche." 2024. https://hazards.utah.gov/avalanche/
[38] Ibid.

## Hazard Profile

| **Potential Impact** | | Catastrophic | **Probability** | X | Highly Likely |
|---|---|---|---|---|---|
| | | Critical | | | Likely |
| | X | Limited | | | Occasional |
| | | Negligible | | | 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 landform | | | | |
| **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, UAC, Utah Division of Emergency Management, local input, and review of historic events and scientific records. | | | | |

## Magnitude/Extent

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

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

**Table 21: Canadian Snow Avalanche Size Classification System and Typical Factors**[39]

| Size | Description | Typical Mass (Tons "t") | Typical Path Length (Meters "m") | Typical Impact Pressure (Kilopascals "kPa") |
|---|---|---|---|---|
| 5 | Largest snow avalanches known; could destroy a village or a forest of 40 hectares | $10^5$ | 3000 | 1000 |
| 4 | Could destroy a railway car, large truck, several buildings, or a forest with an area of up to 4 hectares (40,000 $m^2$) | $10^4$ | 2000 | 500 |
| 3 | Could bury a car, destroy a small building, or break a few trees | $10^3$ | 1000 | 100 |
| 2 | Could bury, injure, or kill a person | $10^2$ | 100 | 10 |
| 1 | Relatively harmless to people | <10 | 10 | 1 |

[39] Canadian Snow and Avalanche Center. "Snow and Avalanche Glossary." 2023. https://www.avalanche-center.org/Education/glossary/avalanche-size.php

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

**Table 22: North American Public Avalanche Danger Scale**[40]

| Danger Level | Travel Advice | Likelihood of Avalanche | Avalanche Size and Distribution |
|---|---|---|---|
| **5 – Extreme** | **Extraordinarily dangerous conditions.** Avoid all avalanche terrain. | Natural and human-triggered avalanches certain. | Very large avalanches in many areas. |
| **4 – High** | **Very dangerous avalanche conditions.** Travel in avalanche terrain not recommended. | Natural avalanches likely; human-triggered avalanches very likely. | Large avalanches in many areas, or very large avalanches in specific areas. |
| **3 – Considerable** | **Dangerous avalanche conditions.** Careful snowpack evaluation, cautious route-finding, and conservative decision-making is 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. |

The Utah Avalanche Center (UAC) forecasts include the overall danger rating using the scale in Table 22 and a "Danger Rose" (Figure 45), which provides additional information on avalanche danger based on aspect and elevation. This tool is used to inform the public, particularly outdoor recreationists, regarding avalanche danger.

[40] Avalanche.org. "North American Public Avalanche Danger Scale." 2010. https://avalanche.org/wp-content/uploads/2018/08/10_ISSW_Statham_etal_DangerScale.pdf

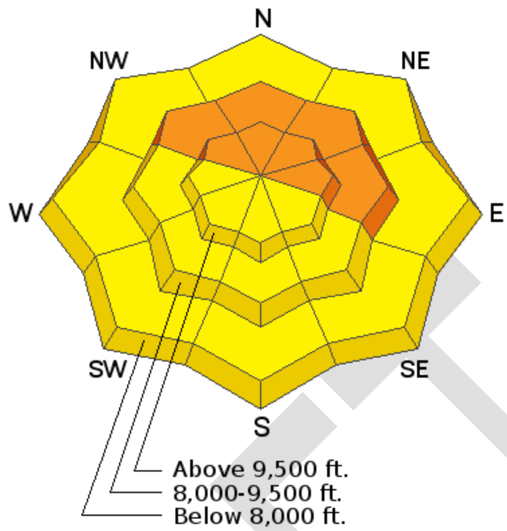



**Figure 45: Avalanche Danger Rose**[41]

## Location

The risk of avalanches in Salt Lake County exists primarily in the Wasatch Range mountains—due to their high use for recreation and increasing development—although avalanches occur throughout Utah's mountainous areas. Avalanche risk in Salt Lake County is centered around the Big and Little Cottonwood Canyons. The Town of Alta and the Town of Brighton are especially at risk from the impacts of avalanches. The following maps from the UAC show the locations of known avalanche paths (Figure 46), and all reported avalanche events from 2009 to 2024, as well as the locations of all reported avalanche fatalities in the Salt Lake County Region (Figure 47).

[41] Utah Avalanche Center. "Danger Rose Tutorial." https://utahavalanchecenter.org/danger-rose-tutorial#:~:text=Avalanche%20Danger%20Rose%20We%20designed,make%20it%20easier%20to%20visualize

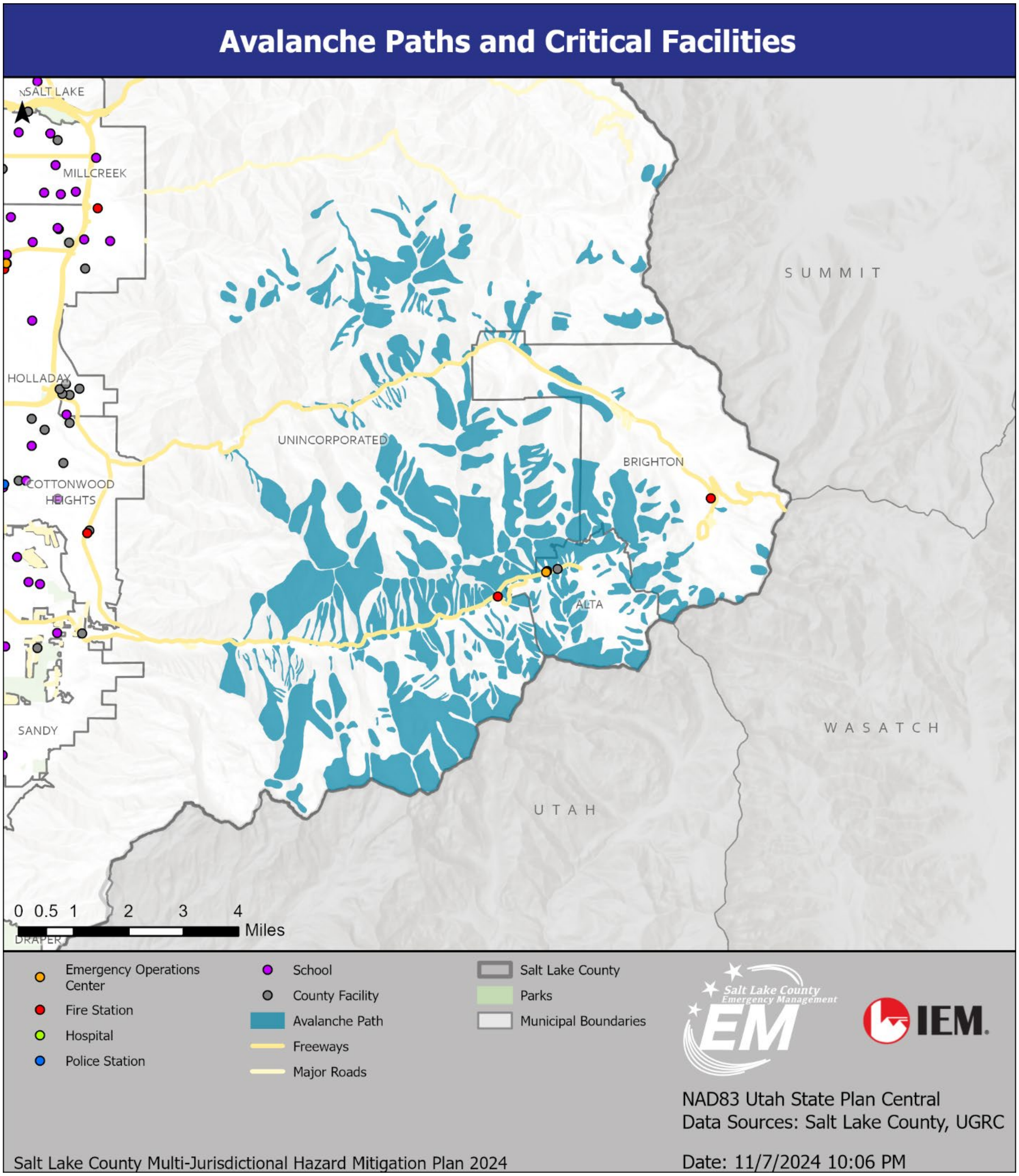



**Figure 46: Historical Avalanche Paths in Salt Lake County**

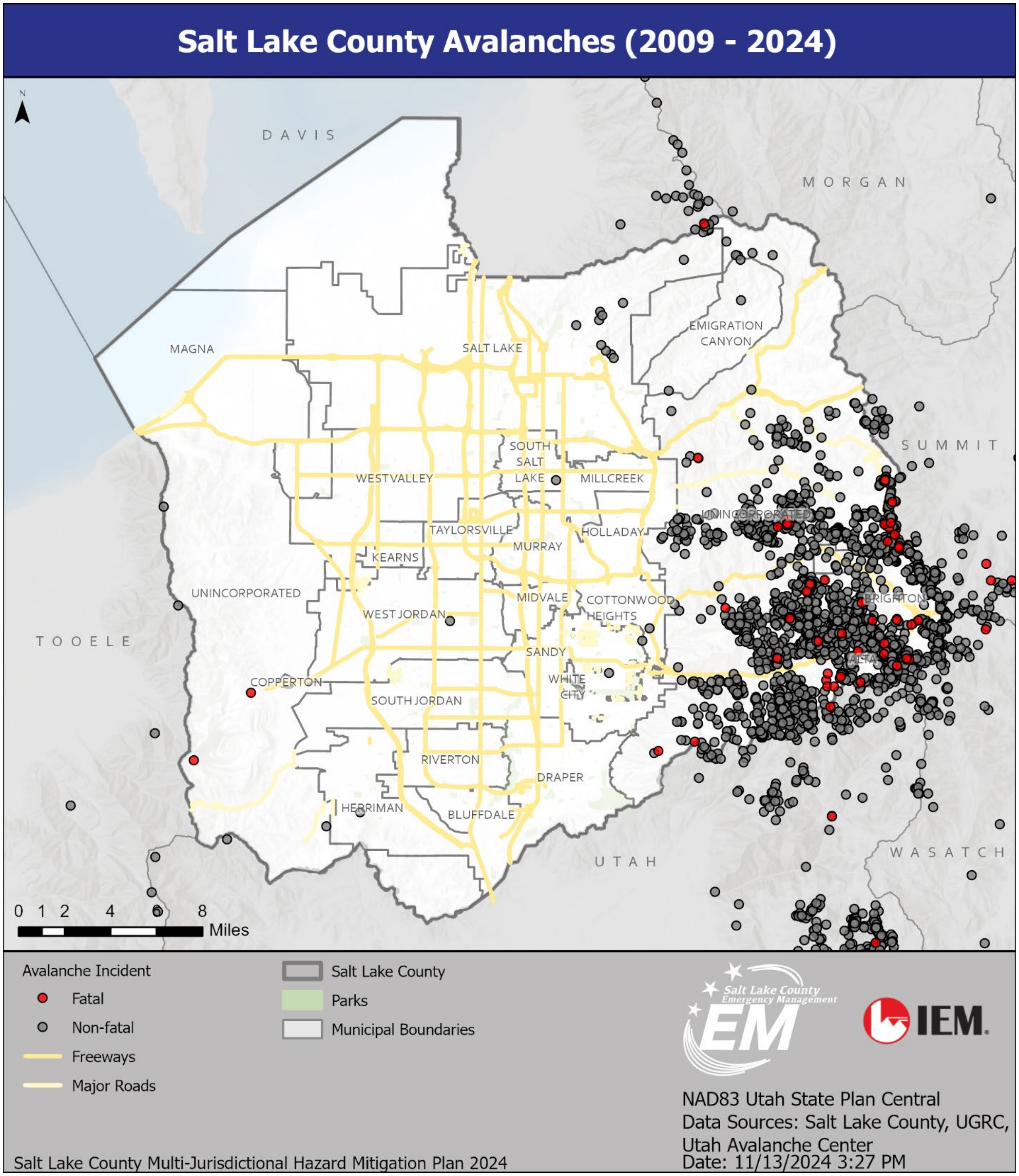



**Figure 47: Salt Lake County Region Avalanche Fatalities Locations**

Highway 210 in Little Cottonwood Canyon has the highest avalanche hazard-rating index of any major roadway in the country. When the Utah Department of Transportation (UDOT) and the Town of Alta's Marshal agree that conditions are unsafe, the town goes into an Interlodge Alert. All occupants (including visitors and residents) must remain indoors until conditions are deemed safe. During large storm cycles, an Interlodge Alert 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, Utah Transit Authority (UTA), and U.S. Forest Service (USFS), that meets monthly to discuss access, usage, and safety and security issues related to the canyon road.

The Town of Brighton can also be affected by avalanche. Highway 190 could be deemed impassable due to avalanche or closed during UDOT avalanche control operations. Residents and skiers may become isolated from the rest of the county.

UDOT is responsible for managing the threat of avalanches on Utah's state and federal highways. The average daily traffic in Big and Little Cottonwood Canyons frequently exceeds the capacity of those roads, and slow-moving traffic conditions pose a significant threat to public safety if avalanche conditions are present. To address these safety concerns, the UDOT Avalanche Safety Plan establishes a process to develop avalanche hazard forecasts, conduct avalanche control and stability evaluations, and perform avalanche rescue.[42] When conditions are met, UDOT coordinates with the Unified Police Department (UPD) and the Town of Alta to implement backcountry access closures where avalanche control work is planned. Following the complete evacuation of avalanche control areas, UDOT uses explosives and artillery to trigger avalanches that threaten public roads. Additional details on these procedures, maps of known avalanche paths, staging areas, and other details are available in the Safety Plan. Road and backcountry closures are announced on UDOT's Avalanche Safety webpage (see Figure 48) and social media sites.[43] Further details on backcountry closure zones are detailed in the Avalanche Safety Backcountry Policy, as shown in Figure 49.[44]



[42] UDOT. "Highway Avalanche Safety Plan for Big and Little Cottonwood Canyon." 2012. https://drive.google.com/file/d/1j-haYETjb3g2-xNq8qKetTDkT4OMuM4w/view
[43] UDOT. "Avalanche Safety." https://udot.utah.gov/connect/current-conditions/avalanche/
[44] UDOT. "Avalanche Safety Backcountry Closure Policy." http://www.udot.utah.gov/avalanche

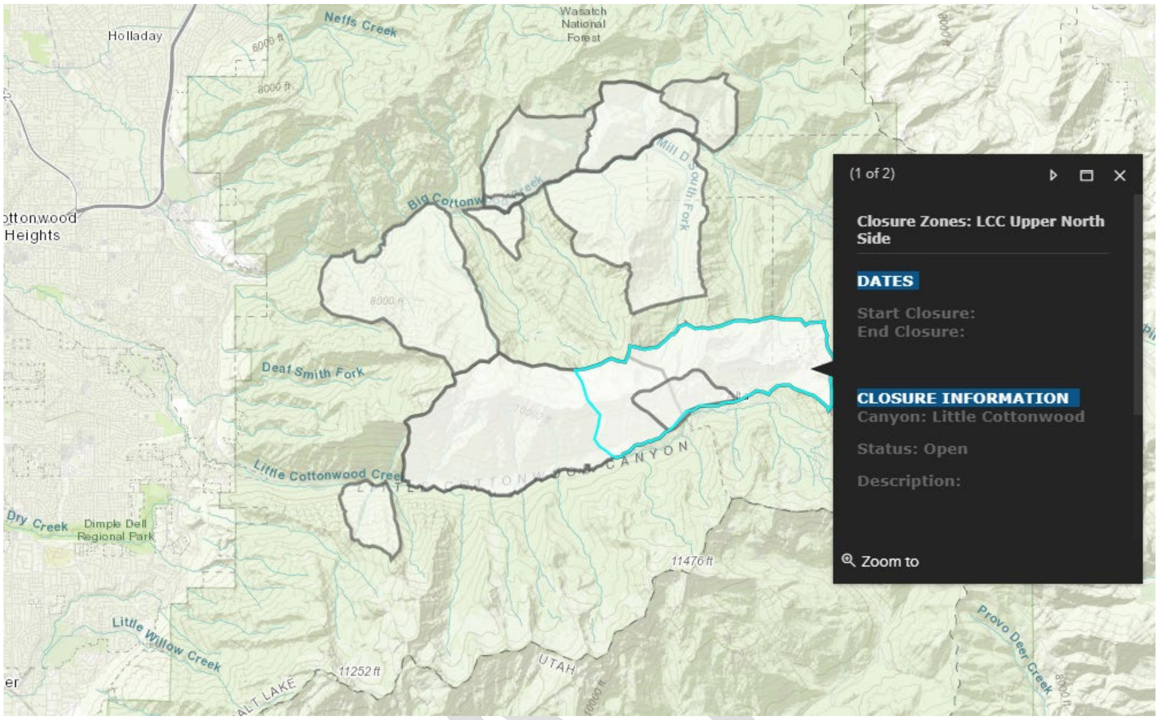



Figure 48: UDOT Backcountry Closure Areas

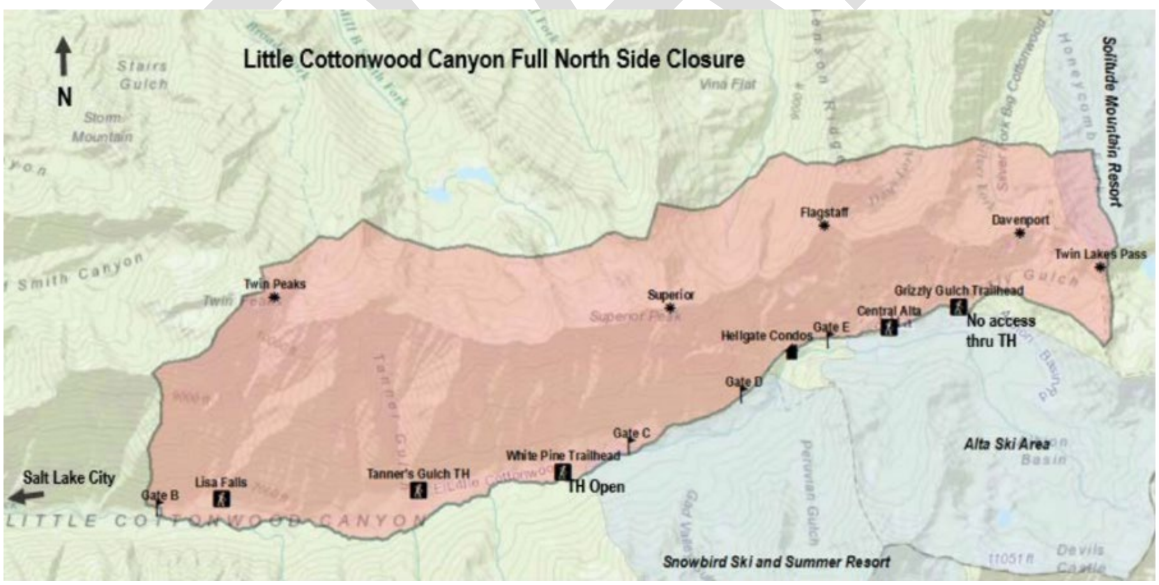



Figure 49: Example of Backcountry Closure Area[45]

45 Ibid.

## Historical Events and Probability of Future Occurrences

Since January 1, 2019, the Salt Lake region has had over 2,400 avalanches. Avalanches are one of the deadliest types of natural disasters in Utah. According to the National Oceanic and Atmospheric Administration (NOAA) National Centers for Environmental Information (NCEI) database, avalanches caused 128 deaths in the state between 1996 and 2022, accounting for 70% of severe weather-related deaths.[46]

According to data from the 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, the region had approximately 2,151 reported avalanches, averaging approximately 215 reported events per year. According to NOAA data from 1996 to 2018, there have been only 2 events with significant recorded property damages, totaling $70,000.

On Thursday, May 9, 2024, two men died in an avalanche in the Big Willow drainage of the Wasatch Mountains. A group of 3 men were hiking toward Lone Peak following a significant, late-season storm. The avalanche broke around the lead hiker, who was partially buried but able to dig himself out. The other two hikers were completely buried. The friend used a transceiver to locate the other two and worked to unbury them, but neither survived.

On Monday, April 17, 2023, a man died after being buried by a roof avalanche outside a cabin in the Town of Brighton. It is believed he was attempting to clear or remove snow from the roof when the avalanche occurred. The following day, the Unified Police Department found him partially buried after they were called to perform a welfare check when the man failed to show up for work.

On Monday, March 27, 2023, a group of six snowmobile riders were recreating in Pole Canyon in the Oquirrh Mountains. Four left to return home while the other two continued toward the top of Flat Top mountain. An avalanche occurred while the two who had remained were descending. One was able to ride safely out of the path and the other was buried. The man called the rest of his party and contacted search and rescue, and began searching for his companion. He was eventually found deceased. It was noted that the Utah Avalanche Center does not forecast avalanche conditions for the Oquirrh Mountains and has minimal data for that range.

On February 6, 2021, two groups of eight people total went skiing in the Wilson Glades area, beginning at the Butler Fork Trailhead in Big Cottonwood Canyon. Both groups were ascending when the avalanche was triggered. Six people were caught and fully buried. Two survived, while the other four did not.

On January 21, 2016, a group of skiers were 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.

[46] "Avalanche." Utah Hazard Mitigation Plan. 2024. https://hazards.utah.gov/avalanche/

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

In 1983, a large avalanche completely covered Highway 210, buried several 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 depend upon many factors, such as previous snow conditions, amount of new snowfall, wind speeds, wind direction, snow density, and avalanche control work success, mostly occurring in the Wasatch Mountain range. It is reasonable to expect that avalanche occurrence frequency will continue to be in line with past events. Based on the average of 215 events occurring annually, the probability of future events is highly likely.

**Table 23: Recent Avalanche Fatalities (2019–2023)[47]**

| Date | Number Killed | Region | Place | Trigger |
|---|---|---|---|---|
| 12/15/2019 | 1 | Salt Lake County | Dutch Draw | Snowboarder |
| 01/08/2021 | 1 | Salt Lake County | Dutch Draw | Skier |
| 01/30/2021 | 1 | Salt Lake County | Squaretop | Skier |
| 02/06/2021 | 4 | Salt Lake County | Wilson Glade | Skier |
| 03/27/2023 | 1 | Salt Lake County | Pole Canyon | Snowmobiler |
| 04/17/2023 | 1 | Salt Lake County | Brighton | Unknown |
| 05/09/2024 | 2 | Salt Lake County | Big Willow | Skier |

## Climate Change Considerations

The Utah State 2024 Hazard Mitigation Plan states that climate change will affect avalanche risk in Utah. Projections for warmer temperatures suggest that the snowline will move to higher elevations, leaving less snow cover at lower elevations. As the snow cover declines, the spatial extent of possible avalanches will decline. The risk of impacts to roads and infrastructure will decline as the spatial extent declines. However, wintertime backcountry enthusiasts may follow the snowpack, and exposure may persist. The relationship between changing snowpack and avalanche deaths and injuries is likely complex.[48]

## Secondary Hazards

Avalanches tend to be localized events causing immediate injury or death but do not have secondary impacts affecting the rest of the county. Nonetheless, avalanche events can damage roadways and other

[47] Utah Hazard Mitigation. "Avalanche Fatalities 2019–2023." Utah Avalanche Center. 2024. https://hazards.utah.gov/avalanche/
[48] Utah Hazard Mitigation. "Climate Change Considerations." Utah Avalanche Center. 2024. https://hazards.utah.gov/avalanche/

transportation infrastructure, producing traffic restrictions and restricting access of essential and critical emergency services delivery for 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 and Town of Brighton are particularly at risk. 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 the town's only arterial connection with the rest of the county. Although the Town of Alta only has a population of 225 [49], it has a significant, fluctuating tourist population due to ski resorts and other mountain recreation sites, which would be greatly impacted if an avalanche blocks Highway 210.

According to the 2019 Utah State Hazard Mitigation Plan, the following 95 structures are vulnerable to avalanche events: 56 commercial, 38 residential, and 1 government with a total value of $57,700,210.

[49] World Population Review. Alta, Utah Population. 2024. https://worldpopulationreview.com/us-cities/utah/alta

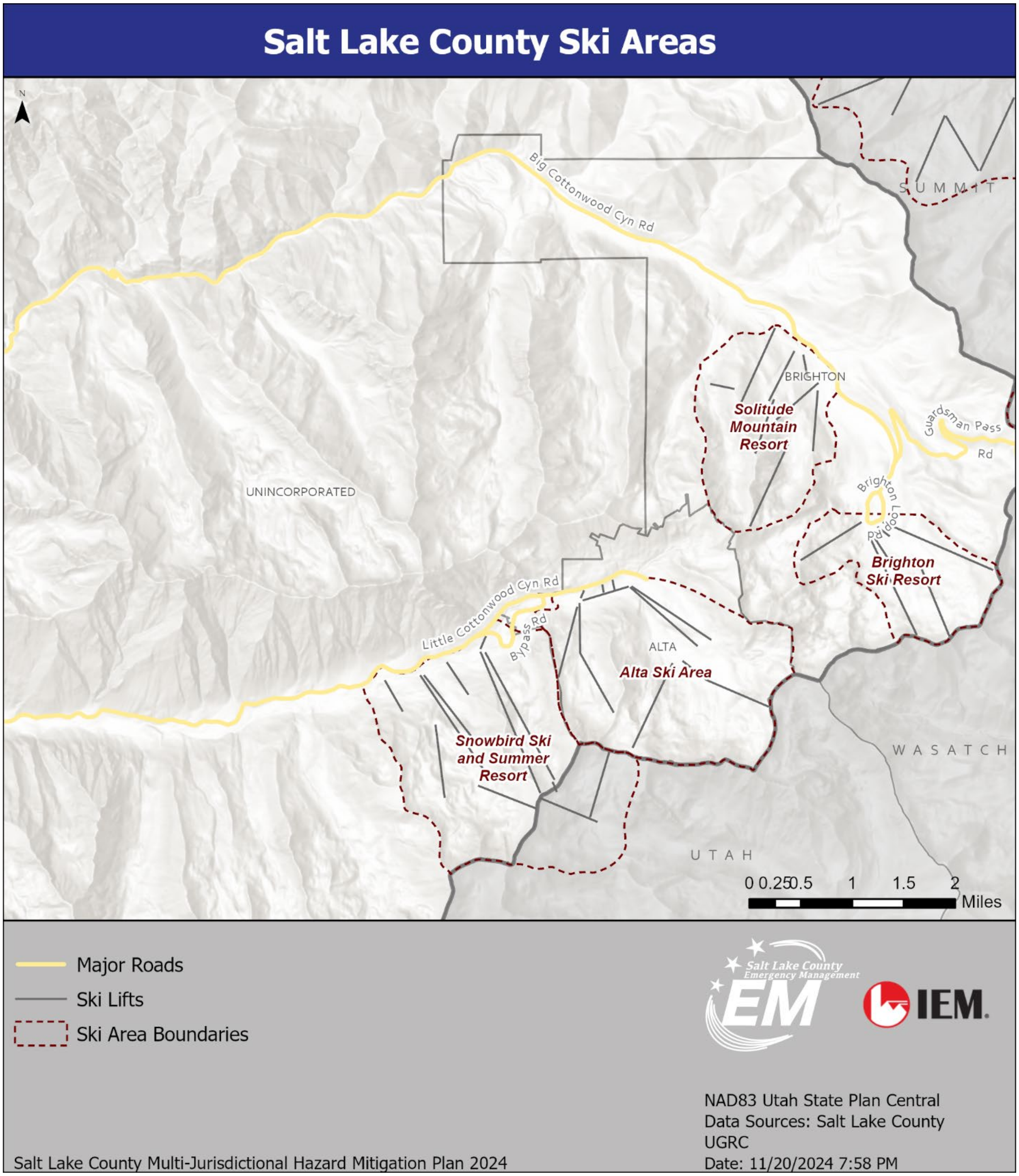



Figure 50: Highway 210, Ski Resort Infrastructure

## ESTIMATED IMPACTS AND POTENTIAL LOSSES

The National Risk Index (NRI) includes data on the expected annual losses from individual natural hazards, historical loss, and overall risk at a county and Census tract level. Salt Lake County's NRI expected annual loss (EAL) value due to avalanches is $2 million, with a risk score of 96.6 and a rating of Very High compared with the rest of the United States (Figure 51).

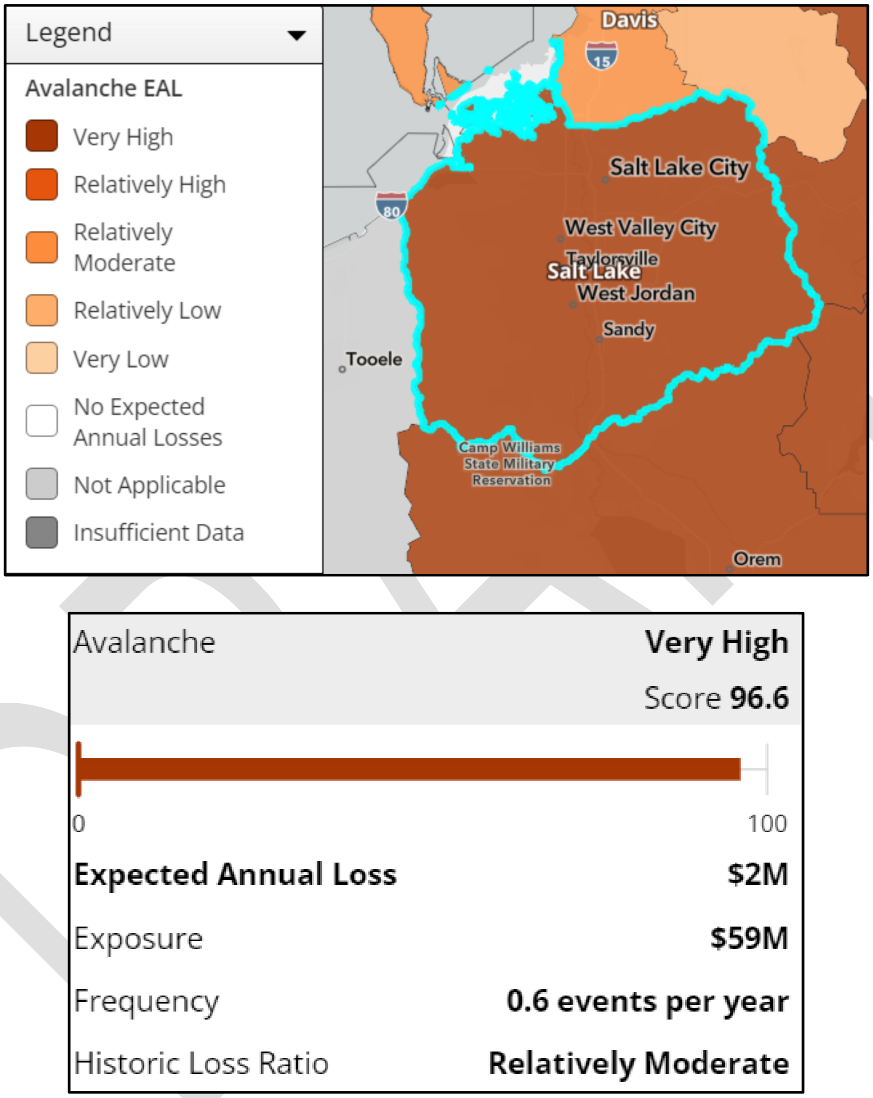



**Figure 51: FEMA National Risk Index Salt Lake County Expected Annual Loss from Avalanche[50]**

## VULNERABLE POPULATIONS

The Utah State 2024 Hazard Mitigation Plan states that victims of avalanche hazards are primarily backcountry skiing or snowmobile enthusiasts, who are often specially trained and equipped to avoid or survive the avalanche hazard and are typically undertaking a calculated risk of injury or death vs. the

[50] FEMA, National Risk Index. "Salt Lake County Expected Annual Loss Avalanche Risk Score, Map and Legend." https://hazards.fema.gov/nri/map

reward of fresh powder snow. Although ski towns, such as the Town of Alta, may have a relatively small permanent population, they also often have significant, fluctuating tourist populations during the winter months, which increases the likelihood of population impacts. Additionally, the American Institute for Avalanche Research and Education (AIARE) reports that 90 percent of avalanche victims die in slides triggered by themselves or a member of their group. Avalanche closures and mitigation in high-risk areas such as Little Cottonwood Canyon are designed to limit risk to populations on roads and those staying at ski areas. Road closures can isolate these populations from critical support, including medical care, ambulances, food, fuel, and other supplies. Although the permanent residents in Alta and Brighton were not identified as vulnerable or underserved communities, tourists and other visitors to the canyon may have unique challenges. Visitors in the canyon may need to shelter in place during Interlodge Alert conditions with minimal resources. They may have few options for food, clothing, and shelter during Interlodge or canyon road closures. Some may not have access to their daily medications.

## COMMUNITY LIFELINES

Lifelines are essential services in a community that, when maintained, allows all other aspects of society to function effectively. Community lifelines are essential for the well-being of any community, providing support and assistance to individuals who need help, especially during times of crisis. FEMA Community Lifelines are a critical component of emergency management in the United States. These lifelines are designed to address the essential needs of a community during and after a disaster. Community Lifelines help create a sense of safety and security within a community. They provide a safety net for individuals who may be struggling and offer comfort and reassurance that help is available when needed. Without these lifelines, communities would be significantly more vulnerable to crises and emergencies. There are eight lifelines, each with a specific focus.


**Figure 52: FEMA Community Lifelines**[51]

The main lifelines for avalanches are food, hydration, shelter, transportation, and safety and security. A primary focus during times of high avalanche risk is ensuring the safety of residents and recreationists. Enforcement of Interlodge alerts and providing adequate food, hydration, and shelter for those in the

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[51] FEMA. “Community Lifelines.” https://www.fema.gov/emergency-managers/practitioners/lifelines

affected area is a priority. Closure of roadways for avalanche control efforts when necessary helps maintain the safety of motorists.

### CHANGES IN DEVELOPMENT

Although the residential populations of the Town of Alta and the Town of Brighton have not grown significantly, record numbers of visitors to the canyon ski resorts have been recorded since the last plan update, and totaled 6.75 million skier visits between Utah's 15 ski areas in the 2023–2024 ski season.[52] The increased volume of recreationists represents an overall increase in vulnerability. No significant developments are underway in the area most at risk of avalanche, but future development, such as changes to road infrastructure, expansion or re-routing of ski infrastructure, or other modifications to the landscape, could affect avalanche risk. In 2022, UDOT announced plans to construct a gondola from the base of Little Cottonwood Canyon to the Snowbird and Alta ski resort areas. The gondola is intended to alleviate traffic congestion and will operate in a separate alignment from the road. However, this development has been controversial, and many residents have protested the gondola. It is not yet clear how construction of the gondola may affect vulnerability to avalanche.

An increase in avalanche vulnerability can increase loss of life and property and negatively affect the reputation of the ski resort area. Climate changes could affect snow levels and might decrease tourism, and businesses may move out of those areas. In addition, people may move to a different area that is less prone to avalanches if the likelihood continues to increase. Overall, vulnerability to avalanches has increased since the last plan update.

### VULNERABILITY SCORE

In order to analyze Salt Lake County's vulnerability to avalanches, the NRI was used as a primary tool during the 2024 update. The NRI defines risk as the potential for negative impacts due to a natural hazard. It determines a community's risk relative to other communities by examining the expected annual loss and social vulnerability in a given community in relation to its resilience. Salt Lake County's NRI Avalanche risk rating is shown in Figure 53. Salt Lake County has a Relatively High Avalanche risk and a risk score of 92.8.

[52] Stefanich, Logan. "Here's what's new at Utah's 15 ski resorts in what's anticipated to be another busy season." KSL.com. November 13, 2024. https://www.ksl.com/article/51189141/heres-whats-new-at-utahs-15-ski-resorts-in-whats-anticipated-to-be-another-busy-season

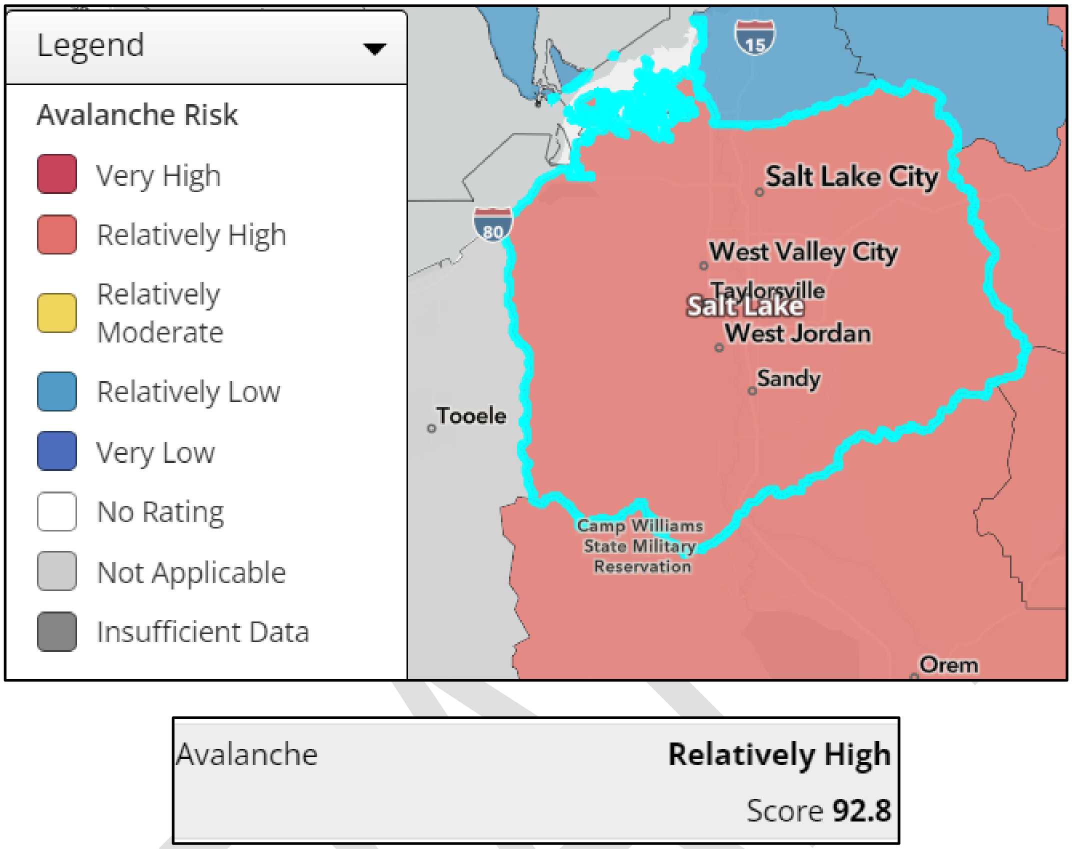


Figure 53: National Risk Index Avalanche Risk Map, Legend, and Score for Salt Lake County, Utah[53]

[53] FEMA, National Risk Index. "Salt Lake County Avalanche Score, Map and Legend." https://hazards.fema.gov/nri/map

# Dam Failure

## Hazard Description

Dams are usually human-made and, therefore, not inherently considered natural hazards; however, dam failures can occur because of natural events. The impacts of a dam failure can be like natural flood events, although they are often more sudden and violent than normal stream floods. Dam failure 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, and loss of property and life.

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 with a large proportion and destructive power. Sunny day failures are due to 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 without warning to owners or downstream residents.

Dam failures can also result from a combination of causes, including the following:

- Failure of upstream dams on the same waterway
- Improper maintenance
- Negligent operation
- Internal erosion caused by embankment or foundation leakage or piping, root growth, or rodent/wildlife activity
- Earthquake/seismic activity
- Prolonged periods of rainfall and flooding, which result in overtopping
- Improper design
- Inadequate spillway capacity resulting in excess overtopping flows
- Intentional structural attacks and cyberattacks

## Hazard Profile

| | | | | | |
|---|---|---|---|---|---|
| **Potential Impact** | | Catastrophic | **Probability** | | Highly Likely |
| | X | Critical | | | Likely |
| | | Limited | | X | Occasional |
| | | Negligible | | | Unlikely |
| **Location** | Dams are located throughout the county, with most representing high and moderate hazards in the eastern and southern portions | | | | |
| **Seasonal Conditions** | Rainy day failure: anytime<br>Sunny day failure: spring and late summer | | | | |
| **Conditions** | Rainy-day failures happen mainly during heavy precipitation events and may have some warning time. By contrast, sunny-day failures can happen anytime, without warning. | | | | |
| **Duration** | Hours or days, depending on the spillway type and area, maximum cubic feet per second (cfs) discharge, overflow or breach type, and dam type | | | | |
| **Secondary Hazards** | Raw sewage/health risks, electrical fires, and gas spills | | | | |
| **Analysis Used** | Review of Bureau of Reclamation (BOR) inundation maps and plans, Flood Insurance Study (FIS), and Utah Division of Water Rights | | | | |

## Location

Salt Lake County Emergency Management (SLCoEM) provided data on dams from the Dam Safety Database Information Viewer maintained by the Utah Division of Water Rights.[54] Figure 54 shows the location of all 72 dams in Salt Lake County. The county has 28 high-hazard, 24 significant-hazard, and 10 low-hazard dams, with an average age of 47 years since construction.

A special concern of dam safety is not only the safety of dams to the community but also the safety of dams themselves in case of other hazards or failures of upstream dams. Floods, earthquakes, ground shaking, surface faulting, and landslides all pose a concern for causing a dam incident. A GIS overlay analysis of the 266 high-hazard dams (and the hazards) was conducted and revealed that 14 dams are within the inundation areas of other dams (Figure 54).

[54] Utah Division of Water Rights. "Dam Safety Database Information Viewer." https://www.waterrights.utah.gov/cgi-bin/damview.exe?Startup

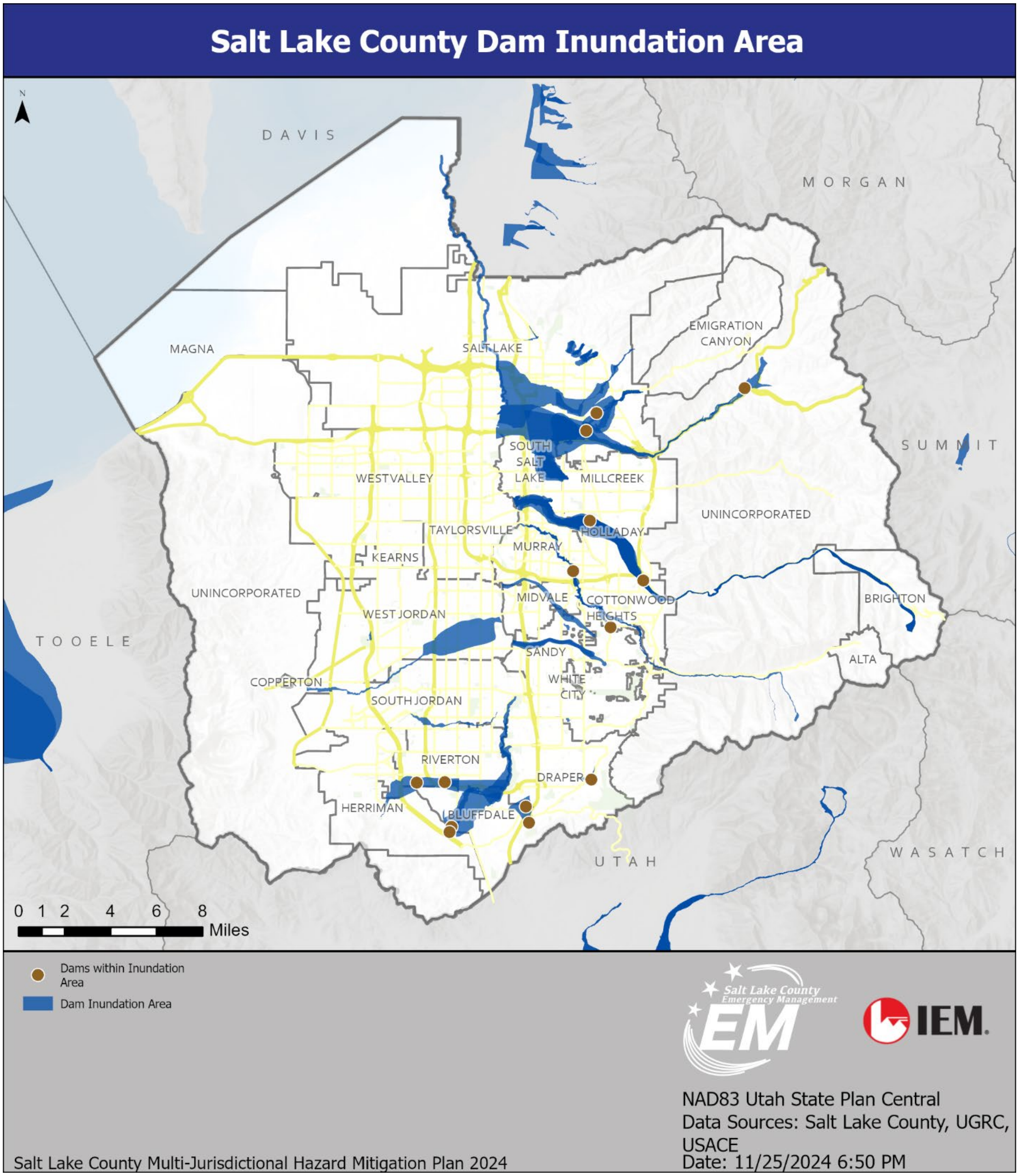


**Figure 54: Dams Within the Dam Inundation Area**

Levees can experience failures under similar conditions to dam failures. Figure 55 shows the location of levees in Salt Lake County.

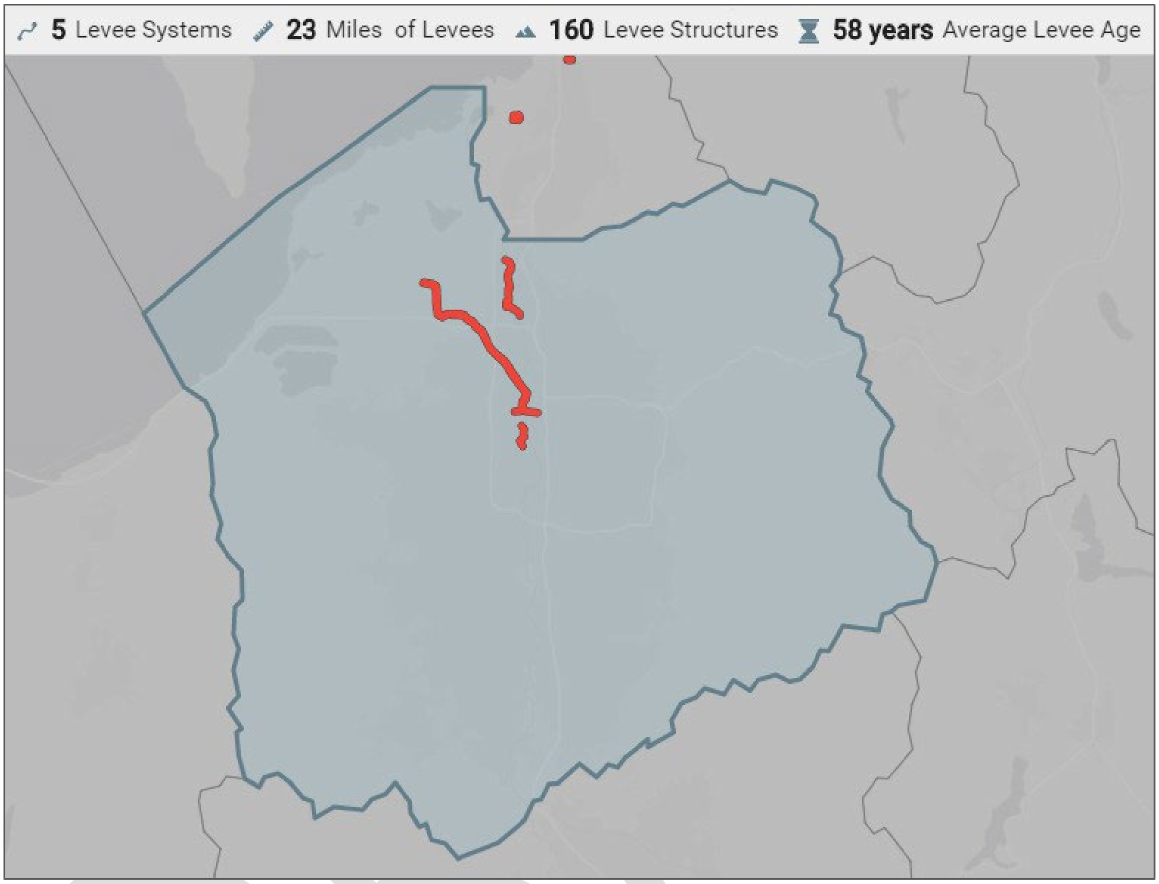


**Figure 55: Levees of Salt Lake County[55]**

## Magnitude/Extent

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 flood usually protected areas, generating impacts like those seen in areas within the floodplain and not generally protected by a levee. Table 24 provides dam failure classifications.

[55] National Levee Database. 2024. https://levees.sec.usace.army.mil/search

**Table 24: Army Corps of Engineers Hazard Profile 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** | In rural locations, 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. The loss of life potential is based on inundation mapping of the 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 are due to project failures or operational disruption, such as the loss of critical medical facilities or access to them.
d. Property losses include damage to project facilities and downstream property and indirect impacts due to the loss of project services, such as the loss of a dam and navigation pool or the loss of water or power supply.
e. The environmental impact downstream is 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.

The hazard rating does not reflect the dam's condition or likelihood of failure; rather, it indicates the potential for loss of life or property damage due to failure and should be prioritized for monitoring.

**Table 25: Number of Salt Lake County Dams by Hazard Rating**

| Low Hazard | Significant Hazard | High Hazard |
|---|---|---|
| 10 | 34 | 28 |

The 2024 Utah Enhanced State Hazard Mitigation Plan provides an inventory of all high-hazard dams by county and owner type in Utah:

**Table 26: High-Hazard Dam Ownership in Salt Lake County**

| High-Hazard Dams | Local Government | Federal | Private | Public Utility | State |
|---|---|---|---|---|---|
| 28 | 61% | - | 36% | 4% | - |

## Dam Safety Inspection in Utah

The 2024 Utah Enhanced State Hazard Mitigation Plan declares that the Utah State Engineer has been charged with regulating non-federal dams since 1919. Utah started its Dam Safety Section in the 1970s within the State of Utah Engineers Office to administer all non-federal dams in response to the Federal Dam Safety Act. In 1990, the legislature directed the State Engineer to regulate all dams in the state, including federally owned dams, except for those owned by the Bureau of Reclamation.

The frequency of dam inspection is designated based on the hazard rating: The Utah Division of Water Rights inspects high-hazard dams annually, moderate-hazard dams biannually, and low-hazard dams every five years.

Dams may be classified according to the type of construction material used, the methods employed in construction, the slope or cross-section of the dam, the way the dam resists the forces of the water pressure behind it, the means used for controlling seepage, the storage characteristics (on a watercourse, off-stream, above, or below ground level), and occasionally, according to their purpose. The materials used for building dams include earth, rock, tailings from mining or milling, concrete, masonry, and combinations.[56]



[56] Utah Hazard Mitigation. “Dam Failure.” 2024. https://hazards.utah.gov/dam-failure/

**Table 27: High-Hazard Dams in Salt Lake County**

| Dam Name | Owner Name | Purpose | Height (ft.) | Year Completed | NID Storage (acre-ft.) | Hazard Classification | Last Inspection | EAP Prepared |
|---|---|---|---|---|---|---|---|---|
| **Salt Lake County - Sugarhouse** | Salt Lake County Public Works | Flood risk reduction | 35 | 1984 | 120 | High | 7/13/2022 | Yes |
| **Salt Lake County Chandler Drive (#13)** | Salt Lake County Public Works | Flood risk reduction | 128 | 1977 | 52 | High | 9/21/2022 | Yes |
| **Salt Lake County - Scott Avenue** | Salt Lake County Public Works | Flood risk reduction | 12 | 1987 | 71 | High | 7/13/2022 | Yes |
| **Salt Lake County Shriners (#12)** | Salt Lake County Public Works | Flood risk reduction | 59 | 1978 | 17 | High | 9/21/2022 | Yes |
| **Twin Lakes (Salt Lake)** | Salt Lake City Corporation | Water supply | 62 | 1914 | 575 | High | 8/3/2023 | Yes |
| **Salt Lake County Federal Heights (#1a)** | Salt Lake County Public Works | Flood risk reduction | 23 | 1978 | 16 | High | 9/21/2022 | Yes |
| **Salt Lake County - Creekside Park (Big Cottonwood)** | Salt Lake County Public Works | Flood risk reduction | 16 | 1969 | 90 | High | 7/13/2022 | Yes |
| **Salt Lake County - Rotary Glen Park** | Salt Lake County Public Works | Flood risk reduction | 25 | 1986 | 5 | High | 7/13/2022 | Yes |
| **Salt Lake County - Big Cottonwood (Spencer's)** | Salt Lake County Public Works | Flood risk reduction | 31 | 1984 | 132 | High | 7/13/2022 | Yes |
| **Lake Mary - Phoebe** | Salt Lake City Corporation | Water supply | 72 | 1915 | 742 | High | 8/3/2023 | Yes |
| **Red Pine** | Salt Lake City Corporation | Irrigation | 20 | 1929 | 100 | High | 8/16/2023 | Yes |
| **Red Butte Dam** | Salt Lake City Corporation | Water supply | 128 | 1930 | 565 | High | 9/8/2023 | Yes |
| **Mountain Dell** | Salt Lake City Corporation | Water supply | 105 | 1916 | 3506 | High | 9/8/2023 | Yes |

| Dam Name | Owner Name | Purpose | Height (ft.) | Year Completed | NID Storage (acre-ft.) | Hazard Classification | Last Inspection | EAP Prepared |
|---|---|---|---|---|---|---|---|---|
| **Little Dell** | Salt Lake City Corporation | Water supply | 224 | 1993 | 25,000 | High | 9/8/2023 | Yes |
| **Ensign Downs Db (Aka Victory Road Db)** | Salt Lake City Public Utilities | Flood risk reduction | 23 | 1991 | 1.75 | High | 9/8/2022 | Yes |
| **Kennecott Mine Bingham Creek** | Kennecott Utah Copper, LLC | Water supply | 77 | 1965 | 2140 | High | 7/11/2023 | Yes |
| **White Pine** | South Despain Ditch Company | Irrigation | 54 | 1933 | 350 | High | 8/25/2023 | Yes |
| **Oquirrh Lake Dam/Kennecott Daybreak** | Daybreak Community Association | Recreation | 17 | 2006 | 1100 | High | 10/31/2023 | Yes |
| **Sandy City - East Sandy Elementary** | Sandy City | Flood risk reduction | 5 | 2002 | 10 | High | 5/25/2023 | Yes |
| **Jordan Valley Water Purification Upper** | Jordan Valley Water Conservancy District | Water supply | 44 | 1981 | 550 | High | 10/31/2023 | Yes |
| **Draper Pressure Irrigation Project** | Draper Irrigation Company | Water supply | 18 | 1993 | 50 | High | 5/4/2023 | Yes |
| **Sandy City - Storm Mountain Db** | Sandy City | Flood risk reduction | 9 | 1990 | 19 | High | 5/25/2023 | Yes |
| **Juniper Canyon Detention Basin 3** | Herriman City | Flood risk reduction | 49 | 2020 | 61 | High | 8/4/2022 | Yes |
| **Sandy City - Flat Iron Mesa** | Sandy City | Flood risk reduction | 7 | Undetermined | 4 | High | 5/25/2023 | Yes |
| **Riverton City - Black Ridge Reservoir** | Riverton City | Irrigation | 32 | 2009 | 77 | High | 9/27/2023 | Yes |
| **Riverton City - 4200 West Pond** | Riverton City | Water supply | 12 | 2000 | 47 | High | 9/27/2023 | Yes |

| Dam Name | Owner Name | Purpose | Height (ft.) | Year Completed | NID Storage (acre-ft.) | Hazard Classification | Last Inspection | EAP Prepared |
|---|---|---|---|---|---|---|---|---|
| **Riverton City - 3200 West Pond** | Riverton City | Water supply | 16 | 2000 | 94 | High | 9/27/2023 | Yes |
| **Point of The Mountain Raw Water Res** | Metropolitan Water District | Water supply | 18 | 2006 | 136 | High | 5/3/2023 | Yes |

## Historical Events and Probability of Future Occurrences

Based on the FEMA Disaster Declarations Database, Salt Lake County has received no designation for dam failure disaster declarations since the last plan update. No record was found of any historical dam failure incident within Salt Lake County either; however, incidents have occurred in other parts of Utah, according to the 2024 Utah Enhanced State Hazard Mitigation Plan.

Dam failure incidents 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 correlated with events beyond those the facility was designed to withstand. However, the probability of any dam or levee failure in the planning area is low in today's regulatory environment.

## Climate Change Considerations

Several recent and high-profile dam incidents related to an unexpected high runoff event have raised serious concerns regarding the impact of climate change on dam safety across the nation. More recently, evidence has mounted that climate change is making extreme weather events more frequent and extreme. The 2024 Utah Enhanced State Hazard Mitigation Plan references studies that found climate change has already doubled the probability of an event sufficiently large to cause catastrophic flooding. In addition, changing the snow/rain regime could increase sudden runoff by another 200–400%.

## Secondary Hazards

Dam failure can have a cascading impact on other hazards, including storms, seismic events, landslides, wildfires, and flooding. Given the relatively higher risk of an earthquake in Salt Lake County, this hazard is of particular concern for dams.

As mentioned previously, a dam failure can threaten downstream dams and may contribute to additional failures. If damage is caused to hazardous material storage facilities in the inundation zone, dam failure could also release hazardous materials.

Dam failure may cause extreme erosion along canyon waterways, resulting in steep, unstable slopes that may later be subject to landslides or other slope failure.

## Vulnerability Assessment

The impact of dam failure hazards on people in Utah is similar to riverine flooding, but the potential magnitude and sudden onset of flooding can be especially catastrophic. Impacts range from death and physical harm to displacement and property damage to inconvenience. Homes, businesses, and other structures downstream of the failure can be damaged or destroyed. Road closures, congestion, and possible water supply and wastewater services loss are likely. Figure 56 shows dam failure rankings in Salt Lake County and the surrounding northern counties.

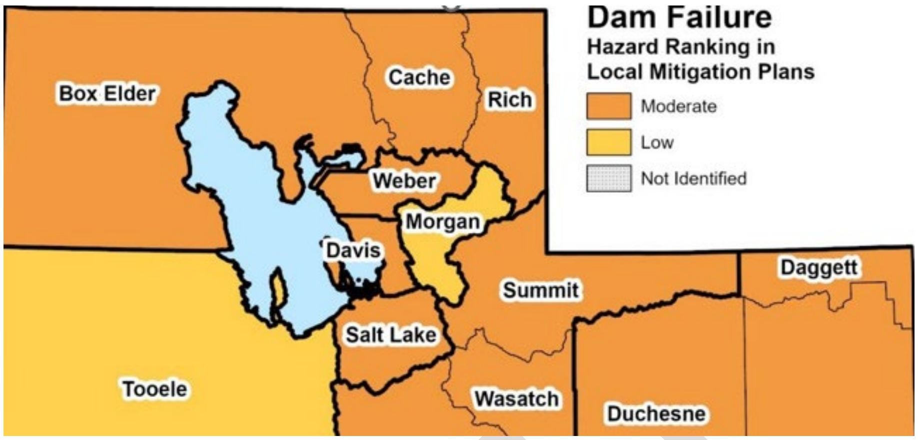


**Figure 56: Dam Failure Rankings Map for Salt Lake County and Surrounding Northern Counties**[57]

**Table 28: Salt Lake County Potential Dam Inundation Area**[58]

| Total Area (sq. miles) | Total Potential Inundation Area (sq. miles) | Potential Percent Inundation Area |
|---|---|---|
| 805.18 | 38.67 | 4.80% |

## ESTIMATED IMPACT AND POTENTIAL LOSSES

Dam failures can occur suddenly, but those downstream may have some warning. The failure of high-hazard dams may lead to injuries and loss of life for those caught in the resulting flood waters. Homes may be damaged or destroyed, resulting in potential long-term displacement for residents. Some of these households may require public sheltering assistance.

Significant structural and infrastructural losses can result from a dam failure. Homes, businesses, and government service facilities can be damaged. The 2019 Utah State Hazard Mitigation Plan estimated over 41,000 buildings in potential inundation zones, with an estimated exposure value of over $13 billion. In addition to the costs of rebuilding structures, significant economic impacts are likely due to lost inventory or revenue during business closures. Businesses not directly impacted by a dam failure may incur losses due to transportation or other infrastructure interruptions or an inability for employees to return to work.

There are 73 critical facilities located within the inundation boundaries of dams in Salt Lake County. A detailed breakdown of these facilities follows. Other city structures and government service facilities within the inundation areas may also be impacted, but these were not included in the mapping.

[57] Utah Enhanced State Hazard Mitigation Plan. “Figure 4-37 Dam Failure Rankings from LHMP.” 2024.
[58] 2019 Utah State Hazard Mitigation Plan. “Dam Failure 2019.” https://site.utah.gov/dps-emergency/wp-content/uploads/sites/18/2019/02/5-Dam-Failure.pdf

- **Three emergency operations centers (EOCs):** Bluffdale, South Salt Lake, and the Municipal Services District
- **Nine fire stations:** Murray Station #82, Bluffdale Station #91, Sandy Station #35, Salt Lake City Station #4, Salt Lake City Station #8, Salt Lake City Station #6, Salt Lake City Station #3, UFA Station #108, and South Salt Lake Station #42
- **Four hospitals:** Holy Cross Hospital Salt Lake, Holy Cross Hospital Jordan Valley, KPC Promise Hospital of Salt Lake, and Marian Center
- **Four police stations:** South Salt Lake Police Department, West Jordan Police Department, Bluffdale Police Department, and Granite School District Police Department
- **Fifty-two schools (count per city):** Bluffdale (1), Midvale (1), Murray (4), Riverton (2), Salt Lake City (36), Sandy (3), and West Jordan (5)
- **Thirty-nine county facilities (count per city):** Cottonwood Heights (1), Holladay (2), Midvale (1), Murray (1), Riverton (1), Salt Lake City (13), unincorporated county (7), South Salt Lake (4), and West Jordan (9)

In addition to the direct damages and loss of life that may occur due to a dam or levee failure, there are many possible consequences for community assets. Disruption of a public water supply or wastewater treatment facility could lead to reduced water quality, water shortages, exposure to sewage, and other health hazards. Damage or disruption to major roads, railroads, power, communication, or other public utilities could delay vital services. Debris, sediment, and other material deposited following a dam failure can require extensive clean-up efforts. Natural environmental resources such as wildlife habitat and recreation areas can also be damaged.

Major transportation corridors that could be impacted include Little Cottonwood Canyon Rd, Big Cottonwood Canyon Rd, I-215 East Belt, I-80 through Parleys Canyon to the intersection with I-15, Bangerter Highway in the southern part of the county, Mountain View Corridor near Riverton and Herriman, and various segments of I-15. TRAX and FrontRunner lines are roughly parallel to the I-15 corridor and may also be affected. Other utility lines and infrastructure likely run along these transportation routes.

The Mitigation Planning Team identified additional significant community assets potentially affected by dam failure hazards. 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 natural resources. More detailed information on jurisdictional assets is presented in their individual annex in Volume 2.

## VULNERABLE POPULATIONS

Individuals with access and functional needs, disabilities, elderly individuals, and those lacking access to reliable transportation may have difficulty evacuating even if given notice of a potential dam failure. Those who speak a language other than English may have difficulty understanding emergency alerts and the proper actions to take if a dam failure is imminent. Those with low household incomes may have significant difficulty finding alternative housing if displaced from their homes.

## CHANGES IN DEVELOPMENT

According to the 2024 Utah Enhanced State Hazard Mitigation Plan, the largest concentration of high- and significant-hazard dams in the state is within the Wasatch Front counties, including Salt Lake County. The National Levee Database also maps 5 levee systems (160 levee structures) within the county. As the county's population grows and shifts, situations arise where development in areas downstream from dams causes the hazard potential for some of these structures to increase, for example, from a significant hazard to a high hazard. The number of high-hazard dams should be monitored over time to determine whether this is a potential trend. Localized changes in growth or development in parts of the county may indicate changes in vulnerability and will be addressed in the jurisdictional annexes. The overall vulnerability to dam failure in the county has remained the same since the last plan update.

## COMMUNITY LIFELINES

Lifelines are the most fundamental services in the community that, when stabilized, enable all other aspects of society to function. Community lifelines are essential for the well-being of any community. They provide support and assistance to individuals who require help, especially during times of crisis. FEMA Community Lifelines are a critical component of emergency management in the United States. These lifelines are designed to address the essential needs of a community during and after a disaster. Community lifelines help create a sense of safety and security within a community. They provide a safety net for individuals who may be struggling and offer comfort and reassurance that help is available when needed. Without these lifelines, communities would be much more vulnerable to crises and emergencies. There are eight lifelines shown in Figure 57, each with its own focus and purpose:


**Figure 57: FEMA Community Lifelines**[59]

The 2024 Utah Enhanced State Hazard Mitigation Plan articulates that any and possibly all community lifelines will be impacted in the aftermath of a dam incident, such as a high-hazard dam failure. The

[59] FEMA. "Community Lifelines." https://www.fema.gov/emergency-managers/practitioners/lifelines

immediate concern is for the safety and security of the people in inundation areas. It is reasonable to expect that access to food, water, shelter, and healthcare will be compromised for many people. Dam failures are notoriously destructive, and impacts to above-ground power distribution, if not generation, can be expected. The same can be said for transportation, especially due to damaged roadways and railways. Cellular communications may fare better. Inundation zones are relatively narrow and elongated; thus, unaffected transmission towers may be able to service inundated areas. The release of hazardous materials is an area of uncertainty. What seems certain is widespread impact. Articulating precisely what these impacts mean and how to mitigate them is a difficult-to-fill knowledge gap.

## VULNERABILITY SCORE

The National Risk Index (NRI) does not include any data on the relative risk of dam failure.

# Drought

## Hazard Description

According to the National Drought Mitigation Center, drought is a deficiency of precipitation over an extended period, resulting in a water shortage for some activity, group, or environmental sector. While yearly variations in recorded precipitation are normal, a drought exceeds these norms, marked by significantly low precipitation for an extended period or over a large area. While most natural hazards are sudden and result in immediate impacts, droughts begin gradually and can last for extended periods, often resulting in profound socioeconomic impacts. Droughts can be categorized based on their unique characteristics and are often viewed as different phases of a single prolonged event (see Figure 58).

- **Meteorological Drought:** A measure of the 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:** Prolonged and severe dry conditions that impact sectors beyond the agricultural community, such as the community drinking supply and other social and economic enterprises

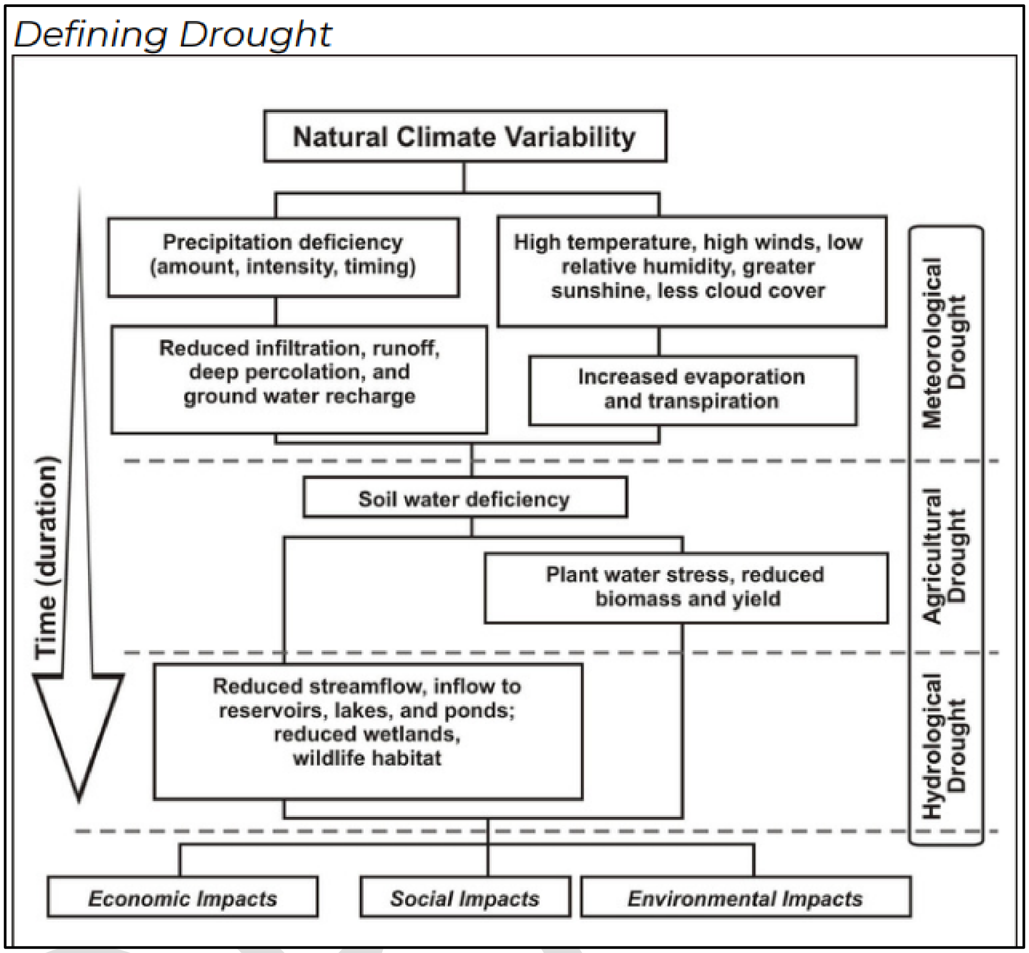


**Figure 58: Defining Drought, United States Drought Monitor[60]**

Although the agricultural community is usually the most heavily impacted by drought, extended droughts can also have direct and indirect impacts on economic, social, or environmental sectors. When drought begins to affect the general population, reservoirs, wells, and aquifers often reach low levels, necessitating conservation measures. These measures can include water-use restrictions, secondary water systems, water recycling, and xeriscaping. Additional conservation options could involve establishing emergency water agreements with neighboring water districts or transporting water from external sources.

[60] Utah Division of Water Resources. “Drought Response Plans: Triggers and Actions.” June 28, 2022. https://water.utah.gov/wp-content/uploads/2022/07/Drought-Response-Plan-070822.pdf

## Hazard Profile

| | | | | | |
|---|---|---|---|---|---|
| **Potential Impact** | | Catastrophic | **Probability** | | Highly Likely |
| | | Critical | | X | Likely |
| | X | Limited | | | Occasional |
| | | Negligible | | | Unlikely |
| **Location** | Countywide | | | | |
| **Seasonal Conditions** | Impacts typically noticeable in summer, conditions can be year-round | | | | |
| **Conditions** | Meteorological Drought: Lack of precipitation<br>Agricultural Drought: Lack of water for crop production<br>Hydrologic Drought: Lack of water in the overall water supply<br>Socioeconomic Drought: Lack of water sufficient to support the population | | | | |
| **Duration** | Months, years | | | | |
| **Secondary Hazards** | Wildfires, dust storms, air quality | | | | |
| **Analysis Used** | National Weather Service, Utah Climate Center, Utah Division of Water Resources, newspapers, local input | | | | |

## Magnitude/Extent

The United States Drought Monitor provides a map that identifies drought-affected areas and classifies them by intensity, ranging from D1 (least intense) to D4 (most intense). Drought is defined as a moisture deficit severe enough to have social, environmental, or economic effects. D0 areas are not in drought but are experiencing abnormally dry conditions that could develop into drought or are still recovering from a past drought and are not yet back to normal.

**Table 29: Drought Classification**[61]

| | | | 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 |

The Palmer Drought Severity Index (PDSI), developed by Wayne Palmer in 1965, measures drought severity based on temperature, precipitation, and soil moisture (Utah Division of Water Resources 2007a). The PDSI is considered the “semi-official” drought index due to its standardization across various climates. It uses zero to represent normal conditions, with values ranging from 6 to −6. Negative numbers indicate dry periods, while positive numbers represent wet periods.

**Table 30: Palmer Drought Severity Index Classification and Range**

| Range | Palmer Classification |
|---|---|
| **4.0 or higher** | 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 lower** | Extreme Drought |

[61] National Drought Mitigation Center, U.S. Drought Monitor. “Drought Classification.” 2024. https://droughtmonitor.unl.edu/About/AbouttheData/DroughtClassification.aspx

## Location

Utah is the second driest state in the United States, and drought has a significant impact on the region. The lack of water affects agriculture and industry, limiting economic activity and reducing the availability of water for irrigation and culinary purposes. Severe drought leads to the depletion of agricultural lands and soil deterioration. In the Wasatch Front Region, the risk of drought is particularly high.

Salt Lake County falls within two climatic regions: the North Central Region and the Northern Mountains Region. While the two regions exhibit distinct characteristics, they often experience similar drought periods, experiencing 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). The Northern Mountain Region experiences more severe drought conditions at its peak than the Western Region. This may be because the Northern Mountains Region simply has more water to lose, as the Wasatch and Uinta Mountains receive significantly more precipitation on average. Figure 59 depicts a recent snapshot of the extent of drought in the State of Utah. Figure 60 shows a time series of drought conditions for Salt Lake County since January 2000. Extreme and exceptional drought conditions occurred from 2021 to 2023.

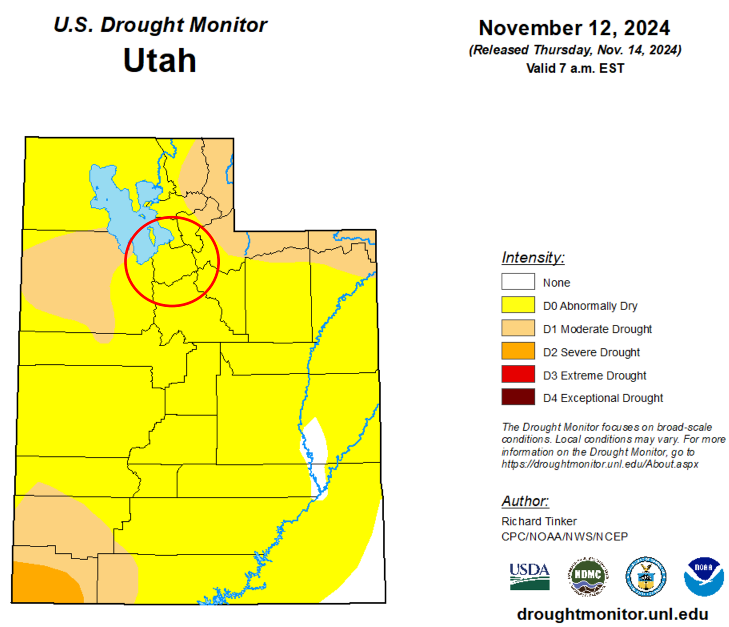


**Figure 59: U.S. Drought Monitor for the State of Utah, November 2024**

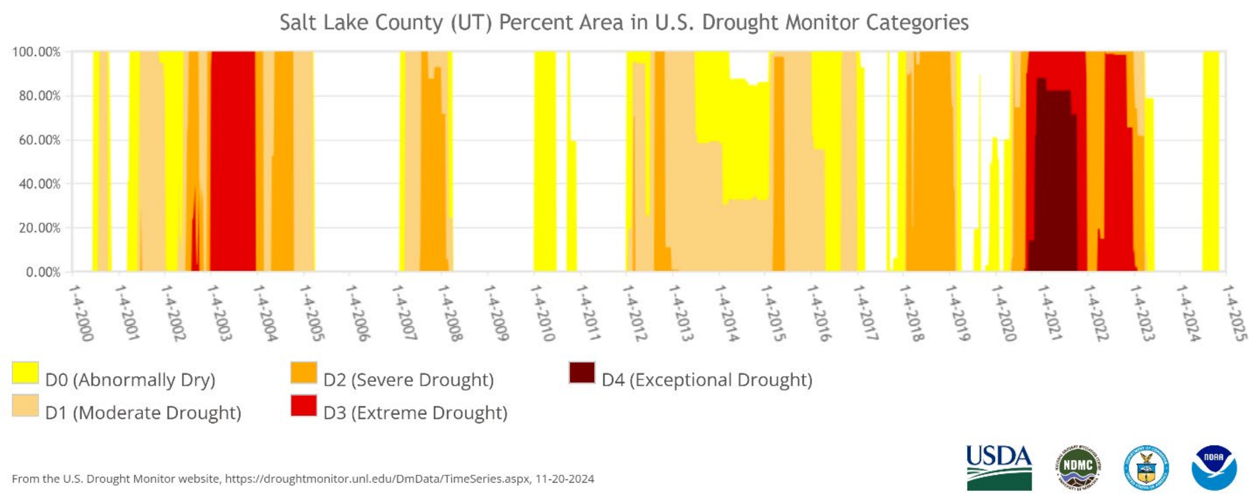


**Figure 60: U.S. Drought Monitor Categories for Salt Lake County, 2000–2024**

Figure 61 shows precipitation for the past 60 days (October 17, 2024, to Dec 13, 2024, when captured) as a percentage of the historical average (1991–2020) for the same period. Green/blue shades indicate higher than normal precipitation, while brown shades indicate lower than normal precipitation.

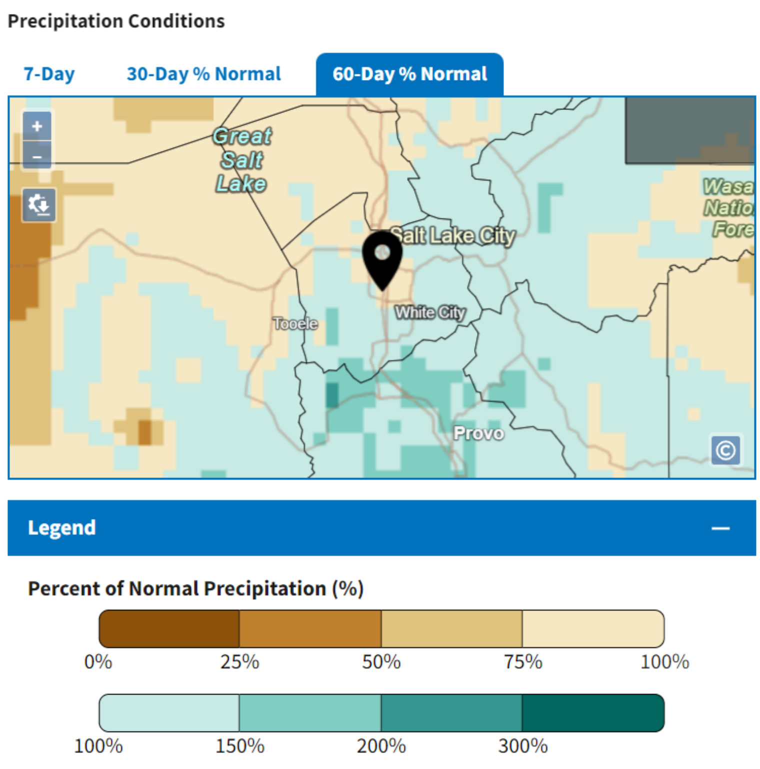


**Figure 61: Recent Precipitation, 60-Day Percent of Normal Precipitation, 1991–2020**[62]

[62] NOAA, National Integrated Drought Information System. "Drought Conditions for Salt Lake County." Drought.gov. 2024. https://www.drought.gov/states/utah/county/salt%20lake

## Historical Events and Probability of Future Occurrences

Based on the FEMA Disaster Declarations Database, Salt Lake County has received no designation for drought Disaster Declarations since the last plan update. However, Governor Spencer Cox issued an Executive Order declaring a State of Emergency due to drought on March 17, 2021, and again on April 21, 2022, due to drought conditions affecting the entire state. Since 2019, 14 USDA drought-related Disaster Declarations have been recorded for Salt Lake County.[63]

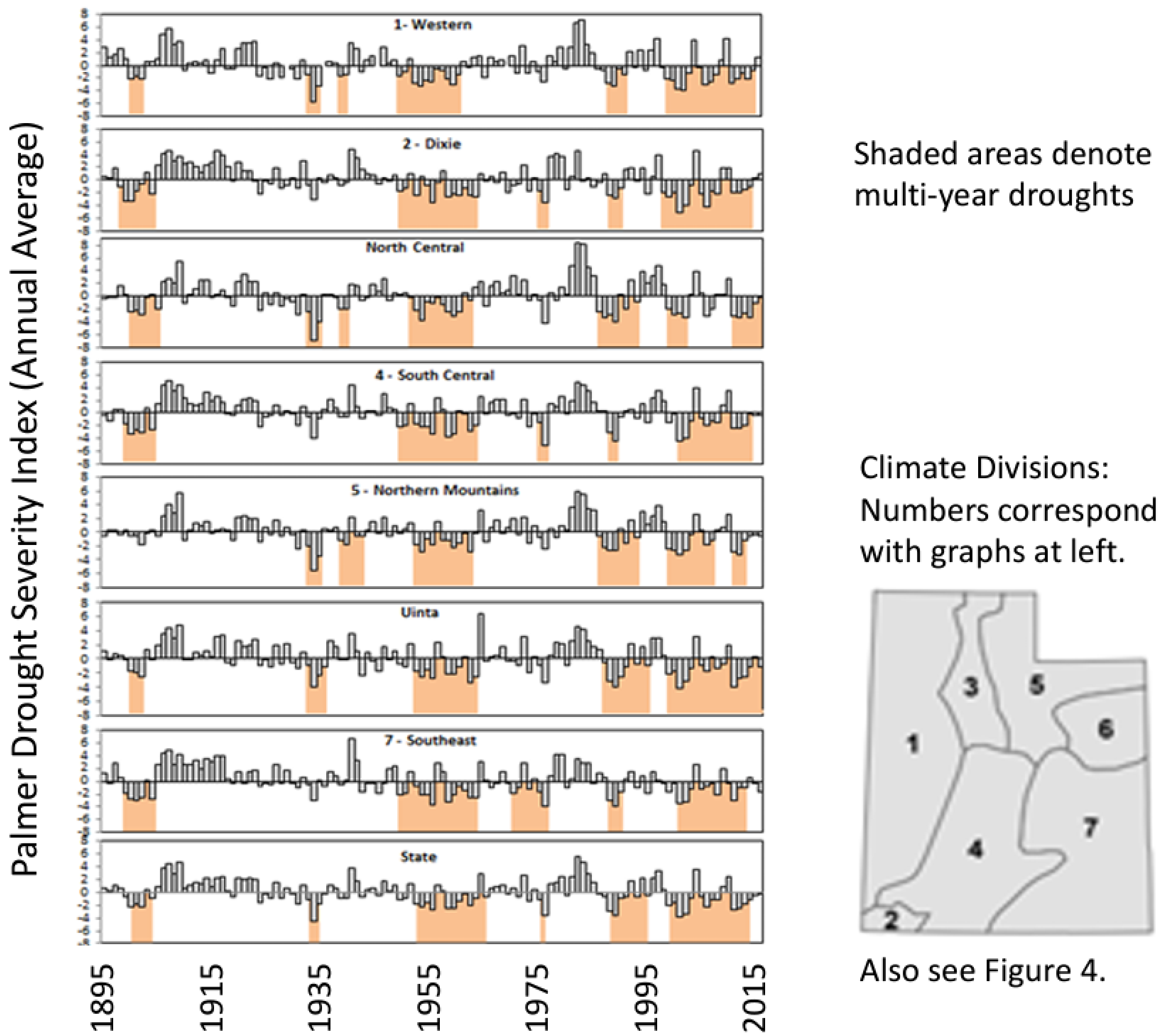


**Figure 62: Palmer Drought Severity Index by Region[64]**

Figure 62 provides a historical reference for multiyear droughts since 1895. The most severe drought in recorded history for the North Central and Northern Mountains Regions occurred in 1934, during the

[63] U.S. Department of Agriculture, Farm Service Agency. "Disaster Designation Information." https://www.fsa.usda.gov/resources/disaster-assistance-program/disaster-designation-information

[64] Utah Hazard Mitigation, Utah Department of Public Safety. "Utah Enhanced State Mitigation Plan 2024." https://hazards.utah.gov/state-of-utah-hazard-mitigation-plan/

height of the Great Depression and coinciding with the same drought period (1930–1936) that caused the "Dust Bowl" on the Great Plains. The longest drought period ranged from 11 years for the North Central region (1953–1963) to 6 years for the Northern Mountains, which occurred twice, from 1900 to 1905 and from 1987 to 1992 (Utah Division of Water Resources 2007a). In 2018, a severe drought plunged virtually the entire state into 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.

Droughts and water shortages will undoubtedly remain a significant concern for Salt Lake County in the future, particularly with the increasing public demand for water. The expected doubling of the population over the next 20 years makes water shortages a virtual certainty. New zoning ordinances, like the use of secondary water for irrigation and mandatory no watering days, are already in force.

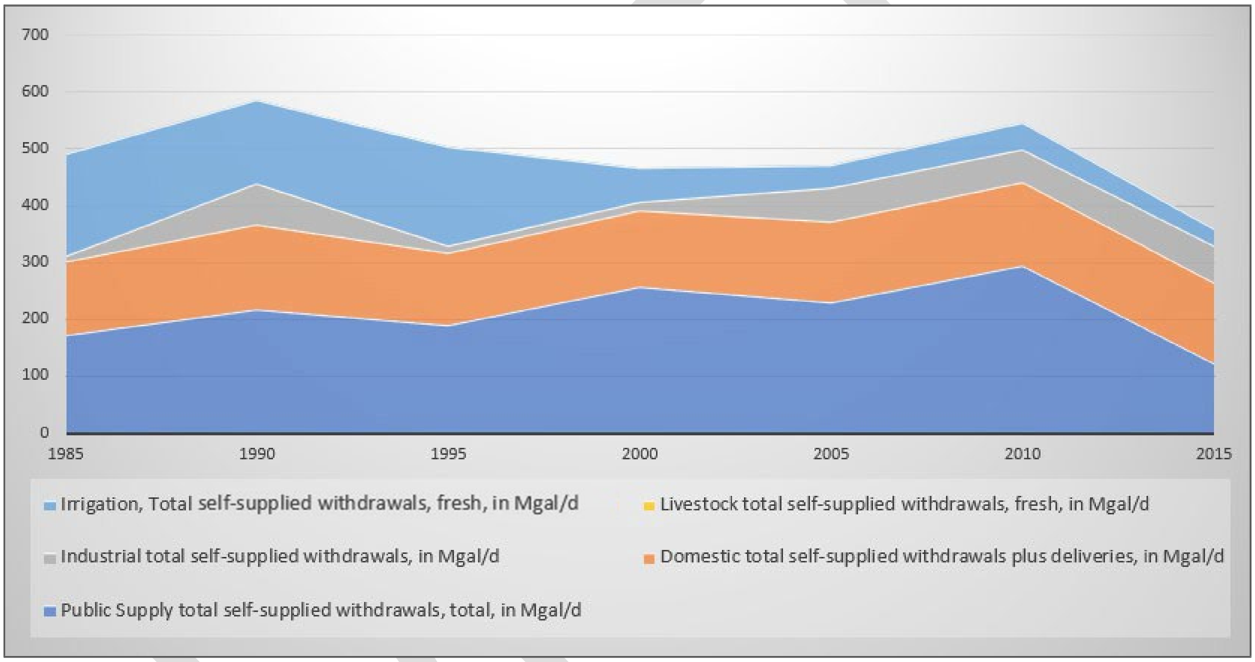


**Figure 63: Annual Water Usage by Category for Salt Lake County (based on USGS data)[65]**

[65] United States Geological Survey, National Water Information System. 2024. https://waterdata.usgs.gov/ut/nwis/water_use/

**Table 31: Annual Water Usage by Category for Salt Lake County (based on USGS data)[66]**

| Year | Public Supply Total Self-Supplied Withdrawals, 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 |

Salt Lake Valley is a largely urban area with a growing population. Most of its development uses municipal water sources, principally wells completed in the basin-fill aquifer system. The population growth and concomitant increase in municipal groundwater pumping could significantly decrease the amount of groundwater 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 groundwater discharge areas. Decreased recharge to the shallow unconfined aquifer from the principal aquifer due to increased groundwater pumping could reduce water supply to these springs and wetlands. In addition, water supply to the springs and wetlands is affected by climatic conditions and the level of the Great Salt Lake. Drought conditions from 1999 to 2004 reduced groundwater aquifer recharge across the state, including in the Great Salt Lake area, which negatively impacted the Salt Lake Valley wetlands. In 2005 and 2008, the water levels of the Great Salt Lake dropped close to the historic low reached in 1963, causing some parts of the Salt Lake Valley wetlands to dry up.

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 the Great Salt Lake, although the results may apply to all 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. This decline would also cause changes in Great Salt Lake levels, with subsurface inflow also decreasing due to higher municipal and industrial well withdrawals over the same period. Therefore, the worst-case scenario for the wetlands would be a combination of both conditions. To meet

[66] Ibid. (Data was not available for this entry, so the average between the 1995 and 2005 amounts was inserted as the best approximate value. Data provided represents the most current available data.)

the U.S. Environmental Protection Agency's goal of no net loss of wetlands, the Salt Lake Valley wetland areas must be managed to maintain their current water budget, estimated at 52,420 acre-feet per year (65 hm3/yr) of recharge in 2010.[67]

The 2012–2016 drought, although less severe, impacted much of the state for 4 straight years. Another drought from 2018–2019 was short-lived but felt across the entire state.

From 2019–2023, Utah experienced a statewide record for dryness and warmth. The driest year on record was 2020, and by the end of the year, 90% of the state was in extreme or exceptional drought. Dry conditions since 2000 have resulted in record-low water levels in the Great Salt Lake. The most intense period of drought since 2000 occurred the week of January 26, 2021, where 69.99% of Utah land was categorized as D4.[68]

The drought that began in 2020 has broken numerous records for its severity, drawing the attention not only of Utah's Water Managers but also the Governor, State Legislature, and the community at large. Drought conditions remained significant through the beginning of 2022, and the drought's impacts continue to be of grave concern.[69]

Figure 64 shows forecasts for total precipitation (left image) and abnormal precipitation (right image) from December 2023 to February 2024 in the Western United States.[70] The map legend indicates that Utah's total precipitation for the observed time frame was between 0 and 10 inches, with abnormal precipitation at 0–2 inches.



[67] Yidana, Sandow, Mike Lowe, and Rich Emerson. "Wetlands in Northern Salt Lake Valley, Salt Lake County, Utah – An evaluation of the threats posed by groundwater development and drought." 2010. https://www.researchgate.net/publication/268257262_Wetlands_in_Northern_Salt_Lake_Valley_Salt_Lake_County_Utah_-_An_evaluation_of_the_threats_posed_by_groundwater_development_and_drought
[68] U.S. Department of Agriculture, Farm Service Agency. "Disaster Designation Information." https://www.fsa.usda.gov/resources/disaster-assistance-program/disaster-designation-information
[69] Utah Division of Water Resources. "Drought Response Plans: Triggers and Actions." June 28, 2022. https://water.utah.gov/wp-content/uploads/2022/07/Drought-Response-Plan-070822.pdf
[70] Utah Climate Center. "Seasonal Drought Forecast For the Intermountain West." Bureau of Reclamation, Utah State University. 2024. https://climate.usu.edu/westernDrought/

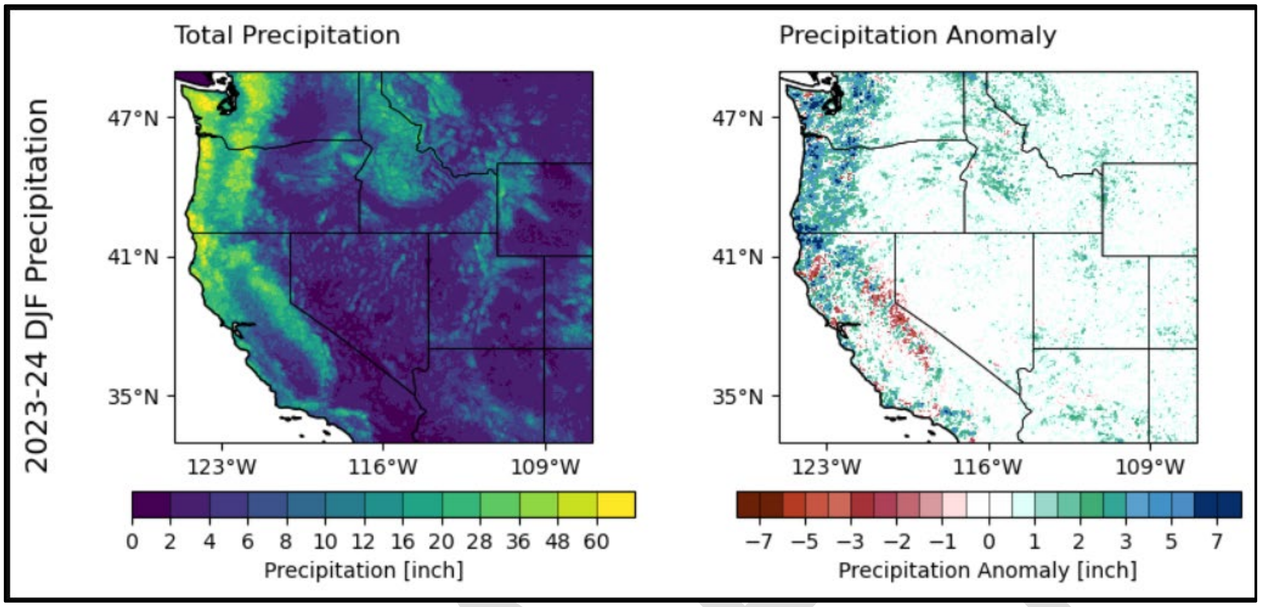


**Figure 64: Seasonal Drought Forecast for the Intermountain West, 2023–2024**[71]

## Climate Change Considerations

Utah is unique in the amount of natural precipitation it receives. Because drought is an ever-present threat, resiliency must be built into planning. Climate change has caused the state to become warmer and drier, highlighting the need to identify areas for improvement to better respond to the challenges and unmet needs caused by drought conditions.[72]

According to the 2024 Utah Enhanced Hazard Mitigation Plan[73] statement on climate, higher temperatures caused by climate change are expected to exacerbate drought conditions. Estimates of additional temperature changes by 2100 vary, largely depending on global emissions of greenhouse gases. However, temperature increases driven by climate change will almost certainly continue, along with the associated intensification of drought conditions. The Climate Mapping for Resilience and Adaptation tool projects an increase in days per year with no precipitation (Figure 65) as well as the maximum number of consecutive dry days (Figure 66) compared to historical averages.



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[71] Ibid.
[72] Utah Division of Water Resources. “Drought Response Plans: Triggers and Actions.” June 28, 2022. water.utah.gov/wp-content/uploads/2022/07/Drought-Response-Plan-070822.pdf
[73] Utah Department of Public Safety, Utah Hazard Mitigation. “Utah Enhanced State Hazard Mitigation Plan.” https://hazards.utah.gov/state-of-utah-hazard-mitigation-plan/

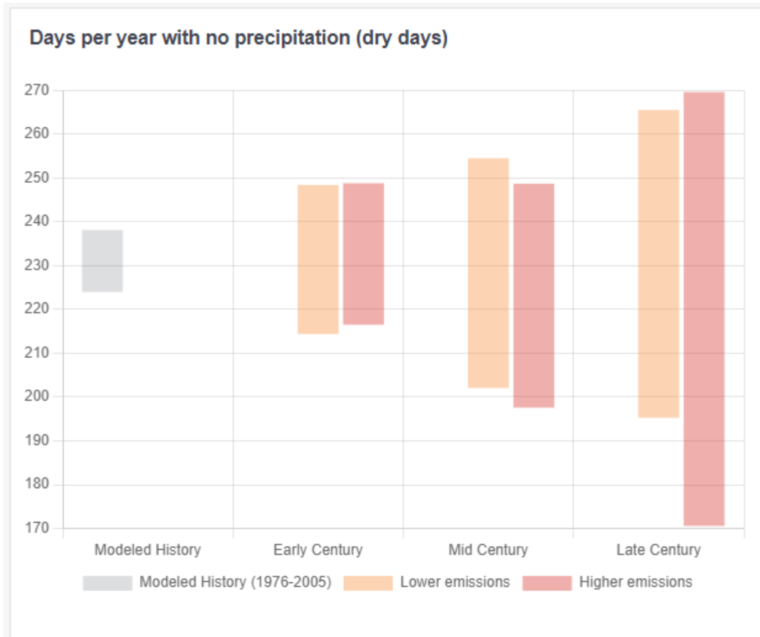


Figure 65: CMRA Projected Days Per Year with No Precipitation

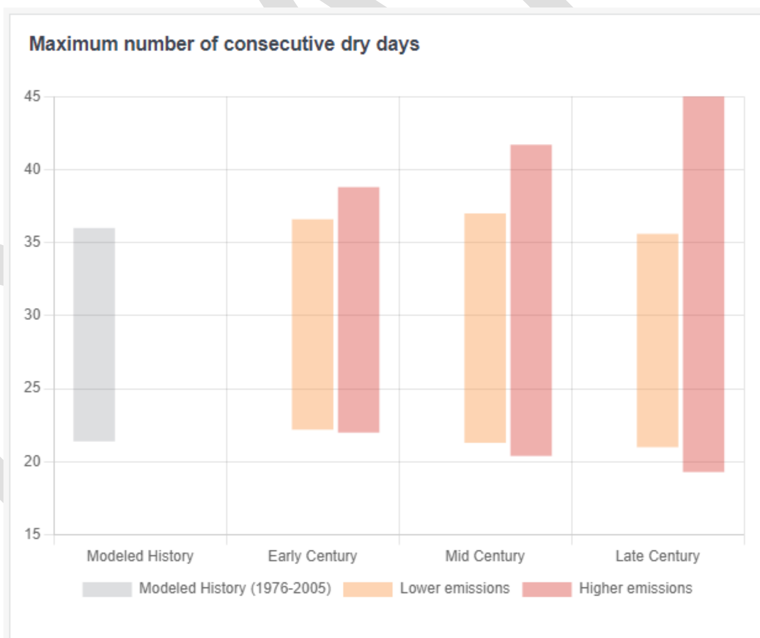


Figure 66: CMRA Projected Maximum Number of Consecutive Dry Days

Figure 67 shows the water-year precipitation changes standardized to reflect climate anomalies. The observed period (blue) reveals the signature cyclic behavior of northern Utah's climate cycle, which can be traced to slow variations in the western tropical Pacific along with jet stream position. The predicted water-year climate anomaly (red) projects wetter-than-average winters by 2020.[74]

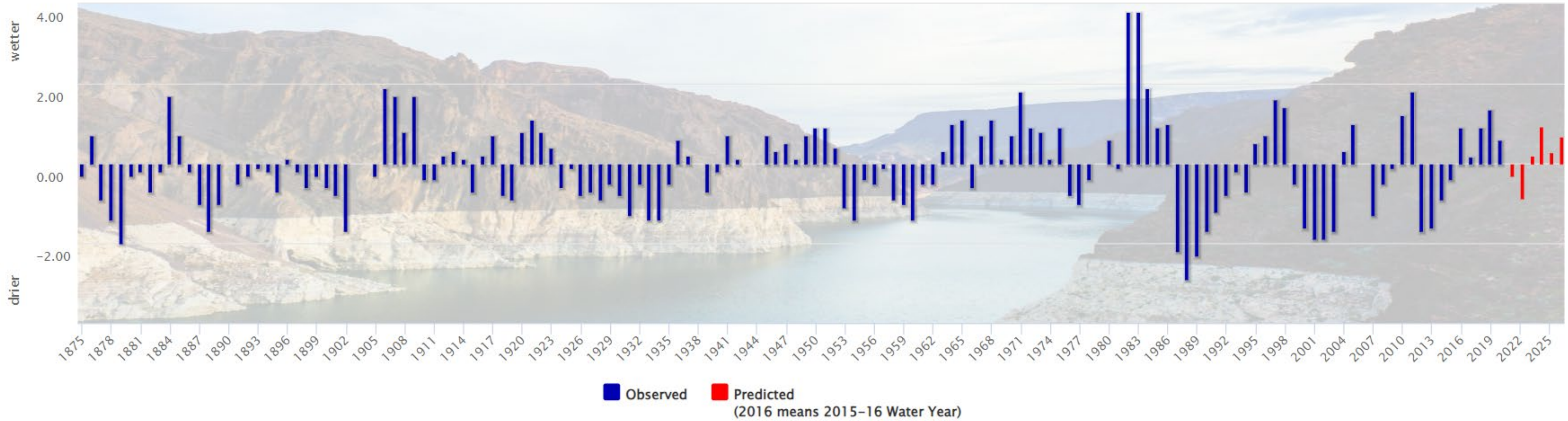


Figure 67: Northern Utah Climate Variability and Prediction[75]

[74] Utah State University, Utah Climate Center. "Northern Utah's Climate Variability and Prediction." 2024. https://climate.usu.edu/snowForecast.php
[75] Ibid.

## Secondary Hazards

Wildfires are the most common secondary hazard associated with drought. Prolonged lack of precipitation dries out vegetation, making it increasingly susceptible to ignition and fueling more extreme fire behavior as drought conditions persist. This vulnerability also extends to crops. Loss of forests and trees exacerbates erosion, leading to heavy silting of streams, reservoirs, and rivers, which in turn causes severe damage to aquatic life, irrigation, and power development. Droughts can also create optimal conditions for dust storms, significantly reducing air quality for both humans and animals. Low stream flows can lead to higher temperatures, oxygen depletion, disease, and loss of spawning areas for fish resources. Drought is often accompanied by extreme heat. Temperatures of 90ºF and higher increase the risk of sunstroke, heat cramps, and heat exhaustion in humans, as well as heat-related injuries in pets and livestock.

The Great Salt Lake, partially located in the northwest corner of the county, is a significant regional natural, economic, and cultural resource. The lake has lost over half its volume since the 1980s due to prolonged droughts along with variations in precipitation and water consumption. As more of the lakebed is exposed, severe dust storms and reduced air quality become more likely. Contaminants in the soil that may become airborne could also pose health risks to the populations of nearby cities.

Lower water levels in lakes and reservoirs can degrade water quality and promote the growth of harmful cyanobacteria, or algal blooms, which can be lethal to pets and pose health risks to humans.

## Vulnerability Assessment

Droughts can have wide-ranging impacts that may affect large areas and cross jurisdictional boundaries. Droughts can last anywhere from a few weeks to several years, with impacts primarily experienced as water shortages and agriculture-related losses. More specifically, droughts can reduce municipal water supplies, lower agricultural yields, damage natural resources and wildlife habitat, and limit recreation opportunities. It is a hazard that can affect all populations, structures, and infrastructure.

Water is a critical resource for everyday household use, including drinking, cooking, and cleaning. It is also critical for day-to-day business operations in manufacturing, and agriculture. Drought can lead to water supply shortages for various community activities, resulting in usage restrictions or higher costs. These shortages may disproportionately affect low-income households, making it harder for them to afford the increased water expenses.

Drought is unpredictable, making it challenging to identify the areas most threatened and provide loss estimate values. However, historical drought records demonstrate that agriculture is typically the economic sector most impacted by drought. These losses can have repercussions throughout the county, as well as neighboring jurisdictions. For example, the agriculture sector was the hardest hit during the 2002 drought, suffering the loss of 6,110 jobs and almost $120 million in income statewide. It also caused an estimated $100 million drop in livestock sales and $50 million in hay sales. Drought-related fires are thought to have contributed to the $50 million drop in tourism sales. The combined effects of the drought in these three sectors resulted in a loss of over 6,100 jobs and $120 million in income during 2002.

Construction, manufacturing, and wholesale trade were also impacted by drought. In its drought report, the Utah Division of Water Resources notes that significant data gaps hinder the quantification of drought impacts in all sectors of the economy and society. It recommends monitoring tax revenues and other economic indicators at all levels of government to improve evaluation methods and gain a clearer understanding of drought impacts.

Drought can also affect local economies by reducing recreation opportunities. Lower stream level flows and declining reservoir and lake levels may limit access to recreation sites, while some have been closed entirely due to algal blooms. Changes in the appearance quality of recreation sites may also decrease demand, leading to fewer visitors and resulting in economic losses for tourism and recreation-related industries. The Great Salt Lake contributes to lake effect snow, which influences snow levels at Utah ski resorts. The lake's reduction in size may limit this lake effect, potentially reducing the snowpack in the nearby mountains. This could lead to less desirable ski conditions, resulting in a significant economic impact for these winter recreation sites.

Drought does not typically cause damage to structures, critical facilities, or infrastructure; however, during severe or prolonged drought, soil may contract due to decreased soil moisture. This contraction could result in damage to structural foundations or building walls.

Many natural systems can be negatively impacted by drought. It can cause higher concentrations of pollutants or other contaminants in water or increased nutrient concentrations and turbidity in the water supply. Algal levels may also increase, and when combined with warm temperatures, this can result in dangerous algal blooms. Reduced water supply and poor water quality also harm habitats for fish and other wildlife. Grass, trees, and other vegetation can dry out, which further alters ecosystems. Drier vegetation also poses wildfire risks, including ignition risk and rate of spread. Drought can also cause soil erosion and contribute to dust storms.

The 2024 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 frequencies and severities of drought as reported in the LHMPs were gathered to determine a drought hazard ranking. The hazard ranking is calculated based on a combination of severity and probability/frequency, both categorized from 0 to 4. The numbers were then combined to calculate a ranking from 0 to 8. The map in Figure 68 shows the drought hazard ranking for each county as reported in the LHMPs.

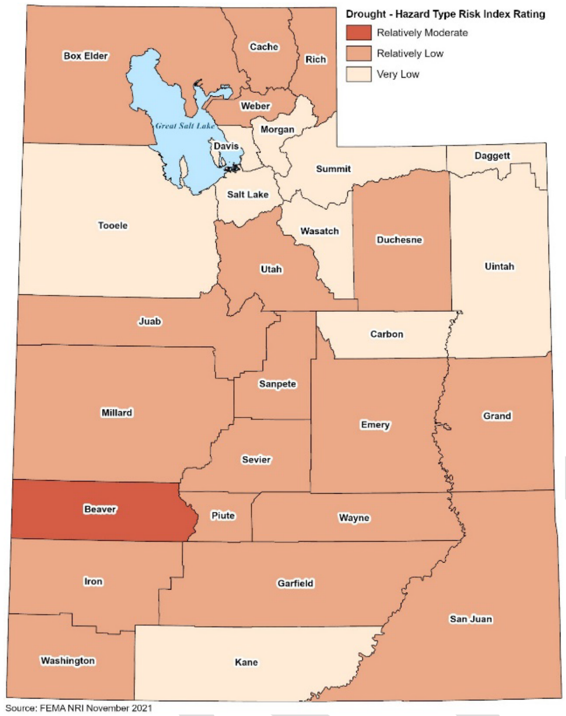


**Figure 68: Drought Hazard Type Risk Index Rating for Utah Counties**

Table 32 lists the agriculture statistics for Salt Lake County from the 2023 Agriculture Census, the most current agriculture census data available.

**Table 32: Salt Lake County Agricultural Statistics[76]**

| Farms | Total Acres | Market Value of Products Sold | Estimated Market Value of Land and Buildings (Avg. per farm) |
|---|---|---|---|
| **592** | 61,965 | 24,102,000 | 1,013,467 |

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.

## ESTIMATED IMPACT AND POTENTIAL LOSSES

The National Risk Index (NRI) includes data on the expected annual losses to individual natural hazards, historical loss, and overall risk at a county and census tract level. Salt Lake County's NRI expected annual loss (EAL) value for drought is $19 million, with a risk score of 40.6 and a rating of Very Low percentile compared with the rest of the United States (Figure 69). This low rating can likely be attributed

[76] National Agricultural Statistics Service Mountain Region, Utah Field Office. "2023 Utah Agricultural Statistics." USDA National Agricultural Statistics Service.gov. https://www.nass.usda.gov/Statistics_by_State/Utah/Publications/Annual_Statistical_Bulletin/2023-Agricultural-Statistics.pdf

to relatively low amounts of agricultural production in Salt Lake County, which is typically the source of most drought losses.

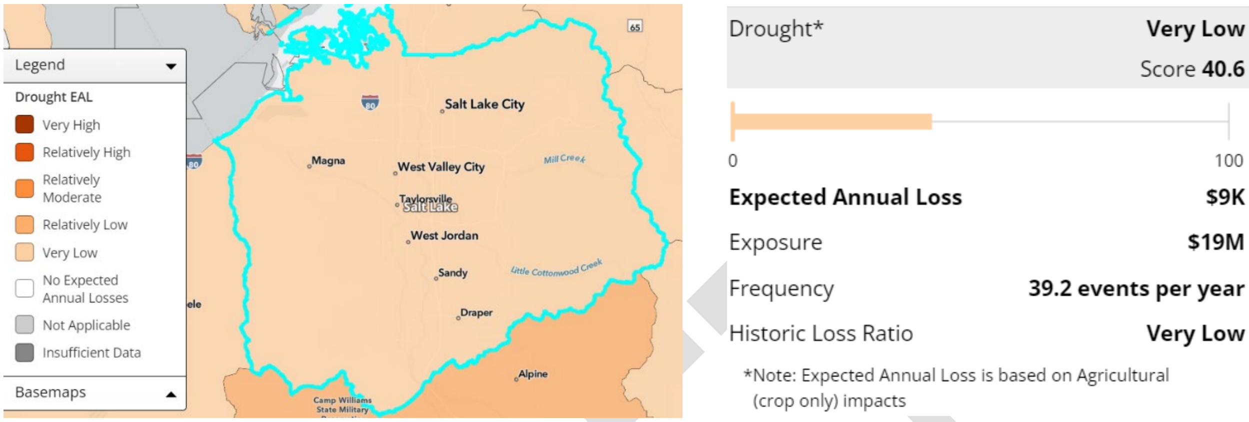


**Figure 69: FEMA National Risk Index Salt Lake County Expected Annual Loss from Drought[77]**

## VULNERABLE POPULATIONS

Drought can impact both surface water and groundwater availability and can have direct, disastrous effects on human populations. The indirect consequences of drought—such as unemployment, lower tax revenues, higher food prices, reduced outdoor recreation opportunities, higher energy costs as water levels in reservoirs decrease and consumption increases, and water rationing—are often not fully known. This complex web of impacts can affect people and economies well beyond the area physically experiencing drought. These impacts may be more significant for some populations, such as lower-income households who may be more strained by increased costs and economic losses. Individuals with underlying health conditions, the elderly, young children, and other medically vulnerable individuals may be more affected by drought-related poor air quality conditions and dust storms.

During a drought, all living organisms, including humans, animals, and crops, require access to essential resources like food, water, and shelter to survive and thrive. Without them, they become stressed and eventually die. Drought also affects shelter, as soil contractions can lead to structural damage in buildings, bridges, and other infrastructure.

## COMMUNITY LIFELINES

Lifelines are essential services in a community that, when maintained, allow all other aspects of society to function effectively. Community lifelines are essential for the well-being of any community, providing support and assistance to individuals who need help, especially during times of crisis. FEMA Community Lifelines are a critical component of emergency management in the United States. These lifelines are designed to address the essential needs of a community during and after a disaster. Community Lifelines help create a sense of safety and security within a community. They provide a safety net for individuals who may be struggling and offer comfort and reassurance that help is available when needed. Without

[77] FEMA, National Risk Index. "Salt Lake County Expected Annual Loss Drought Risk Score, Map and Legend." https://hazards.fema.gov/nri/map

these lifelines, communities would be significantly more vulnerable to crises and emergencies. There are eight lifelines, each with a specific focus.


**Figure 70: FEMA Community Lifelines**[78]

The main lifelines for drought are food, hydration, shelter, and water systems. Crops and animals require water to thrive and grow; without it, they become stressed and ultimately die. Shelter is also affected, as drought can severely damage structural integrity as the soil pulls away from beams, buildings, bridges, and other structures. Mitigating future droughts will require conservation, creative solutions, and innovation to maintain the standard of living Salt Lake County has come to rely on.

## CHANGES IN DEVELOPMENT

Experts agree that a long-term drought strategy is essential to securing Utah's water future, as water demand will continue to rise with population growth. Coupled with climate change, which acts as a magnifier, droughts can become more unpredictable and prolonged. The long-term record of reservoir levels, precipitation inputs, and projected population growth raises growing concerns about Utah's water supply, as shrinking resources face increased demand. Utah's water supply faces pressures on both the supply and demand sides, with state reservoirs reflecting wet and dry cycles. While these fluctuations affect long-term water security and availability, residents may soon face mandatory water conservation measures, highlighting the growing vulnerability to drought.[79]

Potential impacts for the county include a decline in agriculture-related economic opportunities, food scarcity, loss of life or property, and worsened air quality. Changes in population patterns may occur as people relocate seeking improved economic opportunities and quality of life. Changes in land use and development may also lead to changes in agriculture zoning.



[78] FEMA. "Community Lifelines." https://www.fema.gov/emergency-managers/practitioners/lifelines
[79] Jensen, Marcus. "State Climate Officer Explains the Winter Snow Surge and What it Means for Utah's Water Future." Utah State University, Utah State Today. January 17, 2023. https://www.usu.edu/today/story/?story=state-climate-officer-explains-the-winter-snow-surge-and-what-it-means-for-utahs-water-future

## VULNERABILITY SCORE

To analyze the county's vulnerability to drought, the NRI was used as a primary tool during the 2024 Hazard Identification and Risk Assessment (HIRA) update. The NRI defines risk as the potential for negative impacts resulting from a natural hazard. It determines a community's risk relative to other communities by examining the expected annual loss and social vulnerability in a given community in relation to that community's resilience. As shown in Figure 71, Salt Lake County has a relatively high NRI drought risk rating, with a risk score of 36.9.

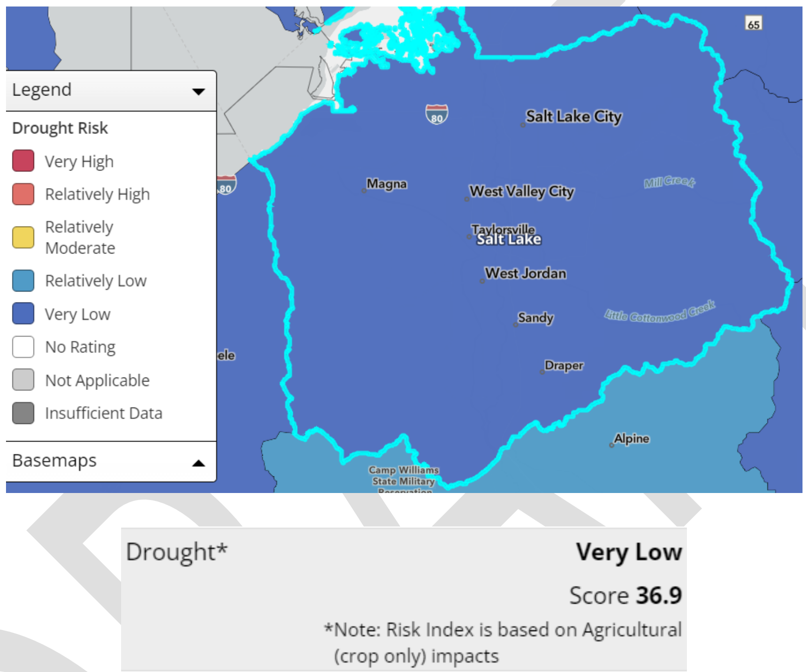


**Figure 71: National Risk Index Drought Risk Map, Legend and Score for Salt Lake County Utah**[80]



[80] FEMA, National Risk Index. "National Risk Index Salt Lake County Drought Score, Map and Legend." https://hazards.fema.gov/nri/map

# Earthquake

## Hazard Description

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 building up deep beneath the Earth's surface. The rocks break along zones of weakness, called faults. Seismic waves are then transmitted outward, causing further ground shaking or vibrations.

The Richter scale measures the magnitude of earthquakes on a seismograph. Generally, an earthquake must 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, groundwater 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 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.

Seismic 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 groundwater depth, basin shape, sediment thickness, and the degree of sediment consolidation.

### SURFACE FAULT RUPTURE AND TECTONIC SUBSIDENCE

Surface fault rupture is caused by relative movement between blocks in the Earth's crust. In Utah, this results in 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 with a magnitude of 6.5 or greater could result in surface faulting with heights of 16 to 20 feet and break segments ranging from 12 to 44 miles long. Surface displacement generally occurs over a zone 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 the 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.

## Hazard Profile

| **Potential Impact** | X | Catastrophic | **Probability** | | Highly Likely |
|---|---|---|---|---|---|
| | | Critical | | X | Likely |
| | | Limited | | | Occasional |
| | | Negligible | | | Unlikely |
| **Location** | Ground shaking will be felt throughout the 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 groundwater. Soil 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, Hazus, UDEM, UGRC | | | | |

## Magnitude/Extent

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

- **Great:** Mw > 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 frequently used estimate of large earthquake magnitudes.

Another commonly used intensity scale is the Modified Mercalli intensity scale, with ratings defined as follows.[81]

| Intensity | Shaking | Description/Damage |
|---|---|---|
| I | Not felt | Not felt except by a very few under especially favorable conditions. |
| II | Weak | Felt only by a few persons at rest,especially on upper floors of buildings. |
| III | Weak | Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated. |
| IV | Light | Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably. |
| V | Moderate | Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop. |
| VI | Strong | Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight. |
| VII | Very strong | Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken. |
| VIII | Severe | Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned. |
| IX | Violent | 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 | Extreme | Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent. |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| PERCEIVED SHAKING | Not felt | Weak | Light | Moderate | Strong | Very strong | Severe | Violent | Extreme |
| POTENTIAL DAMAGE | none | none | none | Very light | Light | Moderate | Moderate/Heavy | Heavy | Very Heavy |
| PEAK ACC.(%g) | <.17 | .17-1.4 | 1.4-3.9 | 3.9-9.2 | 9.2-18 | 18-34 | 34-65 | 65-124 | >124 |
| PEAK VEL. (cm/s) | <0.1 | 0.1-1.1 | 1.1-3.4 | 3.4-8.1 | 8.1-16 | 16-31 | 31-60 | 60-116 | >116 |
| INSTRUMENTAL INTENSITY | I | II-III | IV | V | VI | VII | VIII | IX | X+ |

**Figure 72: Earthquake Intensity Scale[82]**

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

According to the U.S. Geological Survey (USGS), the range of earthquake magnitude experienced in Salt Lake County since 1962 is .01 to 5.7.

[81] USGS. The Modified Mercalli Intensity Scale. https://www.usgs.gov/programs/earthquake-hazards/modified-mercalli-intensity-scale

[82] Earthquake Hazards Program. "EQ Magnitude, Energy Release, and Shaking Intensity." U.S. Geological Survey. https://www.usgs.gov/media/images/eq-magnitude-energy-release-and-shaking-intensity-3

## Location

Utah's earthquake hazard is greatest within the 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 comprises 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 a much longer return interval (2,500 years or more) and is not expected to produce a major quake in the near future. Table 33 describes the characteristics of these fault zones and Figure 73 shows the location of each within the county.

**Table 33: Fault Zones in Salt Lake County**

| 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 | | | | |

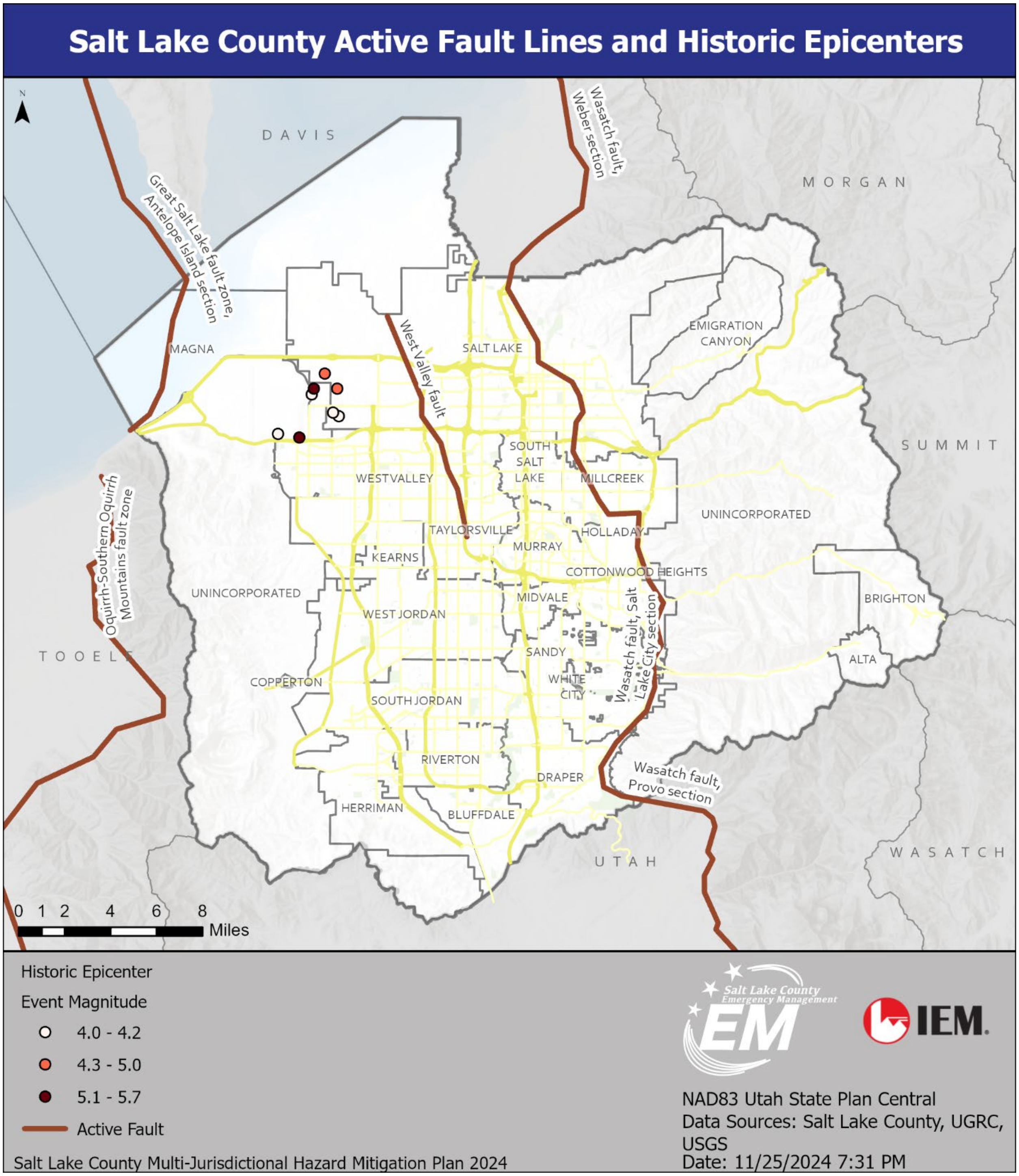


**Figure 73: Map of Salt Lake County Fault Line**

Liquefaction is a major hazard associated with earthquakes in Utah. It may occur when ground shaking causes water-saturated sandy soils to lose strength and soil to behave like a viscous liquid rather than a solid. Liquefaction can cause buildings to sink or tilt, underground storage tanks to rise, and other types of slope failures to occur. As shown in Figure 74, the Salt Lake Valley 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 groundwater. Both contribute to a large area of the north and central part of the county, where liquefaction potential is moderate to high.

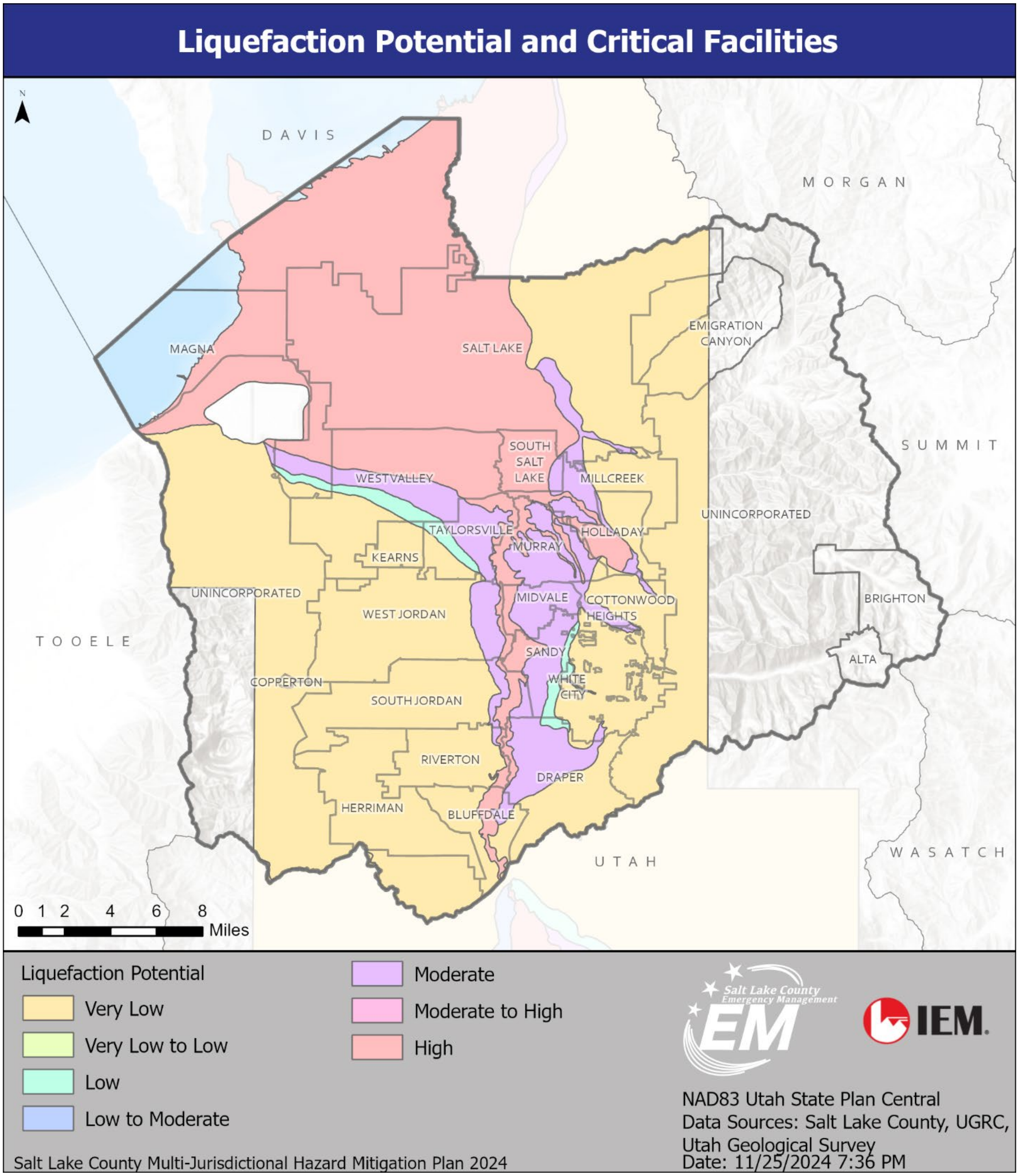


Figure 74: Salt Lake County Liquefication Potential

## Historical Events and Probability of Future Occurrences

Utah experiences approximately 700 earthquakes each year, approximately six with a magnitude of 3.0 or greater. On average, a moderate, potentially damaging earthquake (magnitude 5.5–6.5) occurs within the state every 10 years. Large earthquakes (magnitude 6.5–7.5) occur on average every 50 years. Based on this recurrence interval, future probability is considered to be occasional. 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.

At least 26 large-magnitude (~6.5 or greater), surface-rupturing earthquakes have occurred in the past 6,500 years. On average, a large earthquake occurs every 300 years. The most recent large earthquake took place about 300 years ago in the Nephi segment. The Weber segment experienced a large earthquake about 500 years ago. The Salt Lake City segment has an average recurrence time of about 1,300 years between large earthquakes; however, the last major earthquake affecting most of the Salt Lake City segment occurred about 1,400 years ago. Enough energy has accumulated on the Salt Lake City segment to produce a magnitude 7.0+ earthquake.[83]

**Magna Earthquake, March 18, 2020:** A 5.7 magnitude earthquake rattled homes from southern Idaho to Millard County, causing significant damage to multiple buildings and displacing some residents. According to the USGS, the quake happened at 7:09 a.m., with the epicenter just north of Magna, between the city and Antelope Island near the edge of the Great Salt Lake. The quake forced the Salt Lake City International Airport to shut down operations for several hours, streets were closed, hazardous materials crews considered evacuating all of Magna due to a chemical leak at Kennecott, and damage was reported to structures in Magna, Kearns, West Valley City, and downtown Salt Lake City. Emergency officials called it the largest earthquake in Utah since a 5.9 magnitude quake hit St. George in 1992. An estimated 2.8 million people felt the shaking.[84]

[83] Utah Seismic Safety Commission, Utah Division of Emergency Management, et al. “Putting Down Roots in Earthquake Country, 2nd Ed.” 2022. https://ugspub.nr.utah.gov/publications/non_lib_pubs/putting-down-roots.pdf
[84] PBS News.org. “5.7-magnitude quake shakes Utah, Salt Lake airport closed.” March 18, 2020. https://www.pbs.org/newshour/nation/5-7-magnitude-quake-shakes-utah-salt-lake-airport-closed


**Figure 75: Damage Following Magna Earthquake[85]**

Based on the FEMA Disaster Declarations Database, Salt Lake County received an Earthquake and Aftershocks Major Disaster Declaration on December 31, 2020, for the incident period March 18, 2020, to April 17, 2020, and the county was designated for individual and public assistance.

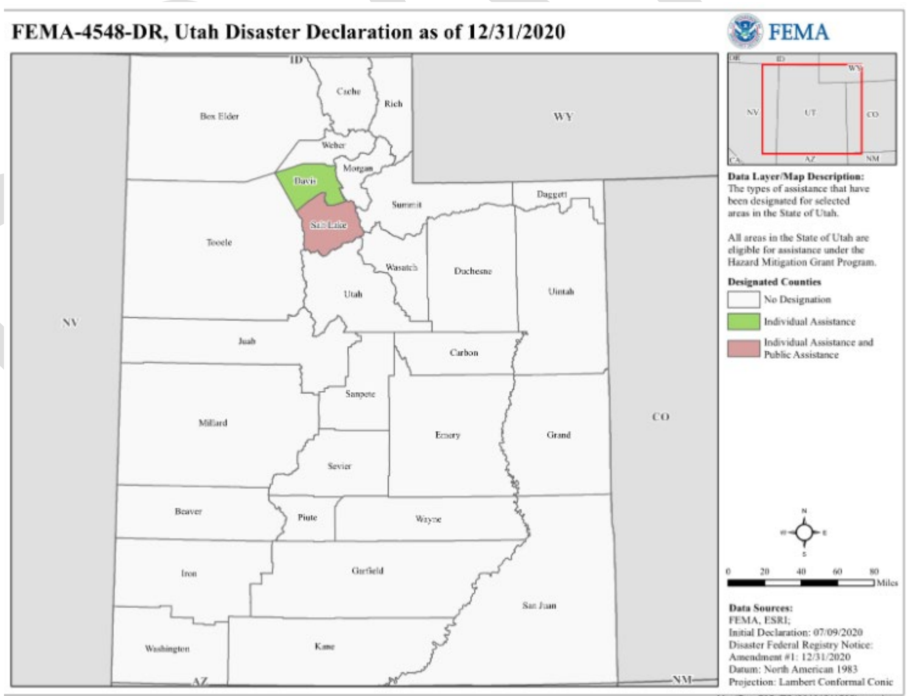


**Figure 76: FEMA DR-4548 Utah Disaster Declaration for Earthquake and Aftershocks, December 31, 2020[86]**

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85 Photo provided by SLCOEM

86 FEMA Disasters and Other Declarations. “Utah Earthquake and Aftershocks: DR-4548-UT.” 2024. https://www.fema.gov/disaster/4548

Figure 77 illustrates <M4 earthquake events occurring in and around Salt Lake County between 2010 and 2024, including the Magna earthquake in 2020.

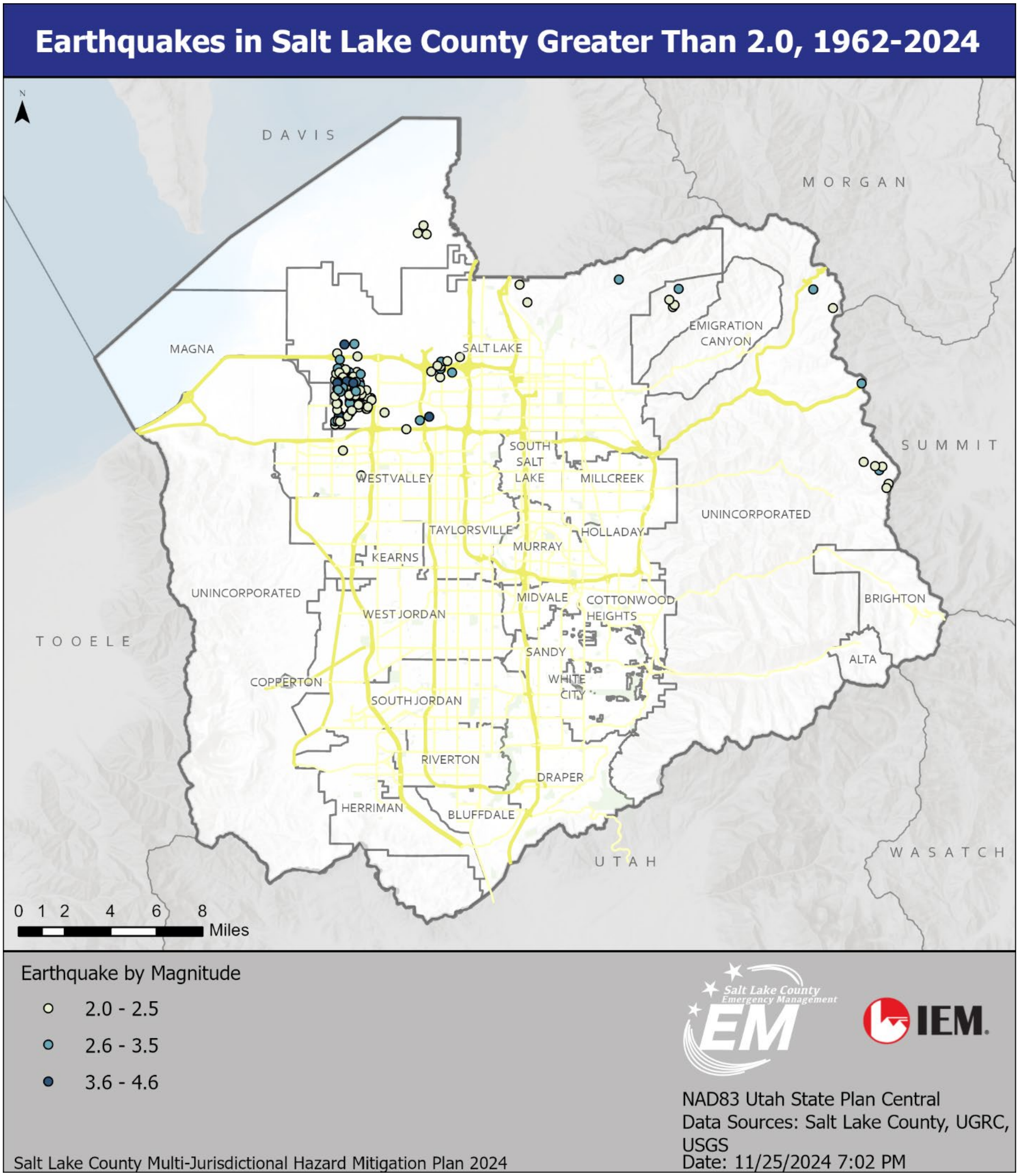



**Figure 77: Earthquakes in Salt Lake County Greater Than 2.0 1962–2024**

Although no surface-faulting earthquakes have occurred on the Wasatch Fault in recent history, evidence of numerous prehistoric events exists in the geologic record.[87] 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.

According to USGS records, more than 159 recorded earthquakes of 2.0 magnitude or greater occurred in or immediately around Salt Lake County from 1962 through 2024. 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.

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.

Utah's most damaging earthquake was of a smaller magnitude (5.7), occurring near Richmond in Cache Valley in 1962. This earthquake damaged over 75% of the houses in Richmond, as well as roads and various other structures. The total damage was about $1 million (in 1962), which would be about $7,768,300 today with inflation.

The Working Group on Utah Earthquake Probabilities (WGUEP) assessed the likelihood of large earthquakes in the Wasatch Front region. The assessment indicates there is an 18% probability of a M6.75 earthquake on the Wasatch Fault in the next 50 years, and a combined 43% probability in the next 50 years based on all faults in the region. For a M6.0 earthquake, the probability is 18% along the Wasatch Fault and 57% in the region.[88] The National Seismic Hazard model shows the potential for peak ground accelerations having a 2% probability of being exceeded in 50 years (Figure 78). The Wasatch Fault is the most active in the region.

[87] Utah Geological Survey, Public Information Series 40. "The Wasatch Fault." 1996. https://ugspub.nr.utah.gov/publications/public_information/pi-40.pdf
[88] U.S. Geological Survey. "Fact Sheet 2016–3019: Earthquake Forecast for the Wasatch Front Region of the Intermountain West." April 2016. ussc.utah.gov/pages/download.php?direct=1&noattach=true&ref=1279&ext=pdf&k=

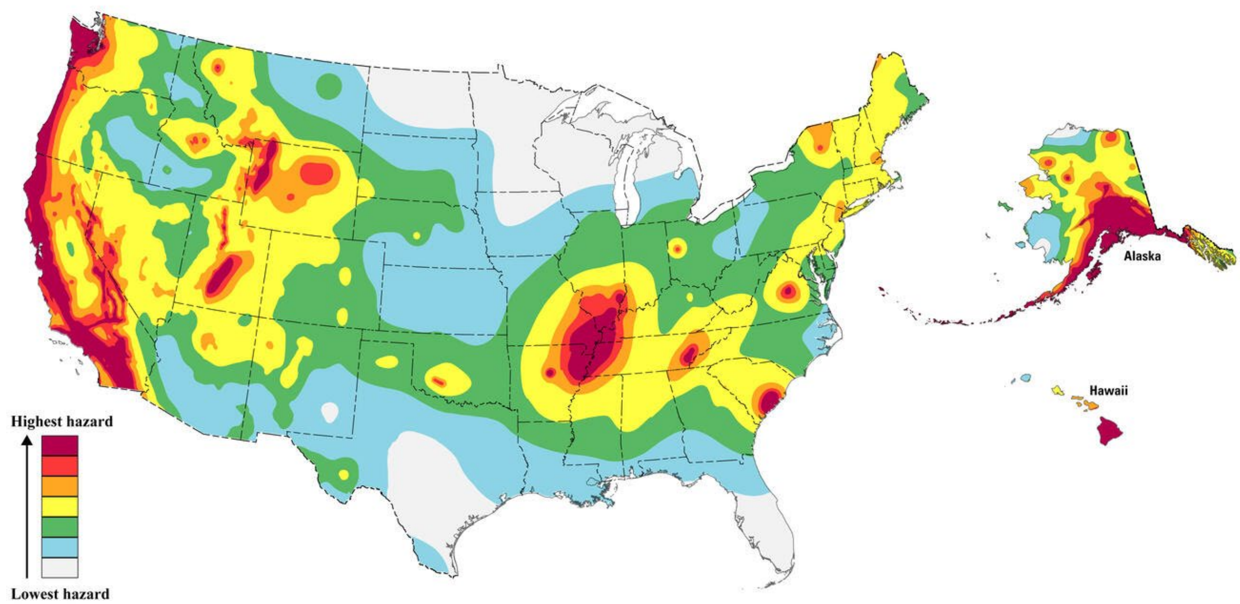



**Figure 78: National Seismic Hazard Model[89]**

## Climate Change Considerations

Recent geological studies have shown that climate change, specifically rising rainfall rates and glacial melting, could exacerbate seismic activity, including earthquakes. Geologists have identified the correlation between the frequency of earthquakes and annual rainfall cycles. Changing climate conditions, such as a warmer atmosphere, can retain more water vapor, leading to higher levels of precipitation. As precipitation levels increase rainfall, the Earth's crust is compressed, both vertically and horizontally, stabilizing it. When this water disappears in the winter, the effective "rebound" destabilizes the region and increases the number of earthquakes that occur.[90]

## Secondary Hazards

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

### 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 groundwater and sandy or silty sediments. Liquefaction can produce lateral spreading and flows, where surface soil layers break up and

[89] Earthquake Hazards Program. "National Seismic Hazard Model." March 9, 2022. U.S. Geological Survey. https://www.usgs.gov/programs/earthquake-hazards/science/national-seismic-hazard-model
[90] Blackett, Matthew and The Conversation. "Scientist Find a Possible Connection Between Climate Change and Earthquake Risk." Inverse. February 20, 2024. https://www.inverse.com/science/climate-change-volcano-earthquake-connection

move independently. Displacement of up to three 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 the foundation materials beneath earthfill dams to liquefy and fail, the flooding of low-lying areas by groundwater, the backup of gravity-fed systems, and the formation of 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.

### 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.

### FLOODING

Flooding can occur 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 groundwater discharge.

### AVALANCHES

Avalanches can be triggered by ground movement. The most vulnerable areas include those with steep terrain, high precipitation, high earthquake potential, high population density, and heavy backcountry use.

### SENSITIVE CLAYS

Sensitive clays are a soil type that lose strength and are subject to collapse when shaken. The resulting type of ground failure is similar to liquefaction.

### SUBSIDENCE

Subsidence involves a settling or sinking of loose granular materials such as sand and gravel that do not contain clay. Ground displacement caused by surface fault rupture can cause tectonic subsidence. This is a broad, permanent tilting of the valley floor down toward the fault scarp. This can alter stream flows, cause flooding along lake and reservoir shorelines, and disrupt gravity-flow systems.[91]

### VALLEY FEVER

Valley fever is an illness caused by the fungus *Coccidioides*, which grows in soils in areas with low rainfall, high summer temperatures, and moderate winter temperatures, such as the project site. It is found most often in the southwestern United States, especially Arizona, Utah, Texas, and California.

[91] Utah Geological Survey, Geologic Hazards, Utah Faults. https://geology.utah.gov/hazards/earthquakes/utah-faults/#toggle-id-2

Exposure typically occurs in connection with ground-disturbing activities that release fungal spores, which are then inhaled. Earthquakes disturb soil-enabling spores, allowing them to spread into the air.

Most people who are exposed to the fungus do not develop symptoms or have relatively mild flu-like symptoms. Common symptoms include fever, cough, headache, rash, muscle aches, and joint pain. Symptoms of advanced coccidioidomycosis may include skin lesions, chronic pneumonia, meningitis, and bone or joint infection. Symptoms may appear between one and three weeks after exposure. Some patients have reported having symptoms for six months or longer, especially if the infection is not diagnosed early. Valley fever is not known to spread from person to person or between people and animals.

## Vulnerability Assessment

Earthquakes have the potential to cause extensive damage to Salt Lake County. Moderate earthquakes have caused costly damage in the past, and there is the potential for stronger earthquakes with even more pronounced effects. A strong earthquake will cause significant structural damage and is likely to damage infrastructure, interrupt other services, and disrupt lives throughout the county and neighboring counties. Recovery will take substantial resources and costs and could take years.

The vulnerability of people and infrastructure to earthquake hazards in Salt Lake County was obtained from the modeling program Hazus 6.1. The Hazus earthquake scenario entails a magnitude 6.2 earthquake occurring within Salt Lake County with an epicenter on the Warm Springs Fault in the northern part of the county. The vulnerability and loss estimates provided in this section are based on this scenario. Hazus evaluates the probability of damage to buildings and infrastructure and impacts on the population based on models of earthquake ground-shaking intensity.

### ESTIMATED LOSSES AND POTENTIAL IMPACTS

#### CRITICAL INFRASTRUCTURE

Critical infrastructure (i.e., schools, emergency operation centers, county facilities, fire stations, hospitals, and police stations) across most of the Salt Lake jurisdiction experienced severe peak ground acceleration based on the Hazus loss estimation model for a magnitude 6.2 earthquake. South Salt Lake and the majority of Millcreek, Magna, West Valley, Halladay, Murray, Taylorsville, and Kearns experienced very strong peak ground acceleration in the same model. Areas experiencing strong peak ground acceleration in the Hazus model include western portions of Magna and South Jordan; northern portions of the unincorporated areas of the county, Riverton, and Draper; southern portions of West Valley, Kearns, Taylorsville, Murray, and Holladay; eastern portions of Emigration Canyon, West Jordan, and Magna; and the majority of West Jordan, Midvale, Cottonwood Heights, Sandy, and White City. The remainder of the county experienced moderate peak ground acceleration in the Hazus model. An examination of the building and contents loss scenario for a magnitude 6.2 earthquake shows that the majority of losses will occur in the southern portion of Salt Lake and the northern portion of West Valley. Figure 79–Figure 84 show the locations of the different categories of critical facilities in relation to peak ground-acceleration values. Table 34 indicates the number of facilities that may be damaged and how long they may lack functionality.

**Table 34: Expected Damage to Essential Facilities**

| Classification | Total | # Facilities | | |
|---|---|---|---|---|
| | | At Least Moderate Damage > 50% | Complete Damage > 50% | With Functionality > 50% on Day 1 |
| **Hospitals** | 16 | 7 | 0 | 5 |
| **Schools** | 422 | 146 | 4 | 170 |
| **Emergency Operations Centers** | 18 | 6 | 0 | 8 |
| **Police Stations** | 33 | 16 | 0 | 11 |
| **Fire Stations** | 67 | 22 | 0 | 31 |

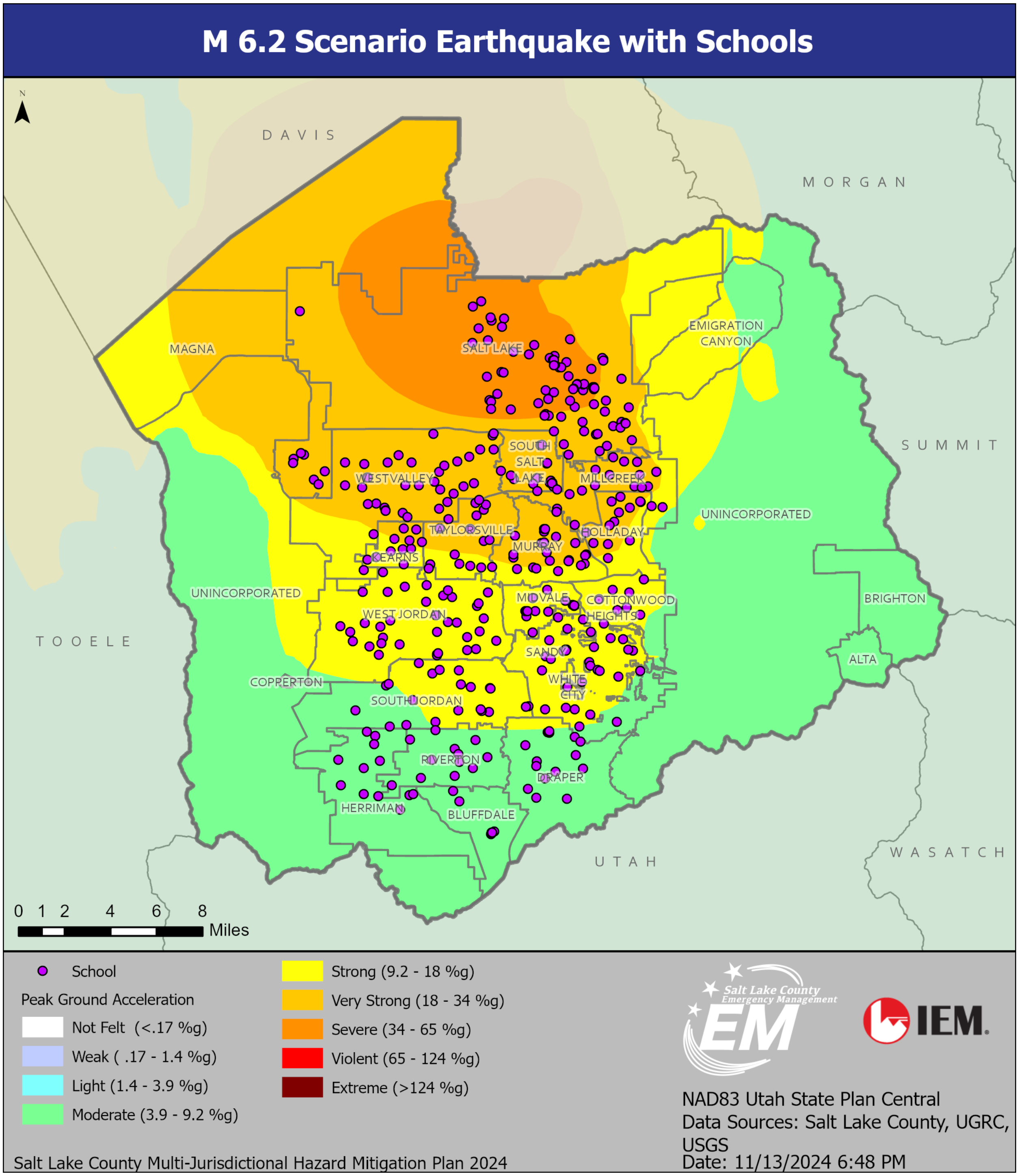



**Figure 79: Schools in M 6.2 ShakeMap Scenario**

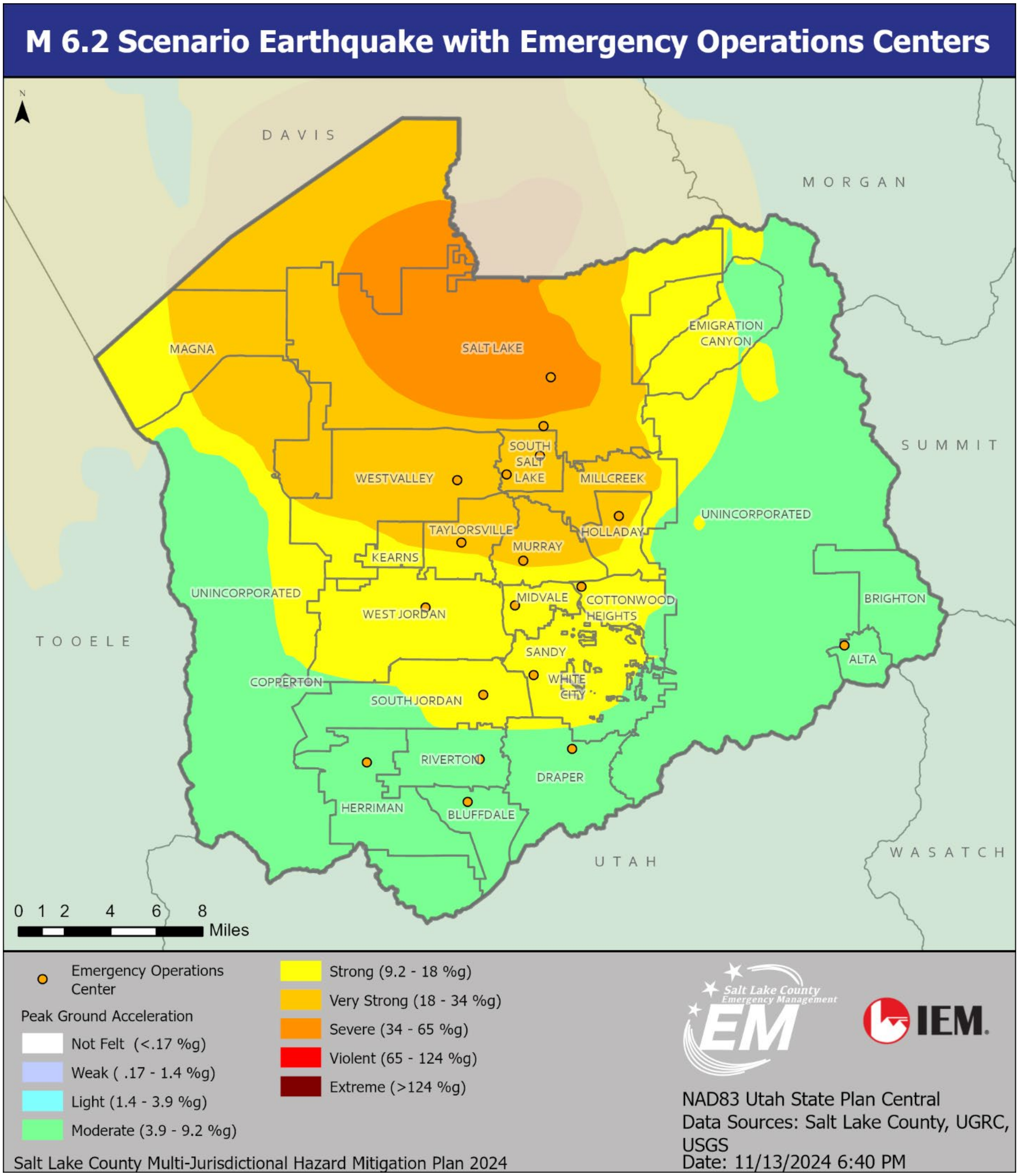



**Figure 80: Emergency Operations Centers in M 6.2 ShakeMap Scenario**

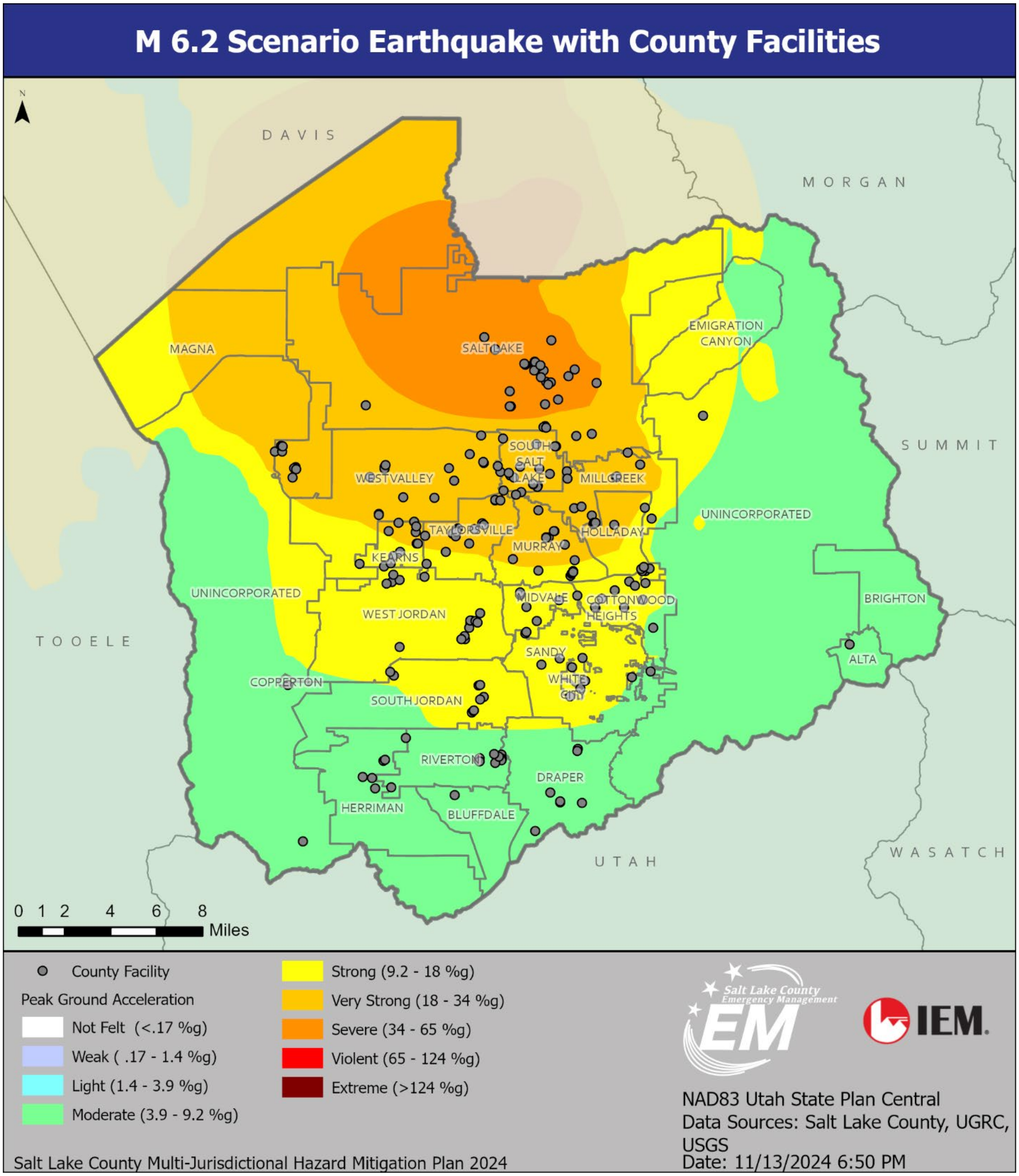



**Figure 81: County Facilities in M 6.2 ShakeMap Scenario**

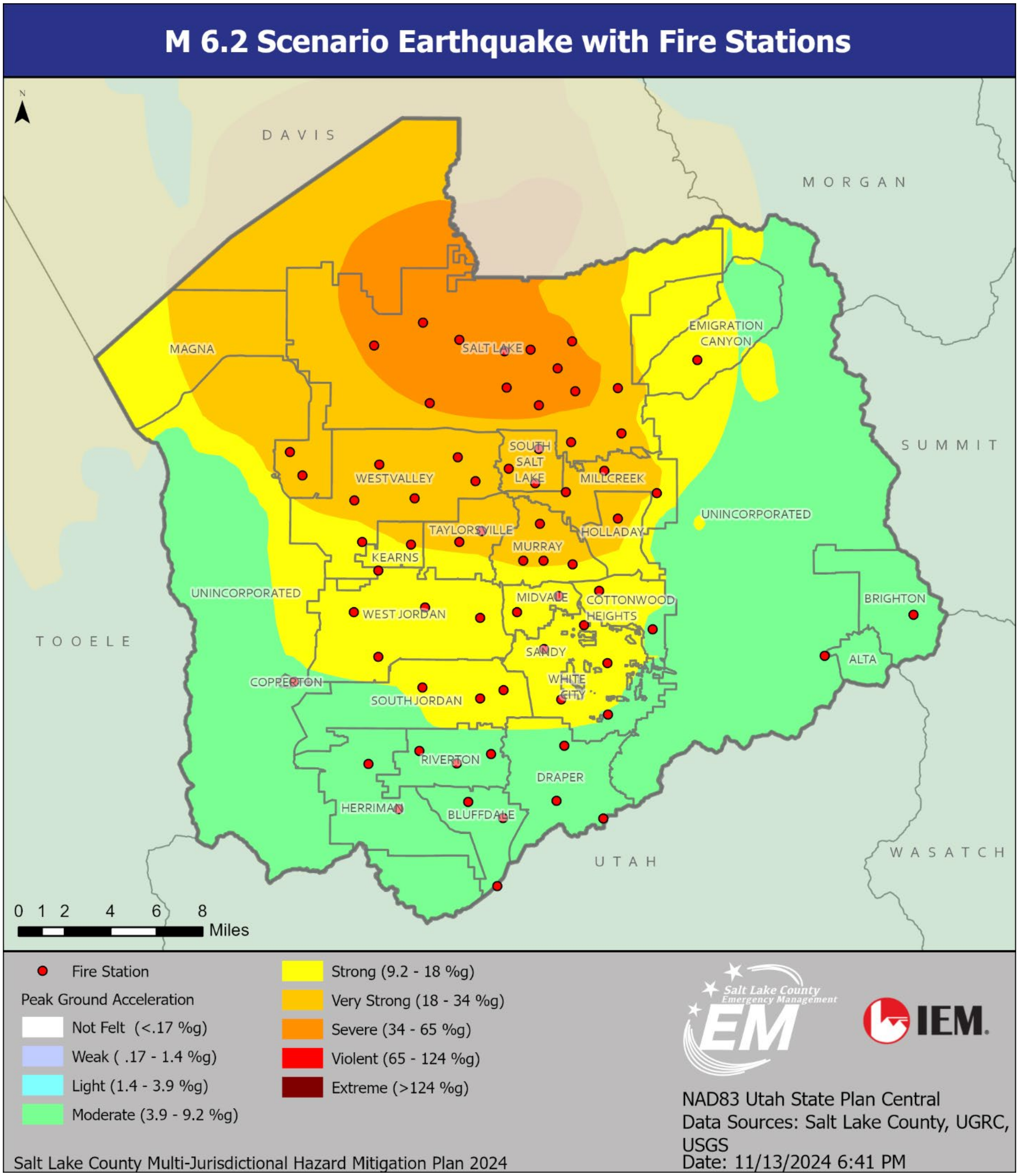



Figure 82: Fire Stations in M 6.2 ShakeMap Scenario

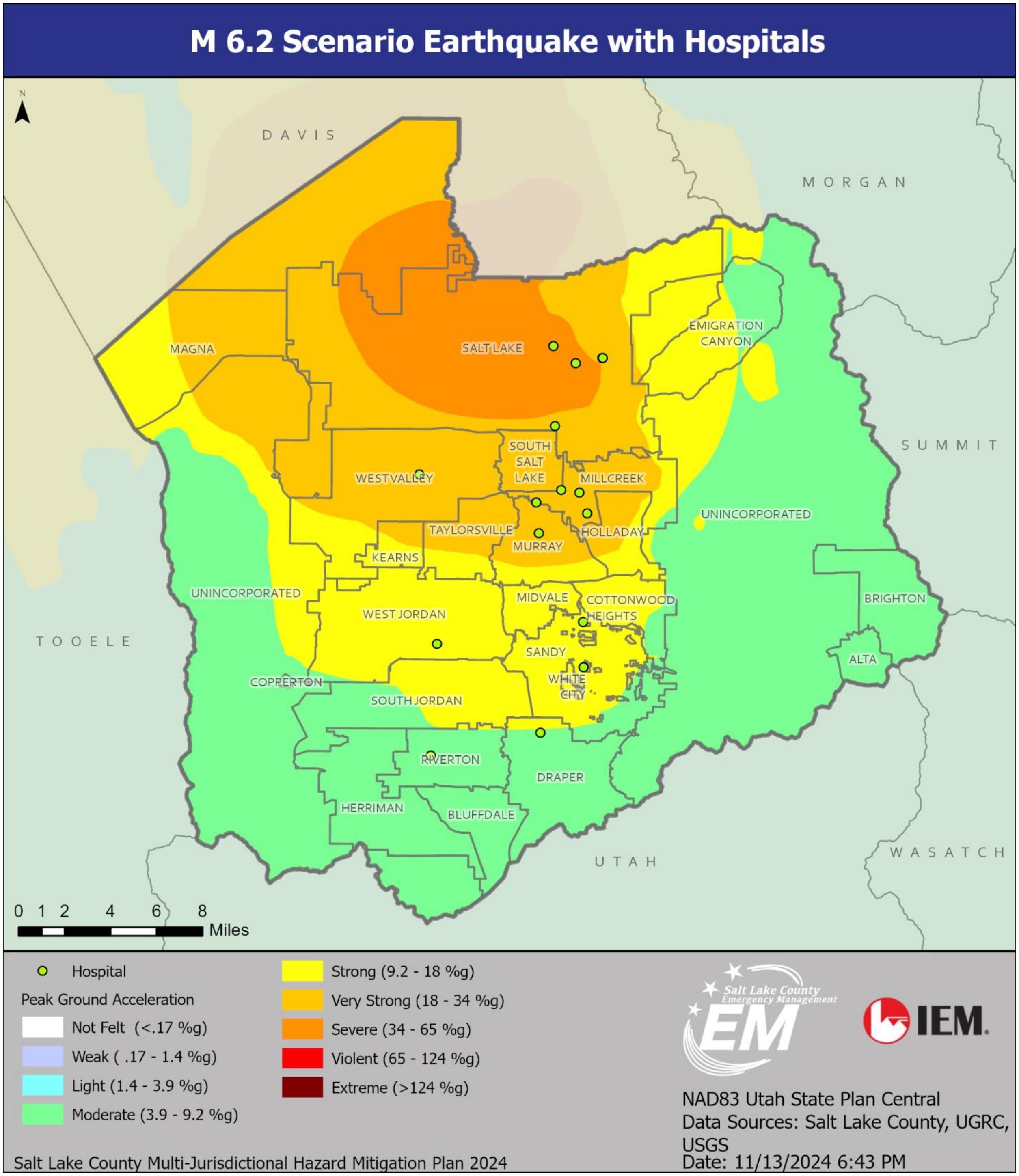



**Figure 83: Hospitals in M 6.2 ShakeMap Scenario**

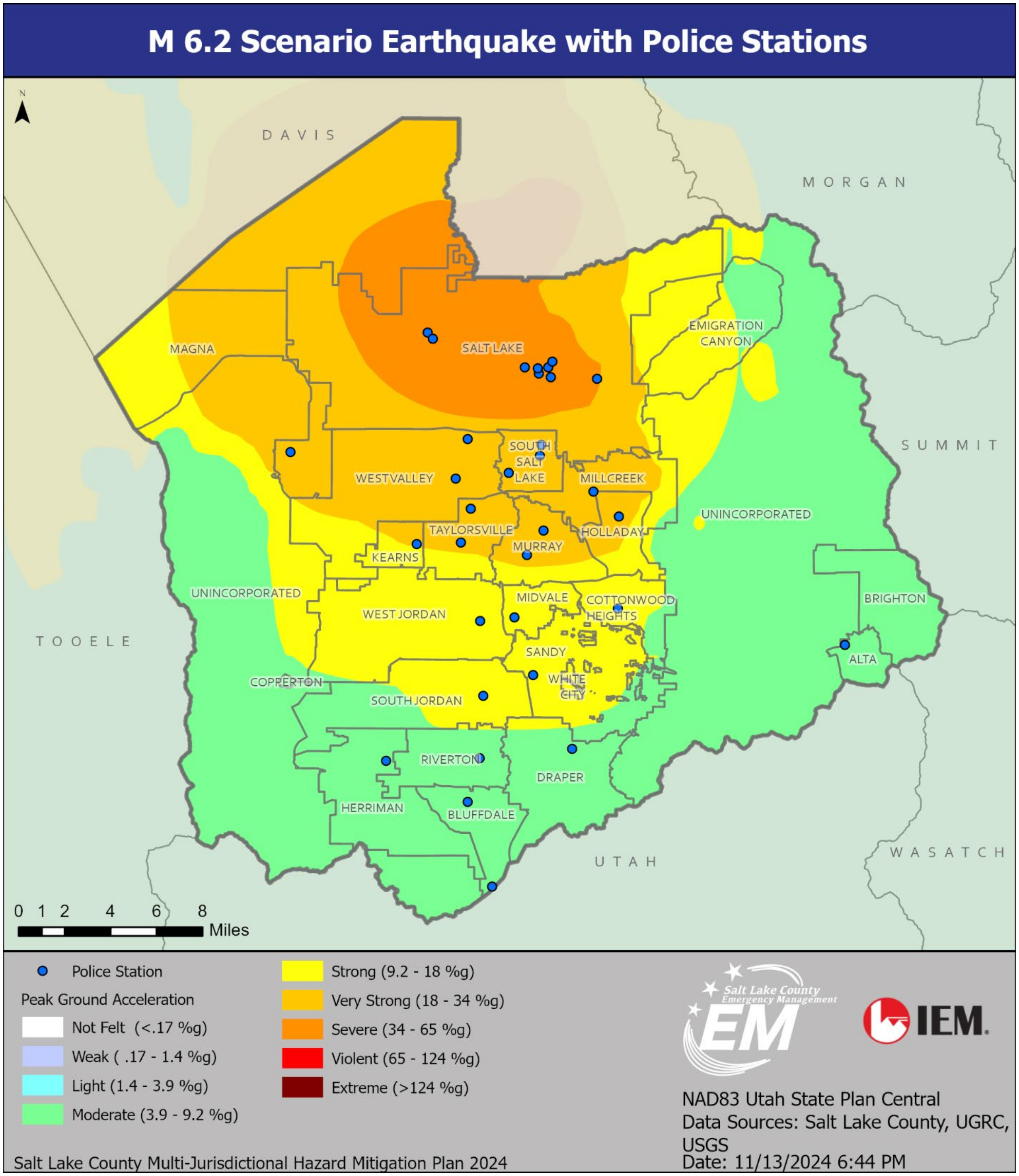



**Figure 84: Police Stations in M 6.2 ShakeMap Scenario**

## STRUCTURAL LOSSES

The total economic loss estimated for the earthquake is approximately $13.7 billion, which includes building- and lifeline-related losses based on the region's available inventory. Hazus estimates that there are 360,000 buildings in the county with a total replacement value of over $172 billion. An estimated 56,217 buildings will be at least moderately damaged in this scenario, which is over 16% of the buildings in the region. Over 6,000 will be damaged beyond repair. 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.

Direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. Business interruption losses are the losses associated with the inability to operate a business due to damage sustained during the earthquake, including temporary living expenses for individuals displaced from their homes by the earthquake. Table 35 shows the direct and indirect losses for the county based on different building occupancy types.

Table 35 summarizes the expected damage and loss. The total building-related losses were $12,546,760,000, 22% of which were related to business interruptions in the region. By far the largest loss was sustained by the residential occupancy category, accounting for 36% of the total loss.

**Table 35: Building-Related Economic Loss Estimates (in Millions)**

| Category | Area | Single Family | Other Residential | Commercial | Industrial | Others | Total |
|---|---|---|---|---|---|---|---|
| **Business Interruption Losses** | Wage | $0.00 | $91.43 | $386.44 | $33.58 | $91.23 | $602.68 |
| | Capital-Related | $0.00 | $38.87 | $344.99 | $20.86 | $17.44 | $422.16 |
| | Rental | $94.93 | $176.80 | $208.32 | $24.11 | $56.57 | $560.73 |
| | Relocation | $332.75 | $98.55 | $319.13 | $123.22 | $297.46 | $1,171.10 |
| | **Subtotal** | **$427.68** | **$405.65** | **$1,258.88** | **$201.77** | **$462.70** | **$2,756.67** |
| **Direct Losses** | Structural | $624.74 | $209.17 | $582.07 | $339.12 | $255.66 | $2,010.76 |
| | Non-structural | $1,445.45 | $820.17 | $1,334.90 | $963.97 | $780.28 | $5,344.77 |
| | Content | $388.33 | $173.04 | $641.09 | $650.22 | $326.17 | $2,178.84 |
| | Inventory | $0.00 | $0.00 | $152.95 | $98.82 | $3.95 | $255.71 |
| | **Subtotal** | **$2,458.52** | **$1,202.38** | **$2,711.01** | **$2,052.13** | **$1,366.06** | **$9,790.08** |
| **Total** | | **$2,886.20** | **$1,608.03** | **$3,969.89** | **$2,253.90** | **$1,828.76** | **$12,546.75** |

Table 36 shows the potential structural losses for each jurisdiction based on the Hazus model. Large cities and urban areas are the most financially affected by the effects of an earthquake. Major urban areas such as Salt Lake and West Valley can expect high structural and income losses. Jurisdictions such as Millcreek, Murray, and Cottonwood Heights can expect structural and building losses with a need for extensive repairs, especially for businesses and residential sectors, while areas such as Alta, Brighton, and Copperton may experience minimal impacts.

The table displays significant losses in the larger urban areas of Salt Lake County, with Salt Lake experiencing the largest loss at $9,407,870,930, reflecting widespread damage in both the residential and business sectors. West Valley reports $851,62,700 in total losses, with significant inventory and building losses resulting in a major loss of building assets. Other significantly impacted areas include the jurisdictions of Millcreek and Murray, with Millcreek experiencing significant structural and building losses ($435,019,240) and Murray experiencing a large income loss ($25,011,510).

Jurisdictions such as Cottonwood Heights, Kearns, Sandy, South Jordan, and Taylorsville can expect to experience moderate losses per the Hazus loss estimation model, with losses ranging from $35,964.36 to $78,365.44. While these areas experience a substantial loss across various categories, it is not considered catastrophic. The unincorporated areas of the county experience the lowest total losses in the model, $5,827.50, with minor impacts in categories such as inventory and wage loss. Unincorporated areas are typically less densely populated, leading to lower overall losses.

Figure 85 and Figure 86 show the areas in the county with the highest losses.

**Table 36: Approximated Hazus Loss Estimation by Jurisdiction (*in Thousands*)**

| Name | Total Loss | Wage Loss | Structural Loss | Rent Loss | Relocation Loss | Non-structural Loss | Inventory Loss | Income Loss | Content Loss | Building Loss |
|---|---|---|---|---|---|---|---|---|---|---|
| Alta | $0.00 | $0.00 | $0.00 | $0.00 | $0.00 | $0.00 | $0.00 | $0.00 | $0.00 | $0.00 |
| Bluffdale | $2,508.93 | $0.63 | $151.15 | $2.63 | $0.00 | $726.64 | $6.91 | $0.19 | $318.60 | $785.50 |
| Brighton | $0.00 | $0.00 | $0.00 | $0.00 | $0.00 | $0.00 | $0.00 | $0.00 | $0.00 | $0.00 |
| Copperton | $0.00 | $0.00 | $0.00 | $0.00 | $0.00 | $0.00 | $0.00 | $0.00 | $0.00 | $0.00 |
| Cottonwood Heights | $49,130.52 | $35.53 | $7,753.55 | $115.88 | $44.55 | $6,841.72 | $63.91 | $40.30 | $2,961.67 | $7,608.81 |
| Draper | $13,094.25 | $6.28 | $735.12 | $25.00 | $0.86 | $2,419.96 | $41.15 | $7.24 | $1,032.62 | $2,642.69 |
| Emigration Canyon | $0.00 | $0.00 | $0.00 | $0.00 | $0.00 | $0.00 | $0.00 | $0.00 | $0.00 | $0.00 |
| Herriman | $2,665.82 | $0.72 | $100.28 | $3.71 | $0.00 | $971.05 | $4.60 | $0.36 | $447.94 | $1,038.71 |
| Holladay | $146,157.89 | $68.77 | $28,995.10 | $226.65 | $221.39 | $13,466.27 | $145.04 | $52.61 | $5,482.66 | $15,273.70 |
| Kearns | $42,721.10 | $38.55 | $6,421.93 | $110.00 | $127.43 | $8,506.71 | $31.80 | $10.14 | $3,548.20 | $9,613.29 |
| Magna | $45,009.31 | $14.76 | $6,822.80 | $153.78 | $267.32 | $11,005.88 | $102.30 | $12.56 | $4,584.70 | $12,572.39 |
| Midvale | $78,365.44 | $43.36 | $10,233.31 | $145.88 | $63.11 | $6,611.46 | $200.01 | $35.45 | $2,743.24 | $7,354.13 |
| Millcreek | $435,019.24 | $535.75 | $76,022.84 | $709.44 | $749.17 | $29,323.69 | $439.66 | $287.67 | $13,026.38 | $33,067.43 |
| Murray | $311,163.29 | $206.48 | $51,390.22 | $582.91 | $499.65 | $25,011.51 | $548.38 | $168.25 | $10,583.85 | $28,350.81 |
| Riverton | $8,983.12 | $4.02 | $726.46 | $15.81 | $3.01 | $2,920.66 | $24.88 | $2.67 | $1,259.86 | $3,195.75 |
| Salt Lake | $9,407,870.93 | $2,982.29 | $1,488,824.51 | $5,779.22 | $10,294.12 | $177,593.20 | $5,816.60 | $2,629.52 | $81,944.58 | $201,958.90 |
| Sandy | $71,489.35 | $34.39 | $8,523.28 | $146.37 | $48.02 | $13,395.09 | $118.74 | $34.73 | $5,640.83 | $14,872.44 |
| South Jordan | $35,964.36 | $16.72 | $2,402.09 | $81.05 | $22.09 | $11,540.07 | $75.86 | $16.72 | $4,950.44 | $12,737.76 |
| South Salt Lake | $736,755.28 | $292.53 | $131,455.63 | $726.88 | $808.69 | $22,423.04 | $1,034.29 | $265.50 | $10,350.39 | $25,230.33 |
| Taylorsville | $205,392.83 | $146.45 | $27,870.49 | $487.39 | $467.93 | $25,685.85 | $285.90 | $101.86 | $10,388.38 | $28,953.34 |
| Unincorporated | $5,827.50 | $0.99 | $511.75 | $6.99 | $4.58 | $1,367.53 | $3.39 | $1.06 | $642.52 | $1,493.74 |
| West Jordan | $91,720.71 | $81.91 | $8,957.20 | $238.80 | $153.31 | $22,556.17 | $281.66 | $45.21 | $9,625.33 | $25,263.29 |
| West Valley | $851,629.70 | $481.36 | $152,025.55 | $1,816.84 | $2,333.75 | $76,916.91 | $1,100.29 | $391.64 | $32,010.19 | $87,186.38 |
| White City | $5,295.40 | $1.87 | $839.65 | $5.41 | $1.25 | $375.00 | $5.63 | $1.85 | $173.03 | $415.50 |

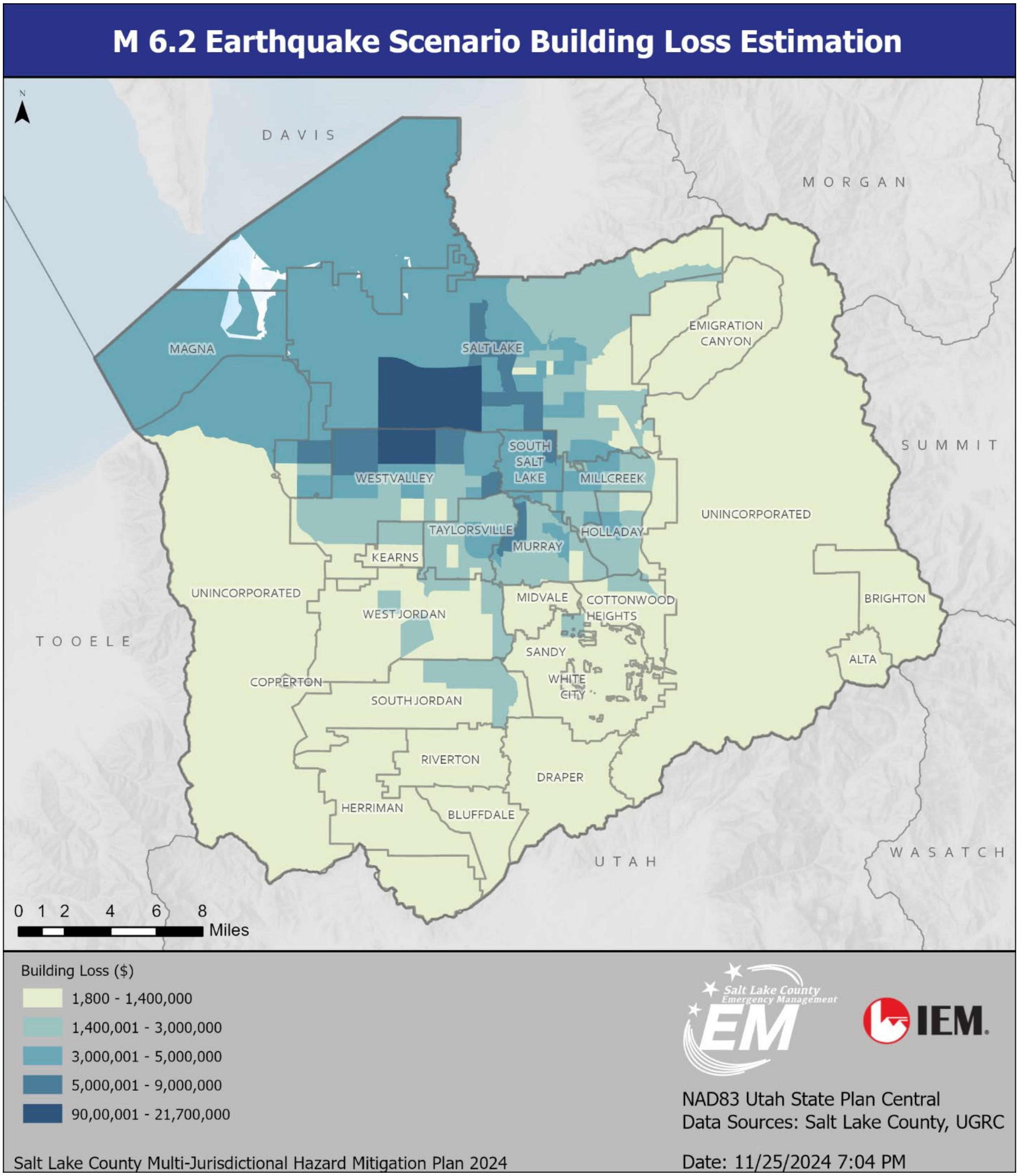



**Figure 85: M 6.2 ShakeMap Scenario Building Loss Estimation**

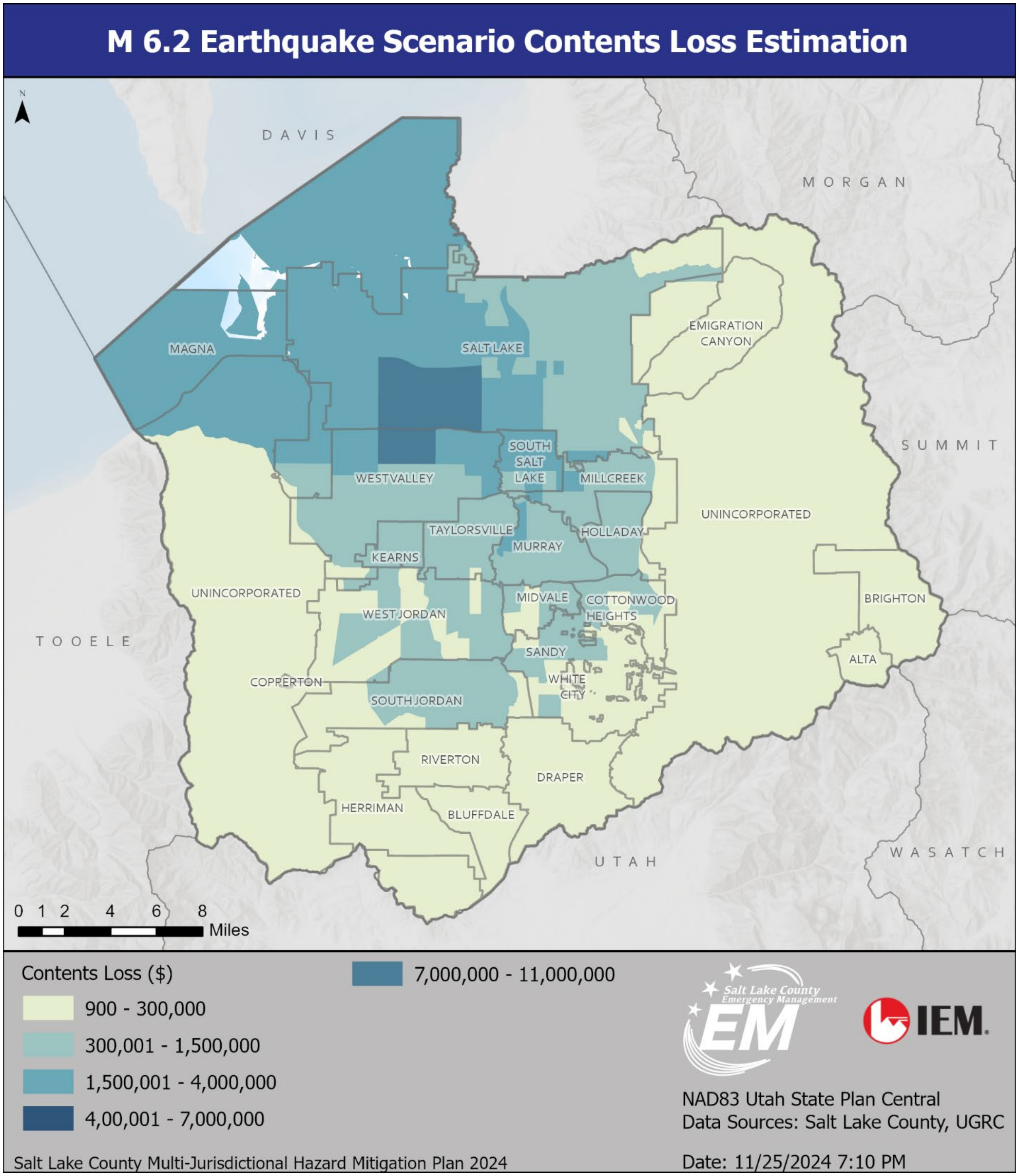



Figure 86: M 6.2 ShakeMap Scenario Contents Loss Estimation

Table 37 shows the extent of damage expected for different types of structures throughout the region. Hazus estimates that about 56,217 buildings will be at least moderately damaged. This is over 16% of the buildings in the region. An estimated 6,437 buildings will be damaged beyond repair.

**Table 37: Expected Building Damage by Occupancy Type**

| Occupancy Type | None | | Slight | | Moderate | | Extensive | | Complete | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Count | (%) | Count | (%) | Count | (%) | Count | (%) | Count | (%) |
| Agriculture | 246.76 | 0.10 | 39.64 | 0.06 | 22.89 | 0.07 | 11.70 | 0.07 | 5.01 | 0.08 |
| Commercial | 10,027.91 | 4.17 | 3,245.53 | 5.10 | 2,534.53 | 7.61 | 1,562.17 | 9.49 | 632.85 | 9.83 |
| Education | 269.04 | 0.11 | 65.55 | 0.10 | 69.19 | 0.21 | 39.03 | 0.24 | 12.19 | 0.19 |
| Government | 5,134.03 | 2.14 | 1,201.71 | 1.89 | 962.40 | 2.89 | 592.29 | 3.60 | 225.57 | 3.50 |
| Industrial | 3,230.14 | 1.34 | 1,339.66 | 2.11 | 1,339.49 | 4.02 | 1,075.74 | 6.54 | 417.97 | 6.49 |
| Other Residential | 12,296.04 | 1.34 | 5,784.62 | 9.10 | 4,554.51 | 13.67 | 2,710.81 | 16.47 | 950.02 | 14.76 |
| Religion | 733.82 | 0.31 | 182.80 | 0.29 | 116.31 | 0.35 | 91.47 | 0.56 | 31.60 | 0.49 |
| Single Family | 208,493.27 | 86.72 | 51,734.64 | 81.35 | 23,726.53 | 71.20 | 10,371.70 | 63.03 | 4,161.87 | 64.65 |
| **Total** | **240,431** | | **63,594** | | **33,326** | | **16,455** | | **6,437** | |

## POPULATION IMPACTS

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 accommodation in temporary public shelters. The model estimates that 6,735 households will be displaced due to the earthquake, with 4,458 individuals seeking temporary shelter in public shelters.

Hazus also estimates the number of people that will be injured and killed by the earthquake. The casualties are broken down into four severity levels that describe the extent of the injuries:

- **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.

Table 38 provides a summary of the casualties estimated for this earthquake. The casualty estimates are provided for three times of day: 2:00 AM, 2:00 PM, and 5:00 PM. These times represent the periods of the day when 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 38: Salt Lake County Earthquake Scenario Casualty Estimates**

| | | Level 1 | Level 2 | Level 3 | Level 4 |
|---|---|---|---|---|---|
| **2 AM** | **Commercial** | 26.97 | 7.15 | 1.08 | 2.13 |
| | **Commuting** | 0.08 | 0.10 | 0.17 | 0.03 |
| | **Educational** | 0.00 | 0.00 | 0.00 | 0.00 |
| | **Hotels** | 2.98 | 0.73 | 0.10 | 0.19 |
| | **Industrial** | 27.01 | 7.27 | 1.11 | 2.18 |
| | **Other Residential** | 1291.46 | 324.93 | 46.47 | 91.27 |
| | **Single Family** | 2749.04 | 682.78 | 98.69 | 194.03 |
| | **Total** | **4,098** | **1,023** | **148** | **290** |
| **2 PM** | **Commercial** | 1959.21 | 514.34 | 78.24 | 152.75 |
| | **Commuting** | 0.70 | 0.90 | 1.56 | 0.30 |
| | **Educational** | 550.07 | 132.73 | 19.33 | 37.56 |
| | **Hotels** | 0.58 | 0.14 | 0.02 | 0.04 |
| | **Industrial** | 199.45 | 53.69 | 8.22 | 16.01 |
| | **Other Residential** | 431.92 | 111.30 | 16.51 | 31.06 |
| | **Single Family** | 877.87 | 225.28 | 33.85 | 63.68 |
| | **Total** | **4,020** | **1,038** | **158** | **301** |
| **5 PM** | **Commercial** | 1458.40 | 379.78 | 58.19 | 111.58 |
| | **Commuting** | 15.09 | 19.47 | 33.67 | 6.48 |
| | **Educational** | 81.03 | 17.48 | 2.29 | 4.38 |
| | **Hotels** | 0.89 | 0.22 | 0.03 | 0.06 |
| | **Industrial** | 124.65 | 33.55 | 5.14 | 10.01 |
| | **Other Residential** | 515.62 | 132.97 | 19.74 | 37.14 |
| | **Single Family** | 1109.14 | 283.62 | 42.55 | 80.05 |
| | **Total** | **3,305** | **867** | **162** | **250** |

## TRANSPORTATION AND UTILITY LIFELINE LOSSES

For the transportation and utility lifeline systems, Hazus computes the direct repair cost for each component only. Hazus does not compute losses for business interruptions due to lifeline outages. Losses for the transportation and utility systems are displayed separately in Table 39–Table 44.

**Table 39: Expected Damage to Transportation Systems**

| System | Component | Number of Locations | | | | |
|---|---|---|---|---|---|---|
| | | Locations/ Segments | With at Least Moderate Damage | With Complete Damage | With Functionality > 50 % | |
| | | | | | After Day 1 | After Day 7 |
| Highway | Segments | 368 | 0 | 0 | 368 | 368 |
| | Bridges | 611 | 9 | 0 | 605 | 605 |
| | Tunnels | 0 | 0 | 0 | 0 | 0 |
| Railways | Segments | 287 | 0 | 0 | 287 | 287 |
| | Bridges | 74 | 0 | 0 | 74 | 74 |
| | Tunnels | 0 | 0 | 0 | 0 | 0 |
| | Facilities | 6 | 0 | 0 | 6 | 6 |
| Light Rail | Segments | 4 | 0 | 0 | 4 | 4 |
| | Bridges | 0 | 0 | 0 | 0 | 0 |
| | Tunnels | 0 | 0 | 0 | 0 | 0 |
| | Facilities | 50 | 0 | 0 | 50 | 50 |
| Bus | Facilities | 2 | 1 | 0 | 2 | 2 |
| Ferry | Facilities | 0 | 0 | 0 | 0 | 0 |
| Port | Facilities | 0 | 0 | 0 | 0 | 0 |
| Airport | Facilities | 4 | 0 | 0 | 4 | 4 |
| | Runways | 5 | 0 | 0 | 5 | 5 |

**Table 40: Transportation System Economic Losses (in Millions of Dollars)**

| System | Component | Inventory Value | Economic Loss | Loss Ratio |
|---|---|---|---|---|
| **Highway** | Segments | $4,634.60 | $0.00 | $0.00 |
| | Bridges | $3,442.01 | $144.30 | $4.19 |
| | Tunnels | $0.00 | $0.00 | $0.00 |
| | **Subtotal** | **$8,076.61** | **$144.30** | |
| **Railways** | Segments | $4,009.38 | $0.00 | $0.00 |
| | Bridges | $327.45 | $4.38 | $1.34 |
| | Tunnels | $0.00 | $0.00 | $0.00 |
| | Facilities | $15.98 | $4.56 | $28.54 |
| | **Subtotal** | **$4,352.81** | **$8.94** | |
| **Light Rail** | Segments | $1,106.21 | $0.00 | $0.00 |
| | Bridges | $0.00 | $0.00 | $0.00 |
| | Tunnels | $0.00 | $0.00 | $0.00 |
| | Facilities | $285.50 | $83.92 | $18.88 |

| System | Component | Inventory Value | Economic Loss | Loss Ratio |
|---|---|---|---|---|
| | **Subtotal** | **$1,391.71** | **$83.92** | |
| **Bus** | Facilities | $3.55 | $0.73 | $20.70 |
| | **Subtotal** | **$3.55** | **$0.73** | |
| **Ferry** | Facilities | $0.00 | $0.00 | $0.00 |
| | **Subtotal** | **$0.00** | **$0.00** | |
| **Port** | Facilities | $0.00 | $0.00 | $0.00 |
| | **Subtotal** | **$0.00** | **$0.00** | |
| **Airport** | Facilities | $971.61 | $270.27 | $27.82 |
| | Runways | $79.05 | $0.00 | $0.00 |
| | **Subtotal** | **$1,050.67** | **$270.27** | |
| **Total** (Millions of Dollars) | | **$14,875.35** | **$14,875.34** | **$478.16** |

**Table 41: 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** | 10 | 4 | 0 | 3 | 10 |
| **Natural Gas** | 1 | 0 | 0 | 1 | 1 |
| **Oil Systems** | 2 | 1 | 0 | 1 | 2 |
| **Electrical Power** | 10 | 5 | 0 | 6 | 79 |
| **Communication** | 41 | 4 | 0 | 39 | 41 |

**Table 42: Expected Utility System Pipeline Damage (Site Specific)**

| System | Total Pipelines Length (miles) | Number of Leaks | Number of Breaks |
|---|---|---|---|
| **Potable Water** | 4,616 | 0 | 0 |
| **Wastewater** | 2,770 | 0 | 0 |
| **Natural Gas** | 38 | 0 | 0 |
| **Oil** | 0 | 0 | 0 |

**Table 43: 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** | 405,229 | 0 | 0 | 0 | 0 | 0 |
| **Electric Power** | | 31,015 | 18,222 | 6,502 | 411 | 44 |

**Table 44: Utility System Economic Losses (Millions of Dollars)**

| System | Component | Inventory Value | Economic Loss | Loss Ratio (%) |
|---|---|---|---|---|
| **Potable Water** | Pipelines | $0.00 | $0.00 | 0.00 |
| | Facilities | $0.00 | $0.00 | 0.00 |
| | Distribution Lines | $148.58 | $0.00 | 0.00 |
| | **Subtotal** | **$148.58** | **$0.00** | |
| **Wastewater** | Pipelines | $0.00 | $0.00 | 0.00 |
| | Facilities | $1,337.24 | $162.27 | 12.13 |
| | Distribution Lines | $89.15 | $0.00 | 0.00 |
| | **Subtotal** | **$1,426.39** | **$162.27** | |
| **Natural Gas** | Pipelines | $149.30 | $0.00 | 0.00 |
| | Facilities | $129.54 | $0.53 | 0.41 |
| | Distribution Lines | $59.43 | $0.00 | 0.00 |
| | **Subtotal** | **$338.27** | **$0.53** | |
| **Oil Systems** | Pipelines | $0.00 | $0.00 | 0.00 |
| | Facilities | $0.20 | $0.03 | 14.23 |
| | **Subtotal** | **$0.20** | **$0.03** | |
| **Electrical Power** | Facilities | $1,976.58 | $508.30 | 25.72 |
| | **Subtotal** | **$1,976.58** | **$508.30** | |
| **Communication** | Facilities | $4.02 | $0.40 | 9.97 |
| | **Subtotal** | **$4.02** | **$0.40** | |
| **Total** (Millions of Dollars) | | **$3,894.04** | **$671.53** | |



## FIRE FOLLOWING EARTHQUAKE

Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight them, they can often burn out of control. Hazus uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burned area. For this scenario, the model estimates five ignitions, burning about 0.02 square miles of the region's total area, displacing approximately 157 people, and causing $8 million in building damage.

### DEBRIS GENERATION

Hazus estimates the amount of debris that will be generated by the earthquake. The model classifies 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—70% reinforced concrete/steel and 30% brick/wood—requiring an estimated 90,320 truckloads (25 tons/truck) for removal.

### VULNERABLE POPULATIONS

When buildings collapse, contents fall, or roads and bridges are damaged, people may be trapped or injured, with severe injuries potentially resulting in death. Entire communities may become displaced and emergency services may be strained beyond their capacity. This can cause lasting effects on people's physical and emotional well-being.

Long-term disruption of infrastructure and utility systems, interruption of government services, and lasting economic impacts are difficult for the entire community. However, vulnerable populations may experience more severe effects from these losses. Lower-income households may live in older or less well-maintained housing that may suffer more damage, placing residents more at risk of injury. They may struggle to find temporary housing and lack the financial reserves needed to sustain them through wage losses from business closures or other economic hardships. Elderly or other medically vulnerable populations, as well as people with disabilities, may have more difficulty receiving their normal care and services. Language barriers may make it more difficult for some to seek or access recovery services.

### COMMUNITY LIFELINES

Lifelines are the most fundamental services in the community that, when stabilized, enable all other aspects of society to function. Community lifelines are essential for the well-being of any community. They provide support and assistance to individuals who require help, especially during times of crisis. FEMA Community Lifelines are a critical component of emergency management in the United States. These lifelines are designed to address the essential needs of a community during and after a disaster. Community lifelines help create a sense of safety and security within a community. They provide a safety net for individuals who may be struggling and offer comfort and reassurance that help is available when needed. Without these lifelines, communities would be much more vulnerable to crises and emergencies. There are eight lifelines, each with its own focus and purpose:


**Figure 87: FEMA Community Lifelines**[92]

Any and possibly all community lifelines could be impacted by an earthquake. The immediate concern is for the safety and security of the people in the areas with the highest shaking intensity. It is reasonable to expect that access to food, water, shelter, and healthcare will be compromised for many people. Earthquakes are destructive to power distribution networks, water systems, roadways and railways, and communication systems. The release of hazardous materials is also a possibility.

## CHANGES IN DEVELOPMENT

Older buildings, typically those built before 1975, used different construction processes that will not hold up in the event of an earthquake. Unreinforced masonry homes (URM) with brick walls and/or a brick chimney are common in Salt Lake County and are particularly susceptible to damage from earthquakes.

On December 22, 2020, FEMA announced an award of more than $3.7 million to Salt Lake City. The funds are the federal cost share for the "Fix the Bricks" mitigation project to address the threat of structural collapse of residential URM structures during an earthquake event.[93] The project funds the seismic retrofitting of 216 residential URM structures, including seismic wall-to-roof retrofits, URM chimney bracing, and marketing efforts to inform the public about the project. This project aims to reduce the likelihood of structural collapse, enabling occupants to escape and reducing injury and loss of life. FEMA is providing a 75% federal cost-share for the $5 million project. Funding is provided through FEMA's Pre-Disaster Mitigation grant program, which is designed to assist states, U.S. territories, federally recognized tribes, and local communities in implementing a sustained pre-disaster natural hazard mitigation program. The goal is to reduce overall risk to the population and structures from future hazard events while also reducing reliance on federal funding in future disasters.[94]

[92] FEMA. "Community Lifelines." https://www.fema.gov/emergency-managers/practitioners/lifelines
[93] SLC.gov. "Fix the Bricks – Salt Lake City Seismic Retrofit." 2024. https://www.slc.gov/housingstability/city-housing-programs/fix-the-bricks/
[94] FEMA. "FEMA Provides Salt Lake City $3.7 Million for Seismic Retrofitting," Press Release. December 22, 2020. https://www.fema.gov/press-release/20210318/fema-provides-salt-lake-city-37-million-seismic-retrofitting

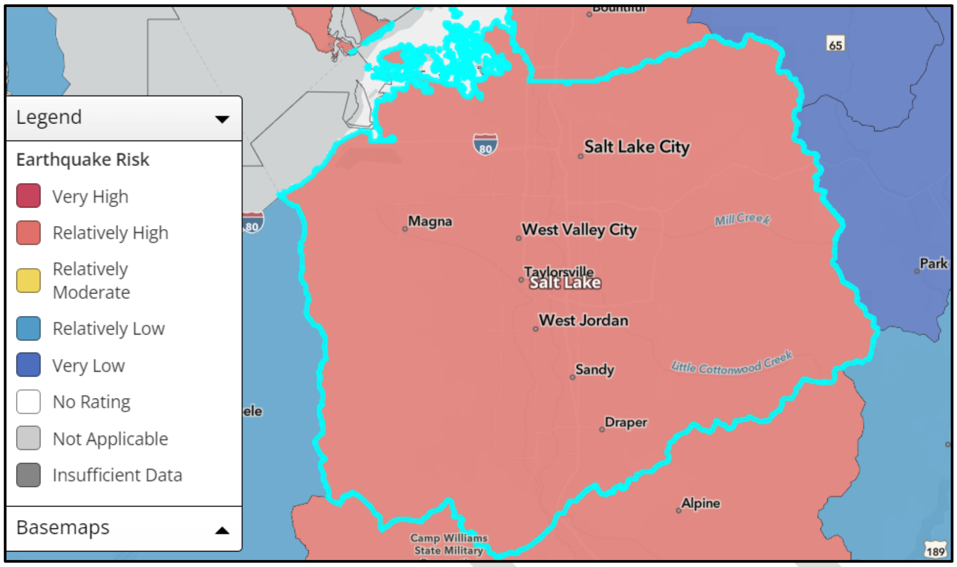
This program has the potential to reduce earthquake vulnerability. However, in 2024, the Fix the Bricks program currently has a three-to-five-year waiting list of homeowners seeking mitigation assistance funding. For these individuals, vulnerability remains the same.

**Figure 88: Salt Lake County Building Earthquake Repair Project[95]**

## VULNERABILITY SCORE

To analyze the county's vulnerability to earthquakes, the National Risk Index (NRI) was used as a primary tool during the 2024 update. The NRI defines risk as the potential for negative impacts due to a natural hazard. It determines a community's risk relative to other communities by examining the expected annual loss and social vulnerability in a given community in relation to that community's resilience. Salt Lake County's NRI earthquake risk rating is shown in Figure 89. Salt Lake County has a relatively high earthquake risk, with a risk score of 99.6.

[95] SLC.gov. "Fix the Bricks – Salt Lake City Seismic Retrofit." 2024. https://www.slc.gov/housingstability/city-housing-programs/fix-the-bricks/



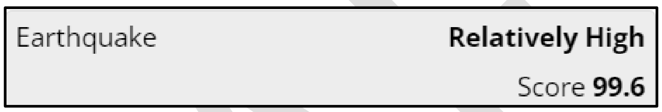




**Figure 89: National Risk Index Earthquake Risk Map, Legend, and Score for Salt Lake County**[96]

[96] FEMA, National Risk Index. "Salt Lake County Earthquake Score, Map and Legend." https://hazards.fema.gov/nri/map

# Extreme Cold

## Hazard Description

Utah frequently experiences extreme temperatures. Winter months often feature temperatures below zero degrees Fahrenheit; however, prolonged periods of extremely cold weather occur infrequently. An exception was January 2013, which was the coldest month on record for Salt Lake City since 1949. Extreme cold in the region can cause hypothermia and frostbite—with the young, elderly, homeless, and animals especially vulnerable—and can also disrupt agriculture, livestock, and crops. Wind chill can enhance the effects of extreme cold.

## Hazard Profile

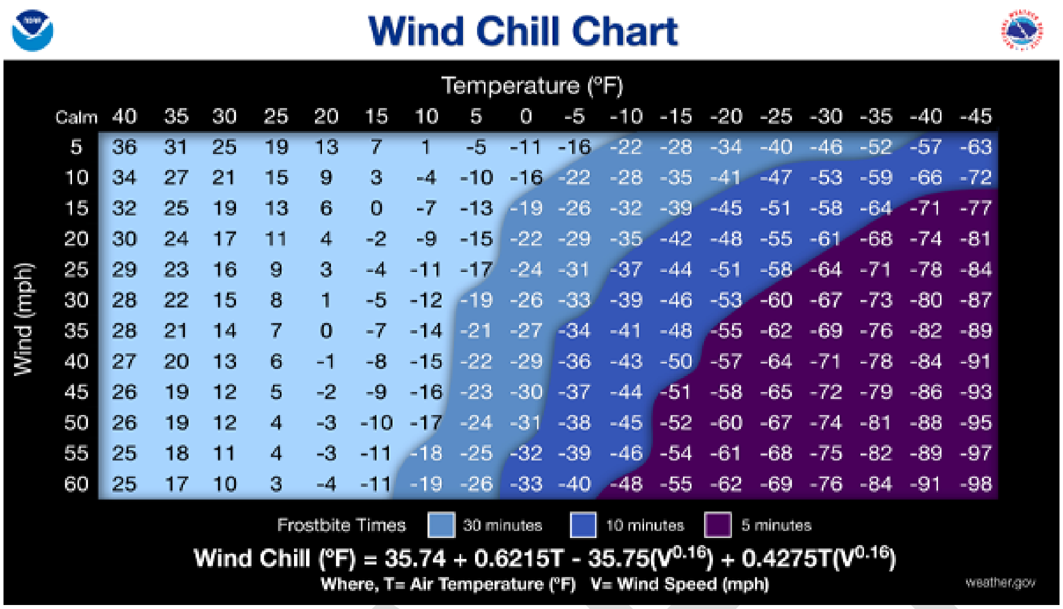
| **Potential Impact** | | Catastrophic | **Probability** | X | Highly Likely |
|---|---|---|---|---|---|
| | X | Critical | | | Likely |
| | | Limited | | | Occasional |
| | | Negligible | | | Unlikely |
| **Location** | Can occur in areas throughout the entire county | | | | |
| **Seasonal Pattern** | Winter months | | | | |
| **Conditions** | Vary based on latitude, elevation, aspect, and landforms | | | | |
| **Duration** | Extreme cold conditions generally last for several hours; some conditions can persist for days. | | | | |
| **Secondary Hazards** | Secondary hazards include transportation disruption and infrastructure damage and failure, including power outages. | | | | |
| **Analysis Used** | National Centers for Environmental Information, National Weather Service, UDEM, local input, and review of historic events and scientific records | | | | |

## Magnitude/Extent

The wind chill temperature is how cold people feel when they are outside based on the rate of heat loss from exposed skin. As wind speed increases, it draws heat from the body, driving down skin temperature and eventually internal body temperature, which makes people feel much colder. The wind chill chart (Figure 90) shows how cold temperatures feel at various wind speeds.[97]

The lowest temperature ever recorded in Salt Lake City was -22ºF on January 25, 1949; the average minimum temperature in January in the county is 23ºF. These temperatures were recorded at the local weather station at the Salt Lake City International Airport. Utah recognizes Code Blue Alerts, which counties issue when temperatures are expected to drop to 18ºF, including wind chill, for 2 or more hours during a 24-hour period.

[97] National Weather Service. "Understanding Wind Chill." https://www.weather.gov/safety/cold-wind-chill-chart




| Wind (mph) \ Temperature (ºF) | 40 | 35 | 30 | 25 | 20 | 15 | 10 | 5 | 0 | -5 | -10 | -15 | -20 | -25 | -30 | -35 | -40 | -45 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5 | 36 | 31 | 25 | 19 | 13 | 7 | 1 | -5 | -11 | -16 | -22 | -28 | -34 | -40 | -46 | -52 | -57 | -63 |
| 10 | 34 | 27 | 21 | 15 | 9 | 3 | -4 | -10 | -16 | -22 | -28 | -35 | -41 | -47 | -53 | -59 | -66 | -72 |
| 15 | 32 | 25 | 19 | 13 | 6 | 0 | -7 | -13 | -19 | -26 | -32 | -39 | -45 | -51 | -58 | -64 | -71 | -77 |
| 20 | 30 | 24 | 17 | 11 | 4 | -2 | -9 | -15 | -22 | -29 | -35 | -42 | -48 | -55 | -61 | -68 | -74 | -81 |
| 25 | 29 | 23 | 16 | 9 | 3 | -4 | -11 | -17 | -24 | -31 | -37 | -44 | -51 | -58 | -64 | -71 | -78 | -84 |
| 30 | 28 | 22 | 15 | 8 | 1 | -5 | -12 | -19 | -26 | -33 | -39 | -46 | -53 | -60 | -67 | -73 | -80 | -87 |
| 35 | 28 | 21 | 14 | 7 | 0 | -7 | -14 | -21 | -27 | -34 | -41 | -48 | -55 | -62 | -69 | -76 | -82 | -89 |
| 40 | 27 | 20 | 13 | 6 | -1 | -8 | -15 | -22 | -29 | -36 | -43 | -50 | -57 | -64 | -71 | -78 | -84 | -91 |
| 45 | 26 | 19 | 12 | 5 | -2 | -9 | -16 | -23 | -30 | -37 | -44 | -51 | -58 | -65 | -72 | -79 | -86 | -93 |
| 50 | 26 | 19 | 12 | 4 | -3 | -10 | -17 | -24 | -31 | -38 | -45 | -52 | -60 | -67 | -74 | -81 | -88 | -95 |
| 55 | 25 | 18 | 11 | 4 | -3 | -11 | -18 | -25 | -32 | -39 | -46 | -54 | -61 | -68 | -75 | -82 | -89 | -97 |
| 60 | 25 | 17 | 10 | 3 | -4 | -11 | -19 | -26 | -33 | -40 | -48 | -55 | -62 | -69 | -76 | -84 | -91 | -98 |

Calm

$$\text{Wind Chill (ºF)} = 35.74 + 0.6215T - 35.75(V^{0.16}) + 0.4275T(V^{0.16})$$

Where, T= Air Temperature (ºF) V= Wind Speed (mph)

**Figure 90: National Weather Service Wind Chill Chart**

# Location

The entire region of Salt Lake County can be affected by extreme cold events. Temperatures and wind chill conditions vary with elevation and other local differences.

# Historical Events and Probability of Future Occurrences

As previously mentioned, the lowest temperature ever recorded in Salt Lake City was -22ºF in 1949. The National Oceanic and Atmospheric Administration (NOAA) recorded three cold/wind chill events within Salt Lake County from 1996 to 2024; however, NOAA did not record any deaths, injuries, or property damage as a result of such events. Despite this, it is important to note that these data do not capture all possible deaths or illnesses related to extreme cold. For example, in 2023, a local news article reported that at least 8 unsheltered people had died during the previous winter.[98] Future occurrences are considered to be likely based on a recurrence interval of one event approximately every 9 years.

Utah Code 35A-16-703, which became effective in 2023, establishes conditions for the Utah Department of Health and Human Services to identify Code Blue events. Code Blue Alerts disseminate details to the public and provide information to assist individuals experiencing homelessness during the event. This may include information regarding expansions of shelter capacity, provisions of temporary shelter (warming centers), or distributions of clothing and blankets.

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[98] Fredde, Ashley. "Utah Bill Aimed to Prevent Homeless Deaths in Winter Headed to Gov. Cox's Desk." KSL.com. March 8, 2023. https://www.ksl.com/article/50594793/utah-bill-aimed-to-prevent-homeless-deaths-in-winter-headed-to-gov-coxs-desk

## Climate Change Considerations

Evidence for increasing temperatures from climate change often focuses on extreme heat events. As noted in the Utah Enhanced State Hazard Mitigation Plan, there is also a possibility that future low temperatures may be less cold. Although this may reduce human health impacts from extreme cold, it could have other negative impacts. For example, warmer winters contribute to bark beetle infestations and tree die-off in forests. This is detrimental to various natural ecosystems and can also increase the risk of wildfire.

## Secondary Hazards

Freezing temperatures can lead to a variety of infrastructure disruptions. They can cause insulators to fail and conductors to break. Extreme cold has the added effect of making people turn up their heaters, which can cause a circuit overload and a resulting power outage. People turning on their lights and heaters in anticipation of the power being restored may extend an outage. These activities create high-power demand on fusing that may not be able to handle the stress of the load. Extreme cold can also cause water in pipes to freeze, leading to burst pipes and water damage.

## Vulnerability Assessment

All residents and infrastructure systems in the planning area are vulnerable to extreme cold, which is likely to affect the entire county. Extremely cold conditions may last for hours or even days. People are particularly vulnerable to extreme cold. Prolonged exposure can lead to hypothermia, frostbite, and death. Windy conditions can increase these risks.

Structures are not typically directly affected by extreme cold but may be affected by secondary hazards. Extreme cold can freeze water in pipes, causing them to burst. This can cause damage to water delivery systems as well as water damage to structures and roadways. Extreme cold can also impact power systems through increased demand.

Extreme cold can damage crops or harm livestock, resulting in economic losses. It can also be harmful to wildlife or other natural systems.

### ESTIMATED IMPACT AND POTENTIAL LOSSES

The National Risk Index (NRI) includes data on the expected annual losses due to individual natural hazards, historical losses, and overall risk at the county and Census tract levels. The NRI refers to extreme cold hazards as "cold wave risk." Salt Lake County's NRI expected annual loss (EAL) value for cold waves is $4,000, with a risk score of 32.9 and a rating of "very low" compared with the rest of the United States.

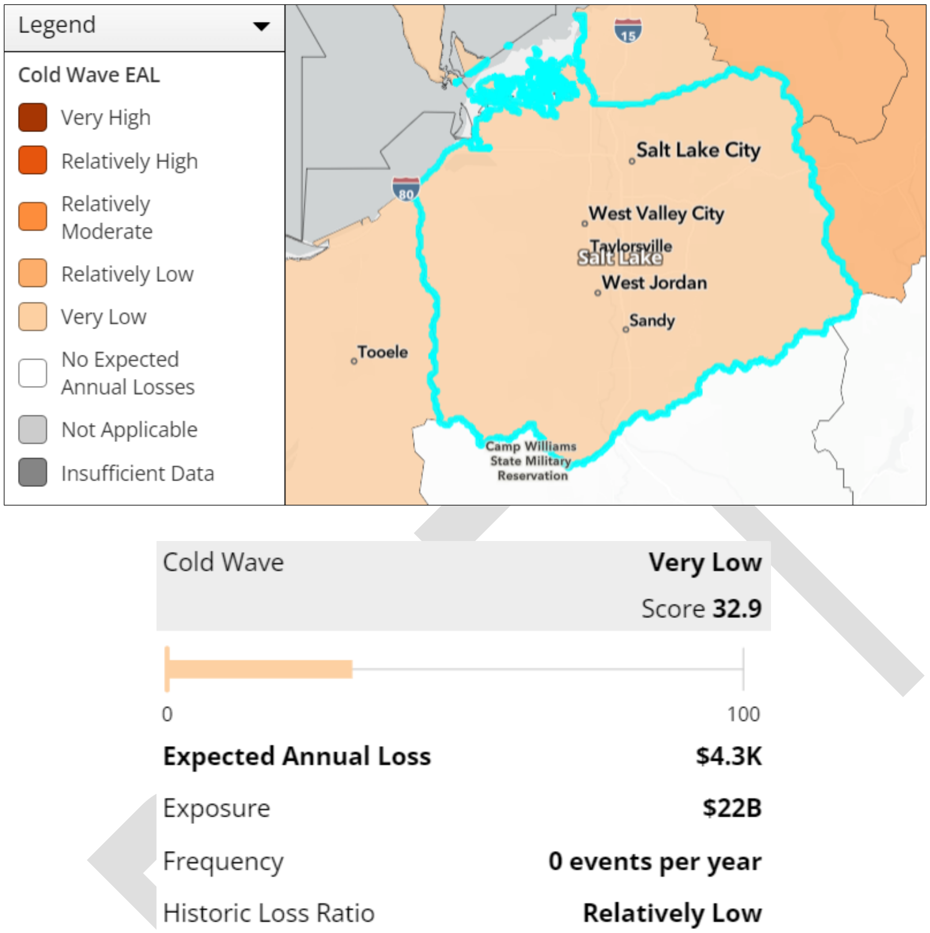


**Figure 91: FEMA National Risk Index, Salt Lake County EAL from Extreme Cold[99]**

## VULNERABLE POPULATIONS

Unhoused populations face the greatest risk of illness or death from exposure to extreme cold. Code Blue Alerts seek to provide emergency shelter for these individuals.

Homebound individuals, such as the elderly or persons with disabilities, who rely on home health supplies or other caregiving services may also be at risk if the power supply or other services are disrupted.

Low-income households are more likely to experience the impacts of extreme cold. They may lack adequate housing or may live in older homes that may have poor heating systems or lack insulation. Residents may be reluctant to use heat systems due to high energy costs. They may also face greater risks from seeking alternative heat sources. About 20% of winter fatalities occur inside the home, primarily

[99] Federal Emergency Management Agency. "National Risk Index." 2023. https://hazards.fema.gov/nri/map

when space heaters catch fire or people suffer from carbon monoxide poisoning from using alternative heating devices without proper ventilation.[100]

## COMMUNITY LIFELINES

Lifelines are the most fundamental services in a community that, when stabilized, enable all other aspects of society to function. Community lifelines are essential for the well-being of any community. They provide support and assistance to individuals who require help, especially during times of crisis. FEMA's Community Lifelines are a critical component of emergency management in the United States. These lifelines are designed to address the essential needs of a community during and after a disaster. There are eight lifelines, each with its own focus and purpose. Extreme cold can disrupt services across the safety and security, energy, transportation, and water sectors.


**Figure 92: FEMA Community Lifelines**[101]

The importance of these lifelines cannot be overstated. In a disaster, communities can be left without access to necessities such as food, water, and shelter. The lifelines help ensure that these needs are met and that people have the resources they need to survive. By providing access to medical care, public health services, and transportation, the lifelines enable people to receive the care they need and safely evacuate if necessary. In addition, the hazardous materials lifeline helps to ensure that dangerous materials are managed safely, reducing the risk of further harm.

Community lifelines help create a sense of safety and security in a community. They provide a safety net for individuals who may be struggling and offer comfort and reassurance that help is available when needed. Without these lifelines, communities would be much more vulnerable to crises and emergencies.

## CHANGES IN DEVELOPMENT

Since the last plan update, there has been a significant rise in cost of living, coupled with inflation, which has contributed to an increase in the county's unhoused population and made more individuals at risk of homelessness and extreme cold. The overall population size in the county has increased, which represents a rise in the number of people potentially exposed to the hazard. Extreme cold particularly

[100] Utah Department of Public Safety, Division of Emergency Management. "Utah Enhanced State Hazard Mitigation Plan 2024." 2024. https://hazards.utah.gov/state-of-utah-hazard-mitigation-plan/
[101] FEMA. "Community Lifelines." https://www.fema.gov/emergency-managers/practitioners/lifelines

affects unhoused populations, and the Salt Lake County Point-in-Time Count Summary indicates that the overall number of people experiencing homelessness in Salt Lake County has risen since 2018.[102] This also represents an increase in vulnerability to this hazard.

## VULNERABILITY SCORE

In the 2024 update, the NRI was used as the primary tool for analyzing the county's vulnerability to severe winter weather. The NRI defines risk as the potential for negative impacts as a result of a natural hazard and determines a community's risk relative to other communities by examining the EAL and social vulnerability of a given community in relation to that community's resilience. Salt Lake County's NRI cold wave risk rating is shown in. The county has a "very low" cold wave risk rating, and a risk score of 30.2.

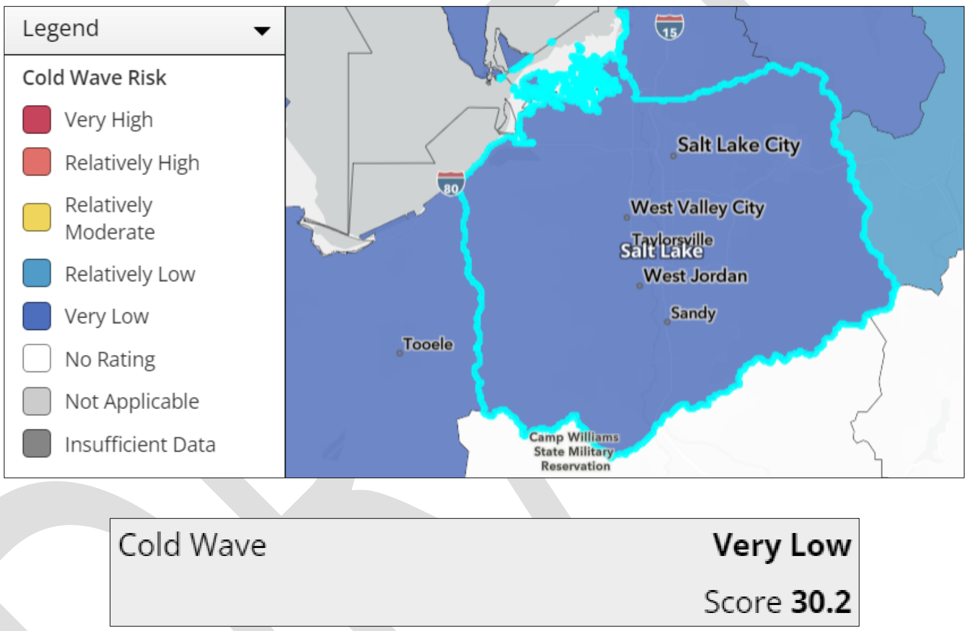


Figure 93: NRI Cold Wave Risk Map, Rating, and Score for Salt Lake County[103]



[102] Smith, Alex. "Salt Lake County CoC Point-in-Time Count Summary, 2018–2022." End Utah Homelessness, Salt Lake Valley. 2022. https://endutahhomelessness.org/wp-content/uploads/2022/08/SLC-PIT-Summary-2018-2022.pdf
[103] FEMA. "National Risk Index." 2023. https://hazards.fema.gov/nri/map

# Extreme Heat

## Hazard Description

Temperatures in Utah can be extreme. Summer temperatures are regularly in the nineties and exceed 100 degrees Fahrenheit on many days. Drastic temperature changes also occur, even in a matter of hours. Extreme heat can cause severe physical stress or illness in people.

Extreme heat is summertime weather that is substantially hotter and/or more humid than average for a location at that time of year. Extreme heat causes discomfort and can affect personal health 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.

## Hazard Profile

| **Potential Impact** | | Catastrophic | **Probability** | X | Highly Likely |
|---|---|---|---|---|---|
| | X | Critical | | | Likely |
| | | Limited | | | Occasional |
| | | Negligible | | | Unlikely |
| **Location** | Can occur in areas throughout the entire county | | | | |
| **Seasonal Pattern** | Summer months | | | | |
| **Conditions** | Vary based on latitude, elevation, aspect, and landforms | | | | |
| **Duration** | Extreme heat generally persists for days | | | | |
| **Secondary Hazards** | Drought, wildfire, health conditions | | | | |
| **Analysis Used** | National Climate Data Center, National Weather Service, UDEM, local input, and review of historic events and scientific records | | | | |

## Magnitude/Extent

The heat index is a measure of what different temperatures feel like to the human body. It combines air temperature with relative humidity, because humidity reduces the body's ability to cool itself through the evaporation of perspiration. Humidity is typically relatively low in Salt Lake County.

The highest temperature ever recorded in Salt Lake City was 107ºF on July 17, 2022. This year also had the highest number of days in one month with a temperature of 100ºF or greater, and 29 days above 95ºF.[104] The average maximum temperature in July in the county is around 91ºF.

[104] National Weather Service. "Salt Lake City Climate Book." 2024. https://www.weather.gov/slc/climatebook#PDFS

**NWS Heat Index** — Temperature (°F)

| Relative Humidity (%) | 80 | 82 | 84 | 86 | 88 | 90 | 92 | 94 | 96 | 98 | 100 | 102 | 104 | 106 | 108 | 110 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 40 | 80 | 81 | 83 | 85 | 88 | 91 | 94 | 97 | 101 | 105 | 109 | 114 | 119 | 124 | 130 | 136 |
| 45 | 80 | 82 | 84 | 87 | 89 | 93 | 96 | 100 | 104 | 109 | 114 | 119 | 124 | 130 | 137 | |
| 50 | 81 | 83 | 85 | 88 | 91 | 95 | 99 | 103 | 108 | 113 | 118 | 124 | 131 | 137 | | |
| 55 | 81 | 84 | 86 | 89 | 93 | 97 | 101 | 106 | 112 | 117 | 124 | 130 | 137 | | | |
| 60 | 82 | 84 | 88 | 91 | 95 | 100 | 105 | 110 | 116 | 123 | 129 | 137 | | | | |
| 65 | 82 | 85 | 89 | 93 | 98 | 103 | 108 | 114 | 121 | 128 | 136 | | | | | |
| 70 | 83 | 86 | 90 | 95 | 100 | 105 | 112 | 119 | 126 | 134 | | | | | | |
| 75 | 84 | 88 | 92 | 97 | 103 | 109 | 116 | 124 | 132 | | | | | | | |
| 80 | 84 | 89 | 94 | 100 | 106 | 113 | 121 | 129 | | | | | | | | |
| 85 | 85 | 90 | 96 | 102 | 110 | 117 | 126 | 135 | | | | | | | | |
| 90 | 86 | 91 | 98 | 105 | 113 | 122 | 131 | | | | | | | | | |
| 95 | 86 | 93 | 100 | 108 | 117 | 127 | | | | | | | | | | |
| 100 | 87 | 95 | 103 | 112 | 121 | 132 | | | | | | | | | | |

Likelihood of Heat Disorders with Prolonged Exposure or Strenuous Activity

Caution | Extreme Caution | Danger | Extreme Danger

**Figure 94: National Weather Service Heat Index Chart**

## Location

The entire county is at risk of extreme heat events. Most of the development in Salt Lake County has taken place in the central valley. One cascading impact of extreme heat is wildfire risk. The Wildfire Urban Interfaces has had significant development with Hi-Country Estates One and Two in unincorporated Salt Lake County, Draper, Mt. Aire, and Emigration Canyon. These areas are at high risk of wildfires, potentially resulting from drought related to extreme heat. Communities with dense development and with limited open green space are at greater risk during extreme heat events. Urban areas tend to absorb more heat and release it slower during the evening than rural areas, leading to overall higher temperatures. This is known as the urban heat island effect. Temperatures tend to be lower at the higher elevations in the mountainous areas of the county, but these areas can be affected when temperatures exceed typical levels.

## Historical Events and Probability of Future Occurrences

Based on the FEMA Disaster Declarations Database, Salt Lake County has received no designation for extreme heat disaster declarations since the last plan update.

As previously stated, the highest temperature ever recorded in Salt Lake City was 107ºF in 2022. The National Oceanic and Atmospheric Administration (NOAA) has not recorded any extreme heat events or any corresponding deaths or injuries within Salt Lake County. However, mild events have occurred with moderate regularity and will continue to occur in the future. The Climate Risk and Resilience Portal

(ClimRR) Heat Index Explorer provides a visual overview of the projected increase in maximum summer heat index values (Figure 95).[105]

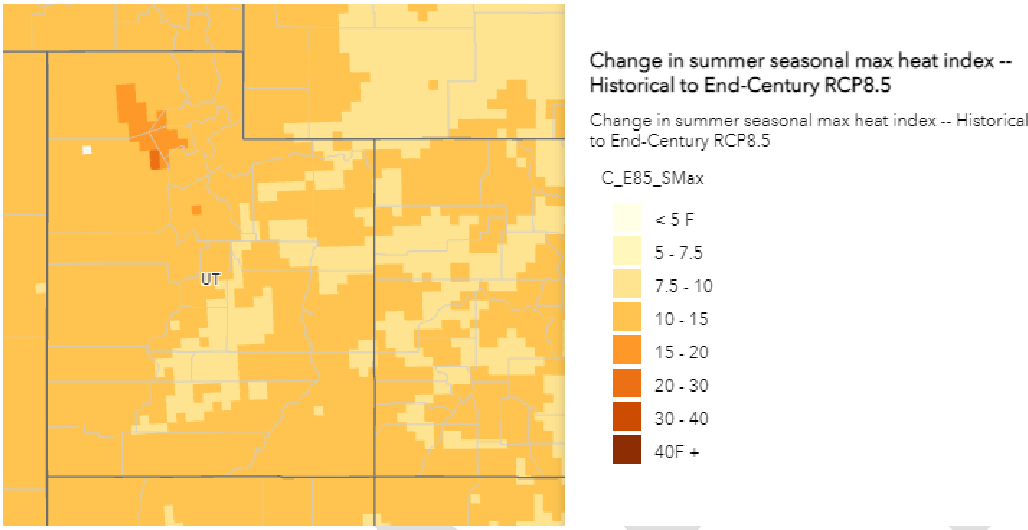


**Figure 95: ClimRR End-Century Heat Index Projection**

Salt Lake County experiences temperatures above 100˚F nearly every summer and 8 days each year on average. The record for the number of days over 100˚F was broken in 2022, with a total of 34 days. The frequency of past events indicates that future probability is highly likely.

## Climate Change Considerations

There is strong evidence showing that extreme heat will continue to increase with worsening climate change. The Climate Mapping for Resilience and Adaptation (CMRA) tool provides projections for future conditions of various hazards based on lower and higher emission scenarios for early, mid-, and late century. This tool projects a significant incline in the number of days with maximum temperatures exceeding 100ºF in mid- and late century for both emission models (Figure 96). It also projects an increase in the annual highest maximum temperature and in cooling-degree days, a measure of the energy needed for air conditioning or refrigeration.[106]

[105] Argonne National Laboratory. “ClimRR Heat Index Explorer.” 2023. https://disgeoportal.egs.anl.gov/portal/apps/webappviewer/index.html?id=06a52da514364cfab2eab106c247f6c3
[106] NOAA. “Climate Mapping For Resilience and Adaptation.” 2022. https://livingatlas.arcgis.com/assessment-tool/explore/details

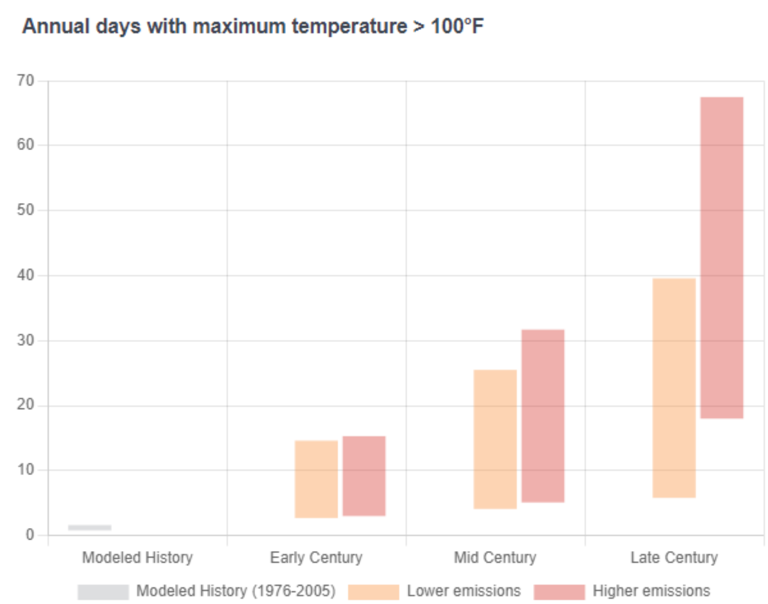


**Figure 96: Projected Number of Days Annually with Temperatures Exceeding 100ºF**

## Secondary Hazards

One of the most significant secondary hazards associated with excessive heat events is the failure of motorized systems, such as ventilation systems used to control temperatures inside buildings. In other parts of the country, extreme heat has contributed to widespread power outages. Heat can cause roads to buckle and may result in road closures for emergency repairs. Extreme heat can also raise the risk of wildfires as vegetation dries out, which allows fires to ignite and spread more rapidly. Furthermore, extreme heat can exacerbate drought conditions.

## Vulnerability Assessment

The primary concern with extreme heat is heat-related illnesses, such as dehydration, heat exhaustion, and heat stroke. This is especially concerning for the county in the summer event season. There are many summer events throughout the county, and if temperatures continue to increase and there are not adequate resources (EMS staff, drinking water, restrooms, shade), it can pose significant health issues. Heat can affect the entire county but may have disproportionate impacts on some populations. Increased demand for healthcare services can put a strain on providers. In addition, the population may not contribute as much to the local economy (eating out, festivals, etc.) because of the heat.

Heat can result in spikes in energy usage as demand for air conditioning increases. This can strain power grids and may lead to outages during peak usage. Increased energy usage raises financial costs for residents and businesses. Damage to roadways from heat-related buckling can require costly emergency repairs and may cause secondary disruptions while transportation routes are closed.

Natural systems can also be impacted by extreme heat. Rising temperatures can affect wildlife habitats, diminish the health of vegetation, and disrupt ecosystems. Extreme heat can contribute to an increase in evaporation rates, reduce water availability for agriculture and recreation, and exacerbate the effects of drought. Therefore, heat can lead to agricultural losses.

## ESTIMATED IMPACT AND POTENTIAL LOSSES

The National Risk Index (NRI) includes data on the expected annual losses attributed to individual natural hazards, historical losses, and overall risk at the county and Census tract levels. Salt Lake County's NRI expected annual loss (EAL) value for heat waves is $2.1 million, with a risk score of 95.3 and a rating of "relatively high" compared with the rest of the United States (Figure 97).

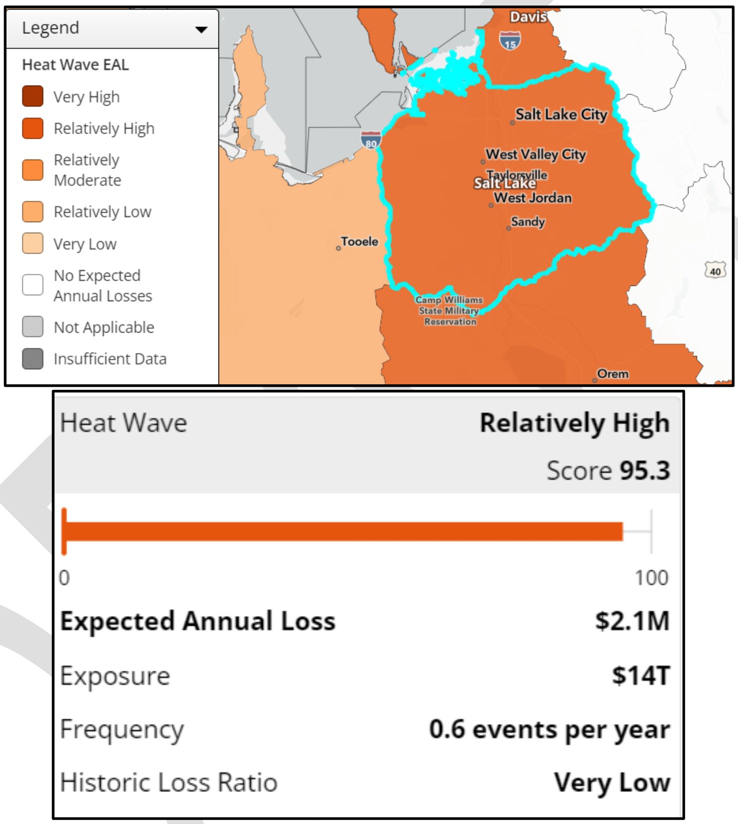


**Figure 97: FEMA National Risk Index, Salt Lake County EAL from Heat Wave[107]**

## VULNERABLE POPULATIONS

Several populations are more vulnerable to extreme heat events, face isolation and exposure during extreme heat events, or can suffer more secondary effects of the hazard. Young children and the elderly are more susceptible to extreme heat due to their bodies' inability to regulate temperature as effectively. The chronically ill and elderly may have underlying health conditions or take prescription medications that interfere with the body's ability to dissipate heat. Even young and healthy individuals can succumb to heat if they participate in strenuous physical activities during hot weather. Males tend to experience a higher

[107] FEMA. "National Risk Index." 2023. https://hazards.fema.gov/nri/map

rate of dehydration than females. Outdoor workers may not have enough breaks, adequate hydration, or a place to adequately cool themselves.

Extreme heat can disproportionately affect people with socio-economic disadvantages. Lower income households may not have functioning air conditioning or may be reluctant to use it due to energy costs. Unhoused populations are highly vulnerable to severe weather hazards. These individuals may seek access to public spaces to escape the heat.

## COMMUNITY LIFELINES

Lifelines are the most fundamental services in a community that, when stabilized, enable all other aspects of society to function. Community lifelines are essential for the well-being of any community. They provide support and assistance to individuals who require help, especially during times of crisis. FEMA Community Lifelines are a critical component of emergency management in the United States. These lifelines are designed to address the essential needs of a community during and after a disaster. There are eight lifelines, each with its own focus and purpose (Figure 98). Extreme heat primarily affects public health, which may impact demands on the health and medical lifeline, but it can also affect the energy and transportation lifelines.


**Figure 98: Community Lifelines**[108]

The importance of these lifelines cannot be overstated. In a disaster, communities can be left without access to necessities such as food, water, and shelter. The lifelines help ensure that these needs are met and that people have the resources they need to survive. By providing access to medical care, public health services, and transportation, the lifelines enable people to receive the care they need and safely evacuate if necessary.

Community lifelines help create a sense of safety and security in a community. They provide a safety net for individuals who may be struggling and offer comfort and reassurance that help is available when needed. Without these lifelines, communities would be much more vulnerable to crises and emergencies.

[108] FEMA. "Community Lifelines." https://www.fema.gov/emergency-managers/practitioners/lifelines

## CHANGES IN DEVELOPMENT

Potential impacts from extreme heat are loss of life/property, poor air quality, and power grid failure. As the population in Salt Lake County continues to grow, the potential for these negative impacts increases. Energy demands may also rise. In addition, the unhoused population has also grown in recent years, which creates more of a challenge to provide enough cooling centers throughout the county and the staffing necessary to adequately manage the cooling centers. Overall vulnerability to extreme heat has increased since the last plan update.

## VULNERABILITY SCORE

In the 2024 update, the NRI was used as the primary tool for analyzing the county's vulnerability to severe weather. The NRI defines risk as the potential for negative impacts as a result of a natural hazard and determines a community's risk relative to other communities by examining the EAL and social vulnerability of a given community in relation to that community's resilience. Salt Lake County's NRI heat wave risk rating is shown in Figure 99. The county has a "relatively moderate" heat wave risk rating, and a risk score of 94.6.

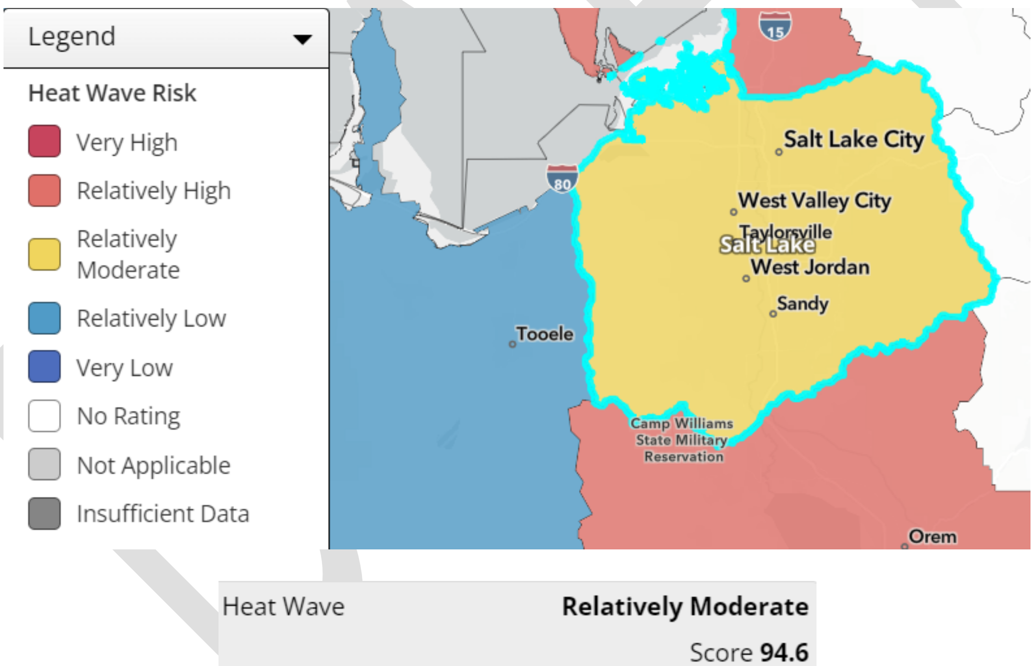


**Figure 99: NRI Heat Wave Risk Map, Rating and Score for Salt Lake County[109]**

[109] FEMA. "National Risk Index." 2023. https://hazards.fema.gov/nri/map

# Flooding (Urban/Flash Flooding and Riverine Flooding)

## Hazard Description

Floods can be caused by 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, man-made 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.

### SPRING RUNOFF/SNOWMELT FLOODS

These are caused by rapid spring snowmelt of mountain snowpack. Intense spring rainfall contributes to 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. Snowmelt risk is greatest when snowpack is at or above normal levels and/or accompanied by an abrupt warming trend.

### FLASH FLOODS

Flash floods are caused by intense thunderstorms and the resulting heavy rainfall. Heavy rainfall may occur in areas of sparse vegetation, steep slopes, and impervious surfaces, and is then channeled into smaller waterways or conduits. Once runoff begins to accumulate across the basin, its volume and speed typically increase rapidly. Flash flood events, while often short-lived, are very dangerous for those caught in a confined area, such as a canyon, when the flood occurs. Flash flooding has caused 34 fatalities in Utah since 1950. In 2015, there were 20 fatalities, including seven at Zion National Park.

Areas of localized flooding may occur in urban areas not associated with existing waterways. Rain may accumulate in low-lying areas with no outlet or where storm drains have become overwhelmed. These types of floods 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 typically occur in the fall or winter months. They are produced by large synoptic weather systems originating out of the south, southwest, or west that produce rainfall for an extended period. The rainfall may cause some snow to melt, potentially causing more significant runoff. This occurs mainly in the southern half of the state.

### 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 soil in a hydrophobic state, resulting in greater peak flows. This issue will be discussed further in the landslide section.

## Hazard Profile

| | | | | | |
|---|---|---|---|---|---|
| **Potential Magnitude** | | Catastrophic | **Probability** | X | Highly Likely |
| | X | Critical | | | Likely |
| | | Limited | | | Occasional |
| | | Negligible | | | Unlikely |
| **Location** | Largely in and along floodplains; debris flows can cause natural damming of water if nearby streams become blocked | | | | |
| **Seasonal Conditions** | Spring, heavy rainfall, and spring snowmelt runoff | | | | |
| **Conditions** | Thunderstorms with 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 Flood Insurance Study (FIS), Flood Insurance Rate Map (FIRM), U.S. Army Corps of Engineers Flood Study, Hazus | | | | |

## Magnitude/Extent

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% 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 “1% annual exceedance probability.”
- **0.2% Special Flood Hazard Area (500-year flood):** A 0.2% (500-year) floodplain is an area at risk for flooding from a creek or other waterway overflowing during a 0.2% (500-year) flood. Structures located in a 0.2% (500-year) floodplain have a minimum of a 0.2% 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, occurring from April through June along the major existing streams and waterways. High-intensity, short-duration heavy rainfall occurs over a relatively small area in the summer months. However, flooding can also occur due to 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 implemented following the major floods of 1983–84 have greatly reduced the flood threat.

The flow of the Jordan River from Utah Lake into Salt Lake County is controlled, somewhat reducing the flood potential 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 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-year and 500-year flood event can be found in the Vulnerability Assessment portion of this hazard profile.

## Historical Events and Probability of Future Occurrences

Based on the FEMA Disaster Declarations database, Salt Lake County has received no designation for flooding Disaster Declarations since the last plan update.

According to NOAA data, there have been 44 flood/flash flood events in Salt Lake County since 1996. Total property damages were approximately $31.627 million, with an additional $1,000 in crop damages.

**Figure 100: Image of Flooded Road[110]**

The following flood events are of notable significance:

- **April 13, 2023:** A State of Emergency was declared for Salt Lake County over the spring runoff flooding that affected the Wasatch Front. The areas most affected by the flooding were along Red Butte Creek, Emigration Creek, City Creek, Big Cottonwood Creek, Little Cottonwood Creek, and Millcreek. Voluntary evacuations along Emigration Creek in downtown Salt Lake City included the evacuation of up to 40 homes.
- **2017:** Thunderstorms producing heavy rainfall moved into the Salt Lake Valley in the early morning hours of July 26 and persisted for three to four hours, producing widespread flash flooding.
- **2015:** Heavy rain caused road, parking lot, and basement flooding in 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 (4,211.6 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, causing the flooding of City Creek in downtown Salt Lake City.
- **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

[110] Pixabay. https://pixabay.com/photos/flooded-road-flood-flooding-storm-5330617/

amount of mitigation was completed along the urban areas of the Wasatch Front. An advanced water-monitoring network of stream gauges, snow telemetry (SNOTEL) sites, and automated stream flow gates provided warnings of elevated flows. The State of Utah constructed a county flood control project that installed pumps on the Great Salt Lake to pump excess water into the west desert. Figure 101 shows the Salt Air Resort on the southeast shore of the Great Salt Lake during the flood years of the 1980s.

**Figure 101: Great Salt Lake Flooding, Salt Air Resort**

During the past 149 years, the Great Salt Lake has three times peaked over 4,211 feet above sea level: 4,211.60 feet in June 1873, 4,211.50 feet in June 1986, and 4,211.60 feet in June 1987. Figure 102 provides a chart showing statistical data on Great Salt Lake elevations from 2007 to 2024.

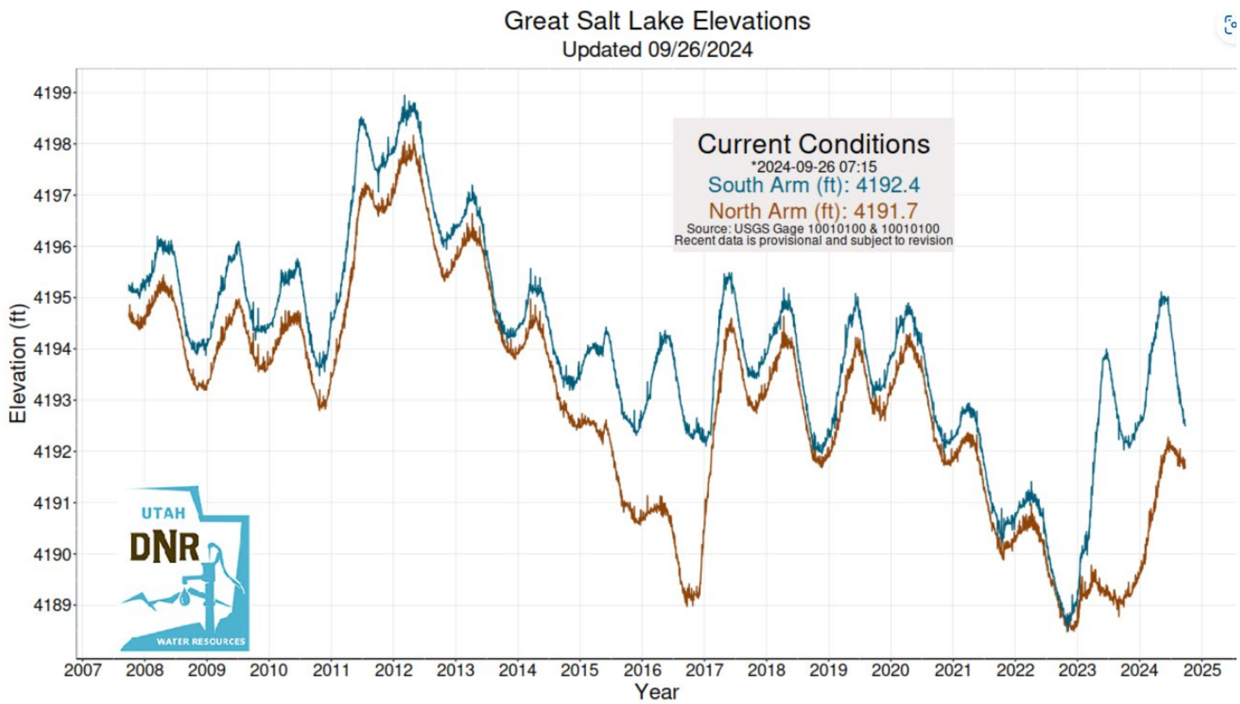


**Figure 102: Great Salt Lake Elevations (2007–2024)[111]**

Depending on the amount of snowfall in the winter and its melting speed, 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 recorded 32 flooding events from 1996 to 2018, for 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.

## Climate Change Considerations

The 2024 State Enhanced Hazard Mitigation Plan states that for decades, climate change experts, government reports, and academic literature have predicted an increase in precipitation intensity. The theoretical basis for these predictions was strong, though studies of actual trends in precipitation records did not detect significant changes in precipitation in the state of Utah.

One clear trend in precipitation with implications for flooding is the change in snowpack. Since 1955, the snowpack has peaked earlier, with a reduced season length. These trends are expected to continue into the foreseeable future. Due primarily to increasing air temperature, the proportion of precipitation that falls as snow will continue to decline. Warmer conditions are simply less likely to produce snow. Also, warmer conditions cause the snow line, the lowest elevation at which snow falls, to recede. As the snow line moves upward, the area receiving snowfall is reduced.

[111] Utah.gov, Utah Division of Water Resources. "Great Salt Lake Elevation Chart." 2024. https://greatsaltlake.utah.gov/current-conditions

## Secondary Hazards

One of the most problematic secondary hazards for flooding is bank erosion, which in some cases can be more harmful than the flooding itself. This is especially true in the upper courses of rivers with steep gradients, where floodwaters may pass quickly without causing much damage but may scour the banks, edging properties closer to the floodplain or causing them to fall in. This may also occur 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, this can put extreme stress on emergency housing and shelter capabilities, not to mention the social fabric of the community.

## Vulnerability Assessment

The vulnerability of people and infrastructure to flooding hazards in Salt Lake County was obtained from the modeling program Hazus. The Hazus flooding scenarios, which are the basis for the vulnerability and loss estimates provided in this section, entail both a 100-year and a 500-year flood occurring within Salt Lake County (1% and 0.2% annual risk, respectively). Hazus uses FEMA FIRM boundaries and digital elevation model data to generate flood depth grids and then uses these depth grids, general building stock data, and damage functions to estimate the level of damage to structures and other social and economic impacts on the region.

Hazus estimates that there are 360,243 buildings in the region with a total replacement value of $172 billion. Of the total building exposure, 61% is from residential structures. There are a total of 16 hospitals, 67 fire stations, 33 police stations, 18 emergency operations centers, and 422 schools.

### ESTIMATED IMPACT AND POTENTIAL LOSSES

#### ESSENTIAL FACILITY DAMAGE

Hazus estimates that there are 2 fire stations, 3 schools, and 4 county facilities within the area of the 100-year flood scenario for Salt Lake County. There is 1 emergency operations center, 22 county facilities, three fire stations, and 13 schools in the 500-year flood scenario. No essential facility is estimated to receive substantial or moderate damage from a 100-year event. For a 100-year event, 3 schools and 2 fire stations are estimated to receive at least moderate damage during the scenario, and 1 fire station and 3 schools are estimated to experience loss of use. For a 500-year event, 1 emergency operations center, 3 fire stations, 2 police stations, and 9 schools are estimated to receive at least moderate damage during the scenario; 4 schools are estimated to receive at least substantial damage; and 2 fire stations and 8 schools are estimated to experience loss of use.

Table 45 and Table 46 list the facilities within the 100-year and 500-year floodplain across various jurisdictions in Salt Lake County. For the 100-year floodplain, most areas, such as Alta, Bluffdale, Brighton, and Copperton, have no facilities at risk. However, Herriman, Millcreek, Salt Lake City, and

Sandy each have one county facility within the 100-year floodplain. Millcreek and Salt Lake City also have one fire station in the 100-year floodplain while West Valley has three schools at risk.

Much like the 100-year floodplain, the 500-year floodplain contains very few jurisdictions with facilities located within it. However, Salt Lake City has a significant number of facilities, including 1 fire station, 4 schools, and 6 county facilities. The South Salt Lake area also has a notable presence, with 1 emergency operations center, 1 fire station, 3 schools, and 5 county facilities. Other areas at risk include Millcreek, with 1 fire station and 2 schools, and West Valley, with 3 schools and 1 county facility. The areas of Cottonwood Heights, Herriman, Murray, Sandy, Taylorsville, and West Jordan each have at least one county facility within the 500-year floodplain. Figure 103–Figure 109 show the locations of these facilities.

**Table 45: Facilities Within the 100-Year Floodplain by Jurisdiction**

| Name | Emergency Operations Centers | Fire Stations | Hospitals | Police Stations | Schools | County Facilities |
|---|---|---|---|---|---|---|
| **Alta** | 0 | 0 | 0 | 0 | 0 | 0 |
| **Bluffdale** | 0 | 0 | 0 | 0 | 0 | 0 |
| **Brighton** | 0 | 0 | 0 | 0 | 0 | 0 |
| **Copperton** | 0 | 0 | 0 | 0 | 0 | 0 |
| **Cottonwood Heights** | 0 | 0 | 0 | 0 | 0 | 0 |
| **Draper** | 0 | 0 | 0 | 0 | 0 | 0 |
| **Emigration Canyon** | 0 | 0 | 0 | 0 | 0 | 0 |
| **Herriman** | 0 | 0 | 0 | 0 | 0 | 1 |
| **Holladay** | 0 | 0 | 0 | 0 | 0 | 0 |
| **Kearns** | 0 | 0 | 0 | 0 | 0 | 0 |
| **Magna** | 0 | 0 | 0 | 0 | 0 | 0 |
| **Midvale** | 0 | 0 | 0 | 0 | 0 | 0 |
| **Millcreek** | 0 | 1 | 0 | 0 | 0 | 1 |
| **Murray** | 0 | 0 | 0 | 0 | 0 | 0 |
| **Riverton** | 0 | 0 | 0 | 0 | 0 | 0 |
| **Salt Lake** | 0 | 1 | 0 | 0 | 0 | 1 |
| **Sandy** | 0 | 0 | 0 | 0 | 0 | 1 |
| **South Jordan** | 0 | 0 | 0 | 0 | 0 | 0 |
| **South Salt Lake** | 0 | 0 | 0 | 0 | 0 | 0 |
| **Taylorsville** | 0 | 0 | 0 | 0 | 0 | 0 |
| **Unincorporated** | 0 | 0 | 0 | 0 | 0 | 0 |
| **West Jordan** | 0 | 0 | 0 | 0 | 0 | 0 |
| **West Valley** | 0 | 0 | 0 | 0 | 3 | 0 |
| **White City** | 0 | 0 | 0 | 0 | 0 | 0 |

**Table 46: Facilities Within the 500-Year Floodplain by Jurisdiction**

| Name | Emergency Operations Centers | Fire Stations | Hospitals | Police Stations | Schools | County Facilities |
|---|---|---|---|---|---|---|
| Alta | 0 | 0 | 0 | 0 | 0 | 0 |
| Bluffdale | 0 | 0 | 0 | 0 | 0 | 0 |
| Brighton | 0 | 0 | 0 | 0 | 0 | 0 |
| Copperton | 0 | 0 | 0 | 0 | 0 | 0 |
| Cottonwood Heights | 0 | 0 | 0 | 0 | 0 | 3 |
| Draper | 0 | 0 | 0 | 0 | 1 | 1 |
| Emigration Canyon | 0 | 0 | 0 | 0 | 0 | 0 |
| Herriman | 0 | 0 | 0 | 0 | 0 | 1 |
| Holladay | 0 | 0 | 0 | 0 | 0 | 0 |
| Kearns | 0 | 0 | 0 | 0 | 0 | 0 |
| Magna | 0 | 0 | 0 | 0 | 0 | 0 |
| Midvale | 0 | 0 | 0 | 0 | 0 | 0 |
| Millcreek | 0 | 1 | 0 | 0 | 2 | 1 |
| Murray | 0 | 0 | 0 | 0 | 0 | 1 |
| Riverton | 0 | 0 | 0 | 0 | 0 | 0 |
| Salt Lake | 0 | 1 | 0 | 0 | 4 | 6 |
| Sandy | 0 | 0 | 0 | 0 | 0 | 1 |
| South Jordan | 0 | 0 | 0 | 0 | 0 | 0 |
| South Salt Lake | 1 | 1 | 0 | 0 | 3 | 5 |
| Taylorsville | 0 | 0 | 0 | 0 | 0 | 1 |
| Unincorporated | 0 | 0 | 0 | 0 | 0 | 0 |
| West Jordan | 0 | 0 | 0 | 0 | 0 | 1 |
| West Valley | 0 | 0 | 0 | 0 | 3 | 1 |
| White City | 0 | 0 | 0 | 0 | 0 | 0 |

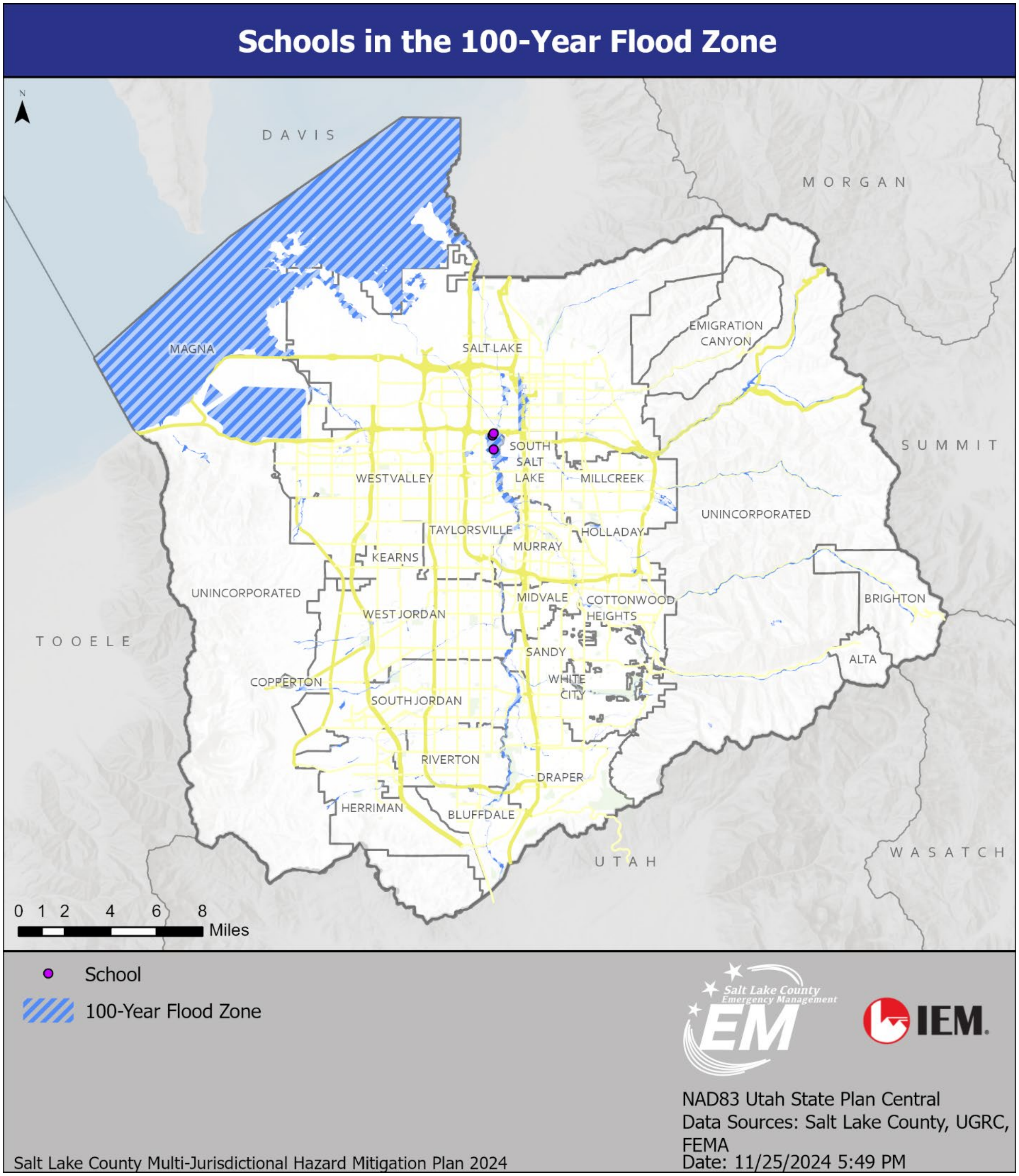


**Figure 103: Schools in the 100-Year Flood Zone**

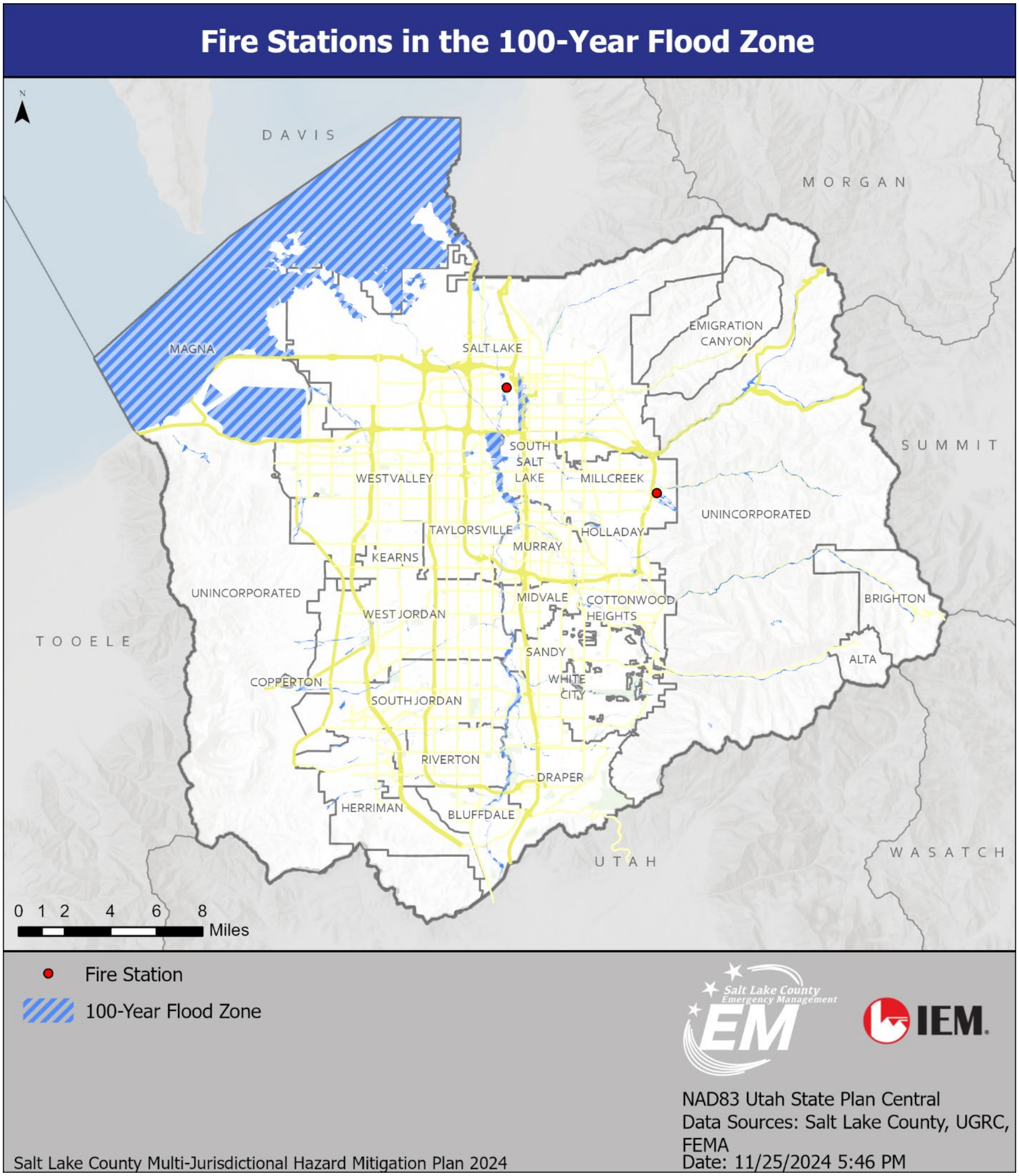


**Figure 104: Fire Stations in the 100-Year Flood Zone**

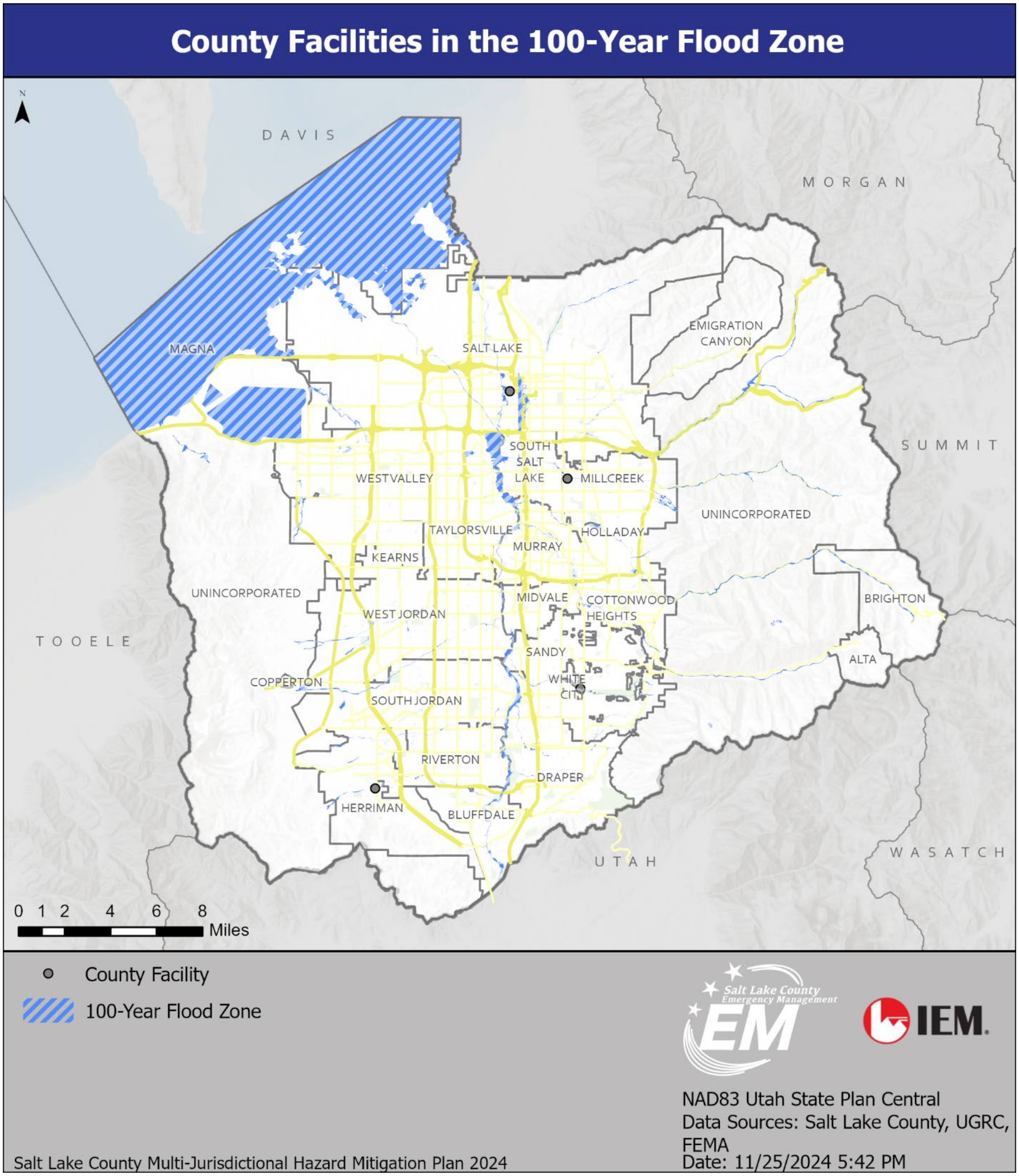


**Figure 105: County Facilities in the 100-Year Flood Zone**

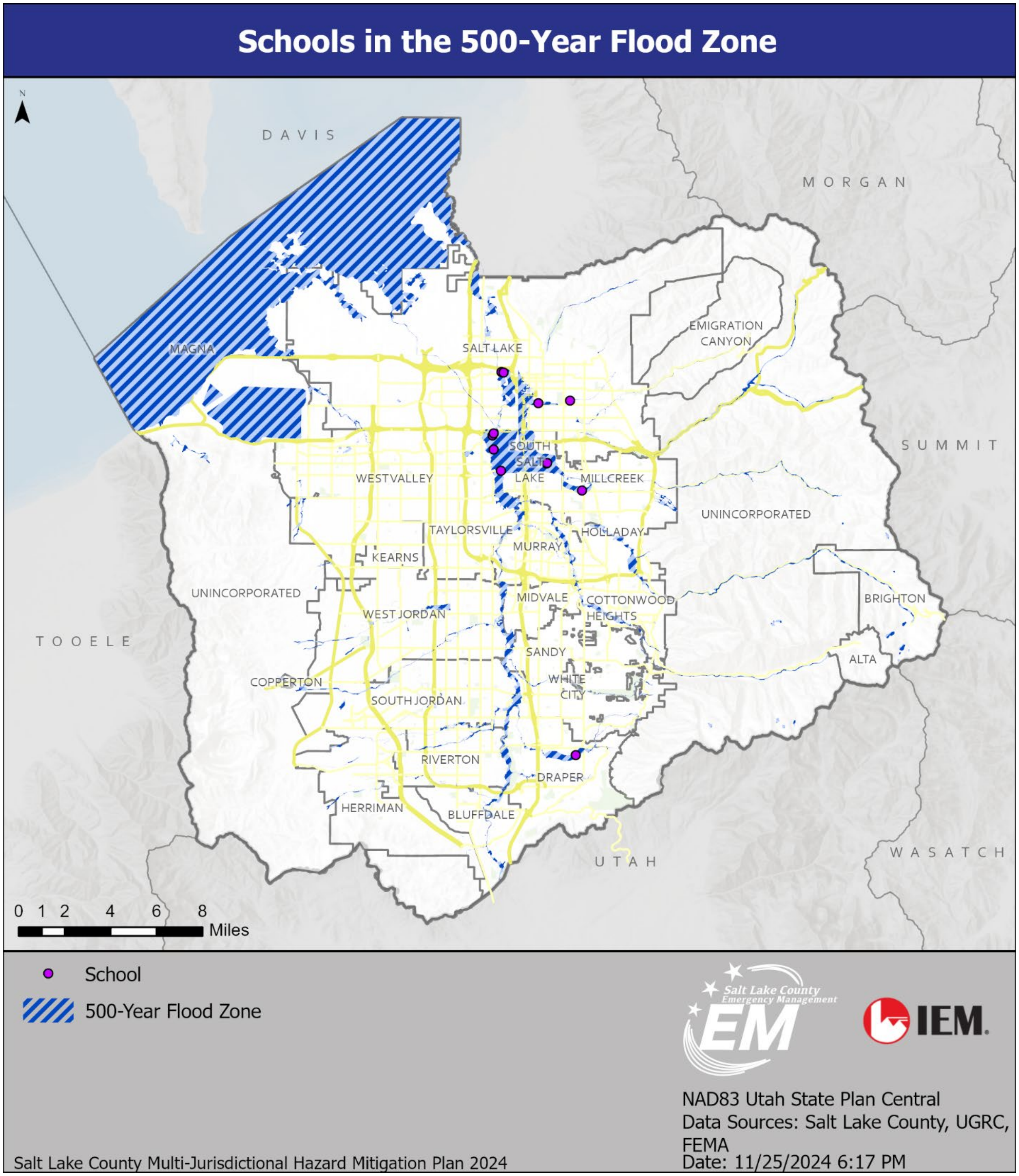


Figure 106: Schools in the 500-Year Flood Zone

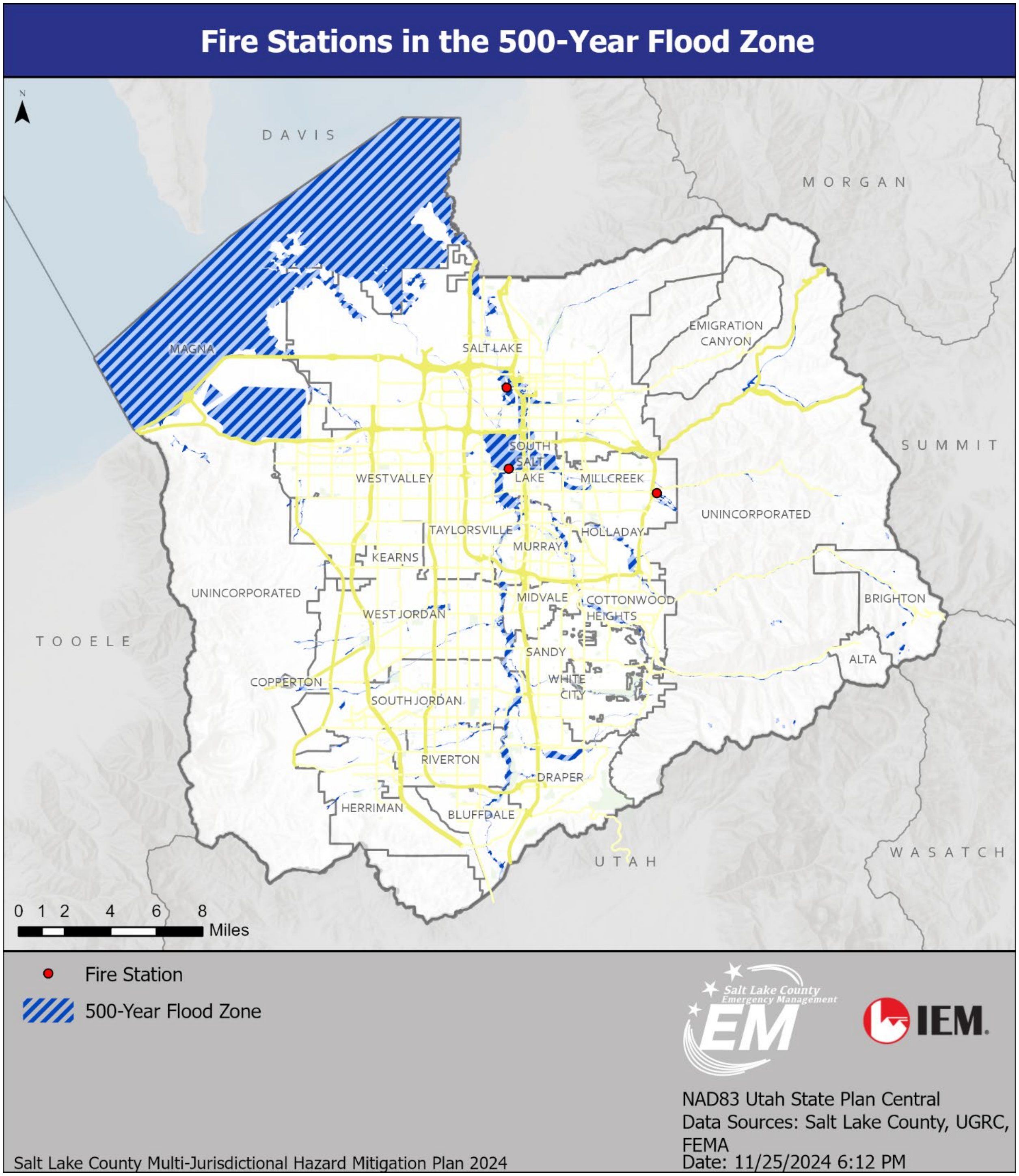


Figure 107: Fire Stations in the 500-Year Flood Zone

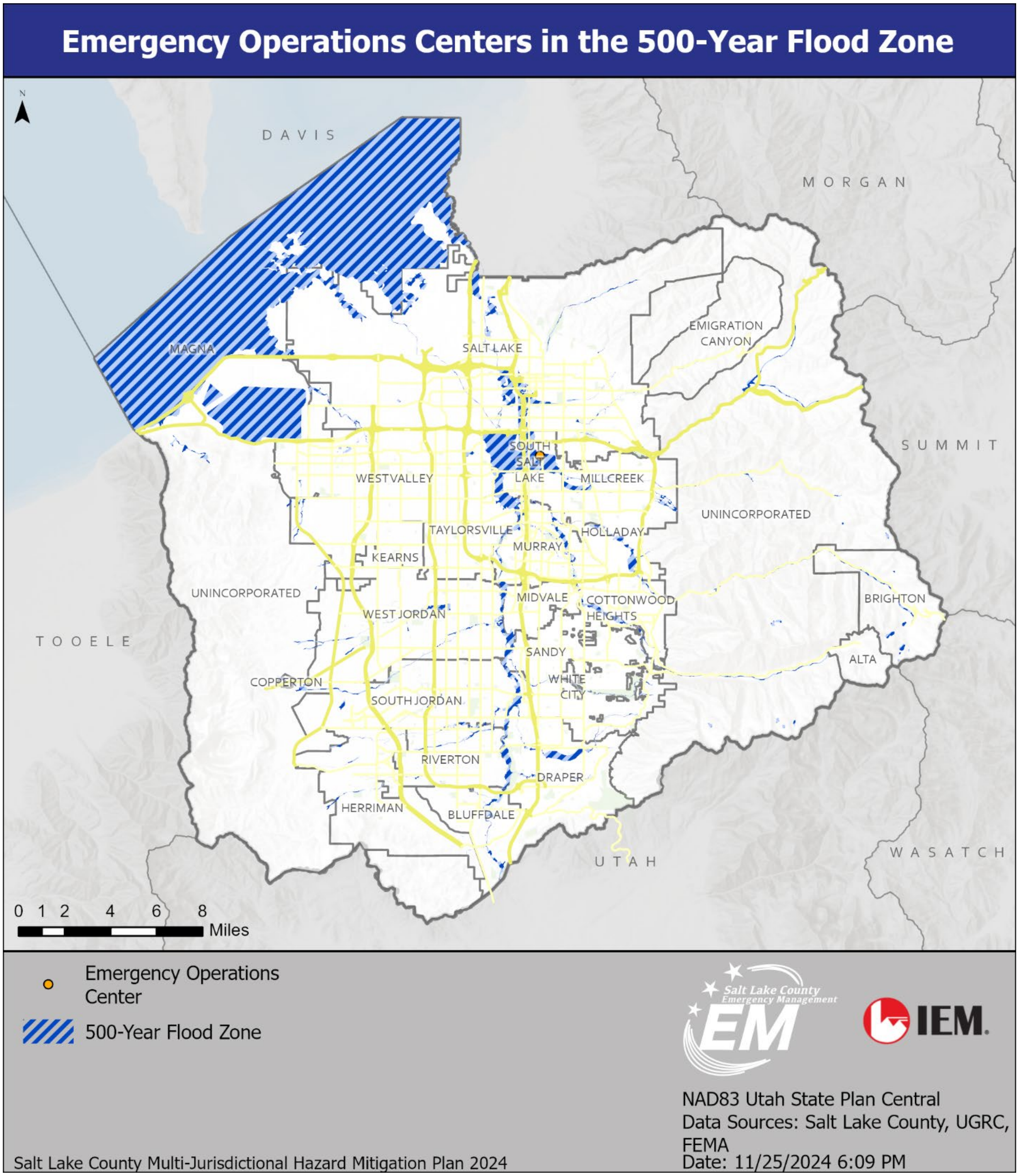


**Figure 108: Emergency Operations Centers in the 500-Year Flood Zone**

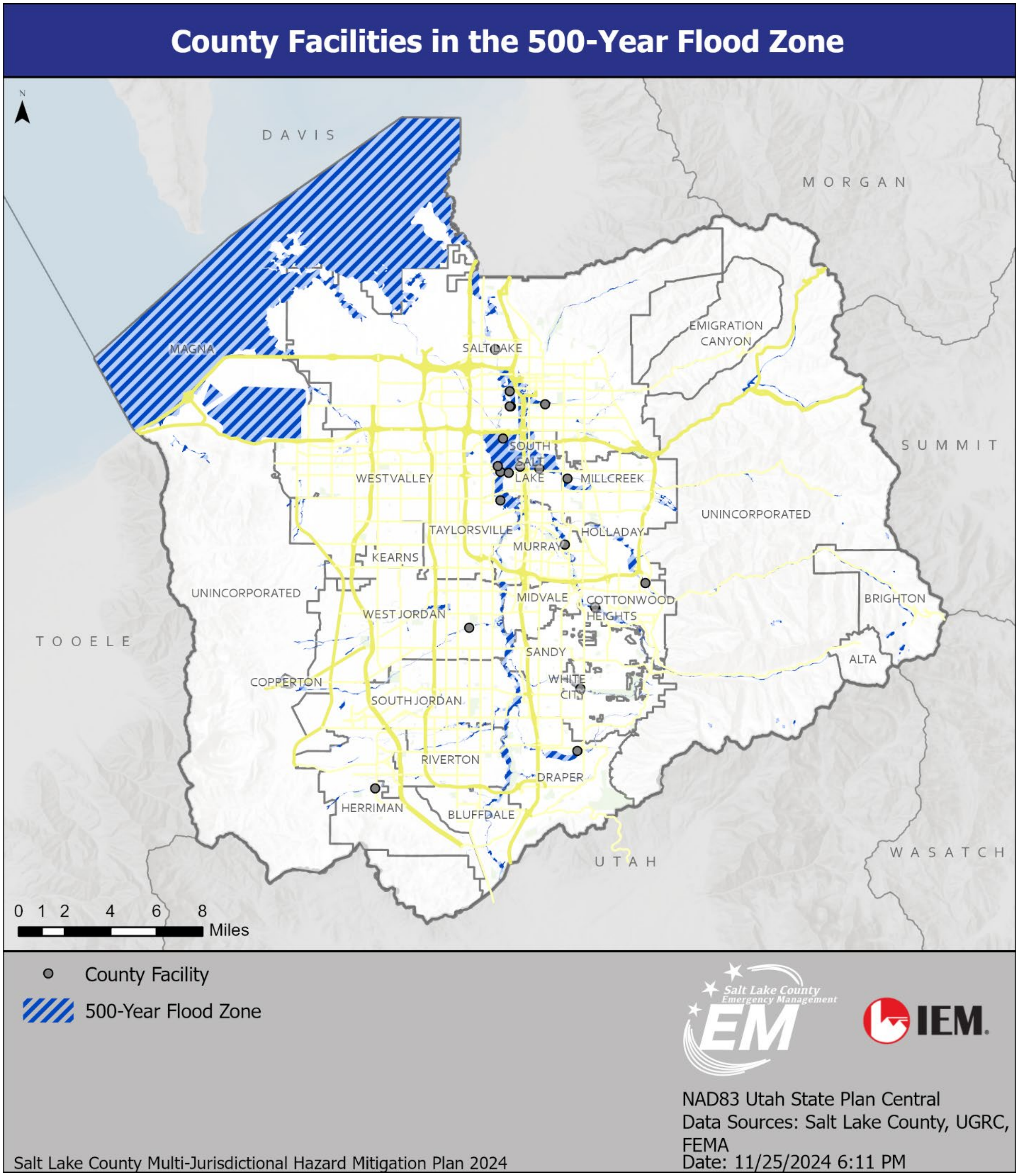


**Figure 109: County Facilities in the 500-Year Flood Zone**

### ECONOMIC LOSS

For a 100-year event, the total estimated economic loss is $882 million, which represents 4.08% of the total replacement value of the scenario buildings. Residential occupancies make up 21.82% of the total losses. For a 500-year event, the total estimated economic loss is $3.74 billion, which represents 12.10% of the total replacement value of the scenario buildings. Residences make up 22.46% of the total losses for the 500-year scenario.

Economic loss is measured by building losses, which can be broken up into two categories: direct building loss and business interruption loss. Direct building losses are based on the estimated costs to repair or replace damage caused to the building and its contents by flooding. Business interruption losses are those associated with the inability to operate a business because of the damage sustained during the flood. This includes income and wage losses, relocation losses, and rental losses, including temporary living expenses for people displaced from homes because of the flood. Of the estimated losses for the 100-year event, 57% were business-related losses.

The Hazus loss estimation for a 100-year flood shows West Valley experiencing the highest total loss at $240,346,000, with significant losses reported in Millcreek ($62,084,000), Brighton ($60,644,000), and Salt Lake City ($100,225,000). Several areas, such as Alta, Copperton, Kearns, and White City, experienced no losses in the 100-year Hazus loss estimation model. Other notable losses include Cottonwood Heights with $29,283,000, Holladay with $35,703,000, and South Salt Lake with $39,331,000. Less significant losses were noted in areas like Bluffdale ($3,080,000), Draper ($9,938,000), and Riverton ($5,885,000).

The Hazus loss estimation for a 500-year flood shows Draper and South Salt Lake experiencing the highest total loss at $344,540,000 and $901,473,000, respectively, with significant losses in Millcreek ($737,529,000), Cottonwood Heights ($169,963,000), and Salt Lake City ($399,620). Much like the 100-flood loss estimation, areas such as Alta, Copperton, and Kearns experienced no losses in the Hazus model. Other notable losses included Bluffdale ($7,534,000) and Magna ($2,728,000).-

Table 47 and Table 48 show the estimated direct losses and business interruption losses for each jurisdiction in the planning area for the 100-year and 500-year flood scenarios, respectively.

**Table 47: Loss Estimation for a 100-Year Flood Event (in Thousands)**

| Name | Building Loss | Content Loss | Inventory Loss | Relocation Loss | Income Loss | Rental Income Loss | Wage Loss | Total Loss |
|---|---|---|---|---|---|---|---|---|
| Alta | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| Bluffdale | $634 | $695 | $65 | $172 | $198 | $50 | $1,266 | $3,080 |
| Brighton | $8,715 | $14,292 | $2 | $2,208 | $16,790 | $1,883 | $16,754 | $60,644 |
| Copperton | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| Cottonwood Heights | $9,667 | $8,093 | $746 | $2,133 | $2,848 | $972 | $4,824 | $29,283 |
| Draper | $3,837 | $2,254 | $57 | $861 | $631 | $354 | $1,944 | $9,938 |
| Emigration Canyon | $2,826 | $5,532 | $0 | $934 | $6,910 | $717 | $6,566 | $23,485 |
| Herriman | $3,334 | $6,071 | $3 | $1,390 | $918 | $476 | $16,599 | $28,791 |
| Holladay | $10,093 | $9,713 | $394 | $3,042 | $3,450 | $1,580 | $7,431 | $35,703 |
| Kearns | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| Magna | $1,238 | $759 | $200 | $311 | $22 | $123 | $75 | $2,728 |
| Midvale | $411 | $1,303 | $288 | $227 | $687 | $162 | $1,080 | $4,158 |
| Millcreek | $25,167 | $18,638 | $1,289 | $3,521 | $2,279 | $1,258 | $9,932 | $62,084 |
| Murray | $5,863 | $11,483 | $1,093 | $2,089 | $4,200 | $1,012 | $13,046 | $38,786 |
| Riverton | $865 | $901 | $37 | $508 | $391 | $133 | $3,050 | $5,885 |
| Salt Lake | $10,477 | $18,191 | $2,487 | $7,703 | $14,385 | $4,250 | $42,732 | $100,225 |
| Sandy | $11,334 | $7,561 | $471 | $1,915 | $1,009 | $744 | $3,769 | $26,803 |
| South Jordan | $3,706 | $4,677 | $270 | $1,663 | $2,843 | $1,287 | $5,076 | $19,522 |
| South Salt Lake | $3,189 | $6,612 | $906 | $3,018 | $4,933 | $1,420 | $19,253 | $39,331 |
| Taylorsville | $2,135 | $1,600 | $16 | $852 | $1,521 | $867 | $1,098 | $8,089 |
| Unincorporated | $16,937 | $25,802 | $3,181 | $4,400 | $5,727 | $2,281 | $71,048 | $129,376 |
| West Jordan | $2,819 | $3,299 | $123 | $768 | $742 | $423 | $5,578 | $13,752 |
| West Valley | $33,941 | $62,987 | $3,846 | $18,788 | $30,131 | $11,970 | $78,683 | $240,346 |
| White City | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| **Total** | **$157,188** | **$210,463** | **$15,474** | **$56,503** | **$100,615** | **$31,962** | **$309,804** | **$882,009** |

**Table 48: Loss Estimation for a 500-Year Flood Event (in Thousands)**

| Jurisdiction | Building Loss | Content Loss | Inventory Loss | Relocation Cost | Income Loss | Rental Income Loss | Wage Loss | Total Loss |
|---|---|---|---|---|---|---|---|---|
| **Alta** | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| **Bluffdale** | $1,595 | $1,577 | $174 | $542 | $386 | $174 | $3,086 | $7,534 |
| **Brighton** | $8,715 | $14,292 | $2 | $2,208 | $16,790 | $1,883 | $16,754 | $60,644 |
| **Copperton** | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| **Cottonwood Heights** | $38,301 | $44,373 | $1,250 | $12,791 | $27,112 | $5,714 | $40,422 | $169,963 |
| **Draper** | $80,368 | $71,901 | $192 | $16,635 | $16,128 | $5,972 | $153,344 | $344,540 |
| **Emigration Canyon** | $2,826 | $5,532 | $0 | $934 | $6,910 | $717 | $6,566 | $23,485 |
| **Herriman** | $3,334 | $6,071 | $3 | $1,390 | $918 | $476 | $16,599 | $28,791 |
| **Holladay** | $41,270 | $33,656 | $4,288 | $10,570 | $7,289 | $4,748 | $24,784 | $126,605 |
| **Kearns** | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| **Magna** | $1,238 | $759 | $200 | $311 | $22 | $123 | $75 | $2,728 |
| **Midvale** | $3,211 | $14,102 | $319 | $5,122 | $17,362 | $3,858 | $37,532 | $81,506 |
| **Millcreek** | $203,497 | $217,414 | $4,811 | $32,856 | $82,354 | $19,000 | $177,597 | $737,529 |
| **Murray** | $21,193 | $30,158 | $3,056 | $7,790 | $12,713 | $4,302 | $41,161 | $120,373 |
| **Riverton** | $14,305 | $9,560 | $211 | $3,261 | $887 | $965 | $4,551 | $33,740 |
| **Salt Lake** | $68,217 | $88,216 | $8,773 | $32,548 | $48,643 | $16,208 | $137,015 | $399,620 |
| **Sandy** | $18,623 | $13,667 | $812 | $3,677 | $2,363 | $1,493 | $9,360 | $49,995 |
| **South Jordan** | $10,843 | $14,301 | $755 | $7,523 | $15,558 | $4,623 | $33,215 | $86,818 |
| **South Salt Lake** | $122,851 | $302,803 | $47,431 | $60,375 | $116,217 | $35,214 | $216,582 | $901,473 |
| **Taylorsville** | $2,731 | $2,076 | $19 | $2,037 | $3,328 | $2,046 | $2,669 | $14,906 |
| **Unincorporated** | $18,272 | $26,872 | $3,284 | $4,652 | $5,918 | $2,390 | $71,360 | $132,748 |
| **West Jordan** | $64,769 | $40,332 | $1,574 | $9,304 | $5,587 | $4,066 | $20,363 | $145,995 |
| **West Valley** | $39,185 | $69,425 | $4,003 | $22,339 | $33,370 | $14,350 | $88,282 | $270,954 |
| **White City** | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| **Total** | **$765,344** | **$1,007,087** | **$81,157** | **$236,865** | **$419,855** | **$128,322** | **$1,101,317** | **$3,739,947** |

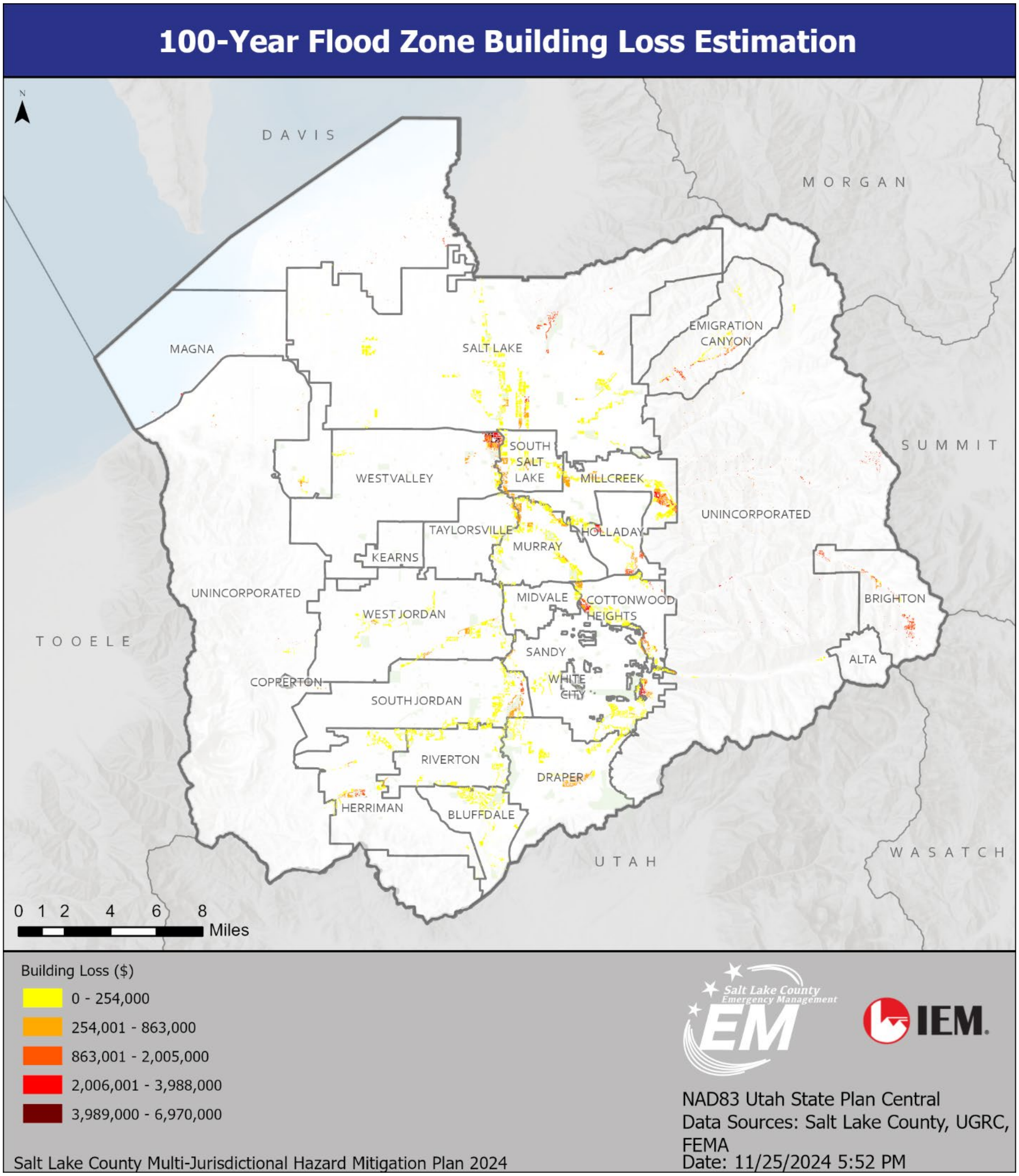


Figure 110: Estimated Building Losses for 100-Year Flood Scenario

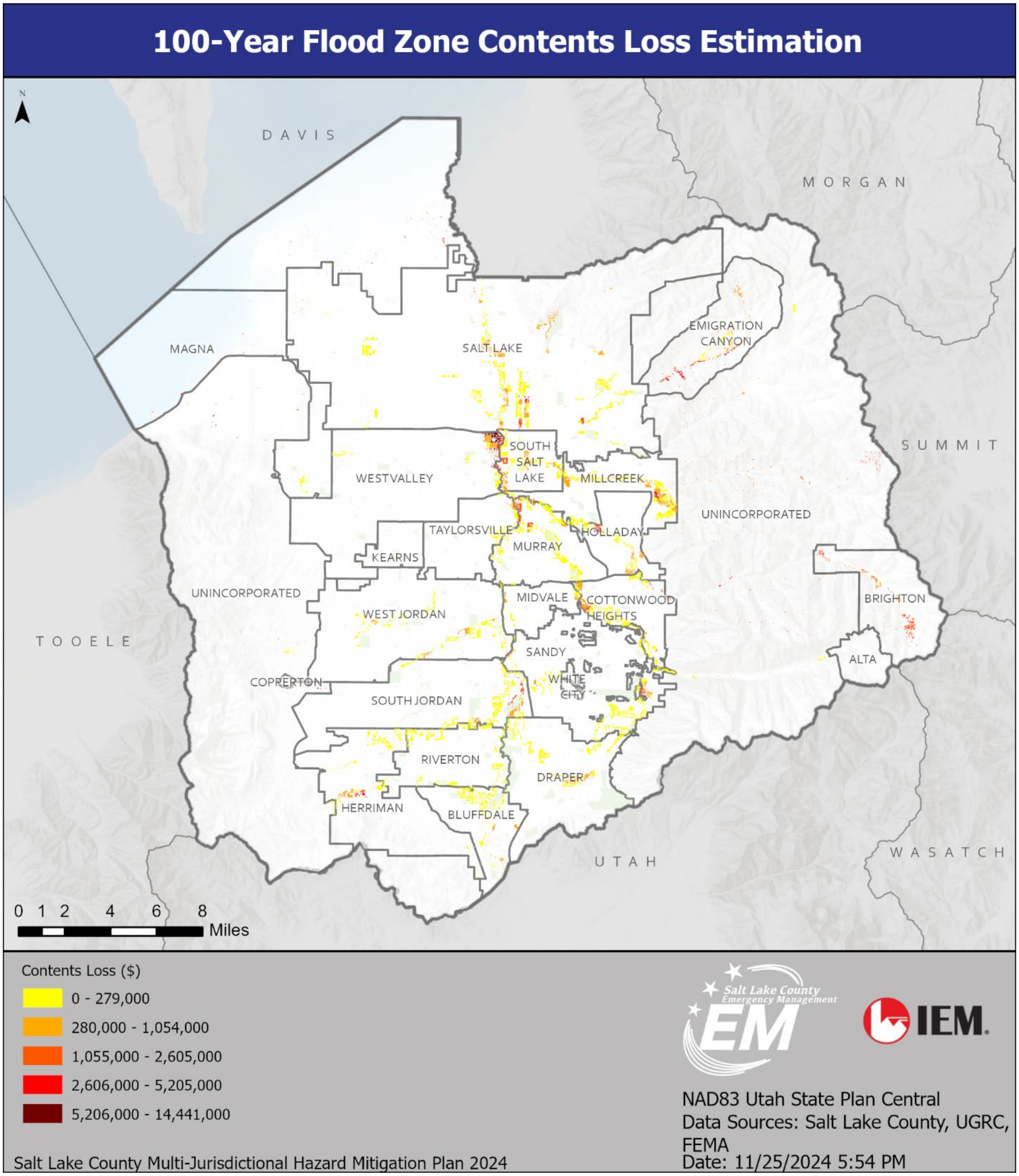


**Figure 111: Estimated Contents Losses for 100-Year Flood Scenario**

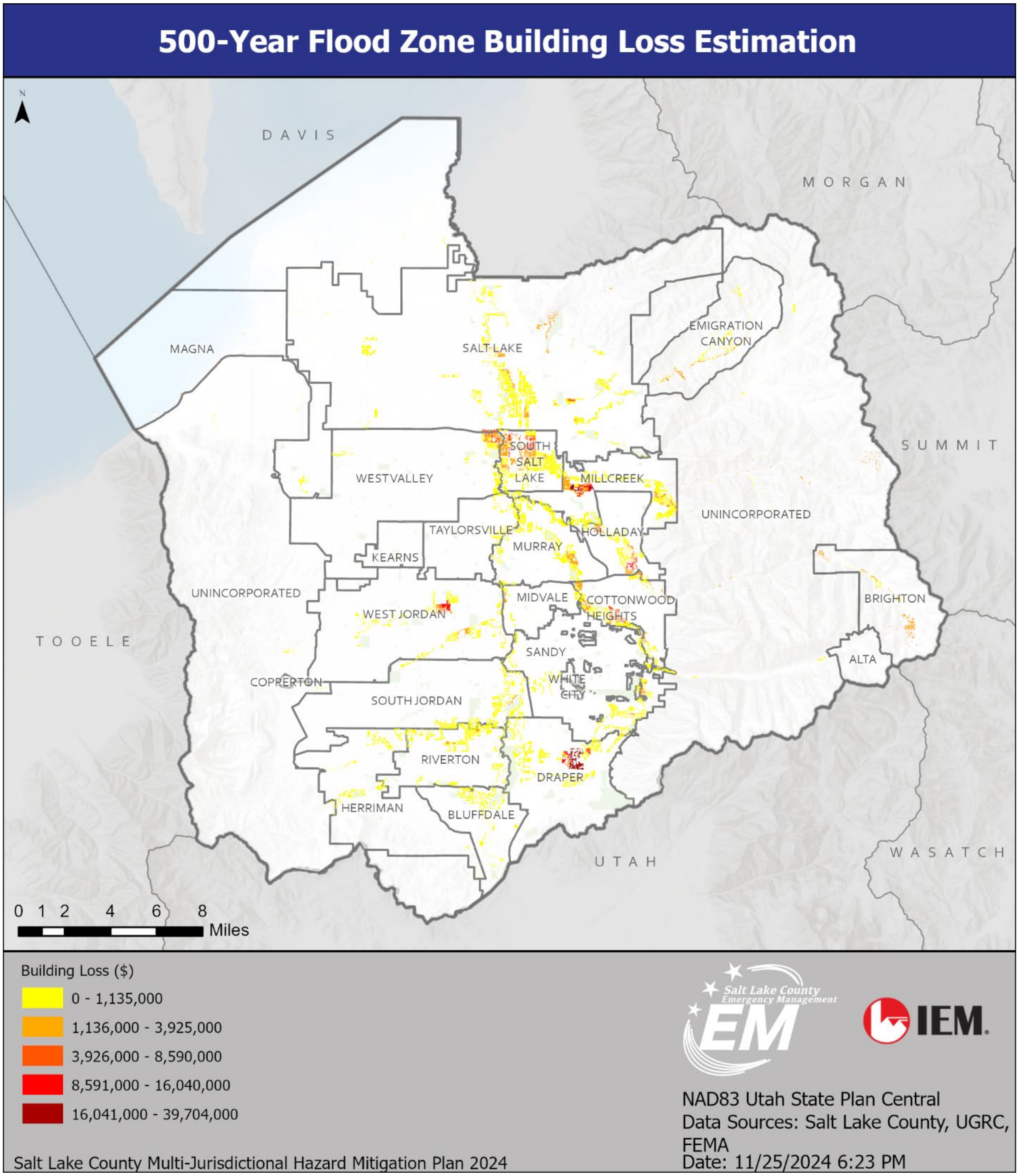


**Figure 112: Estimated Building Losses for 500-Year Flood Scenario**

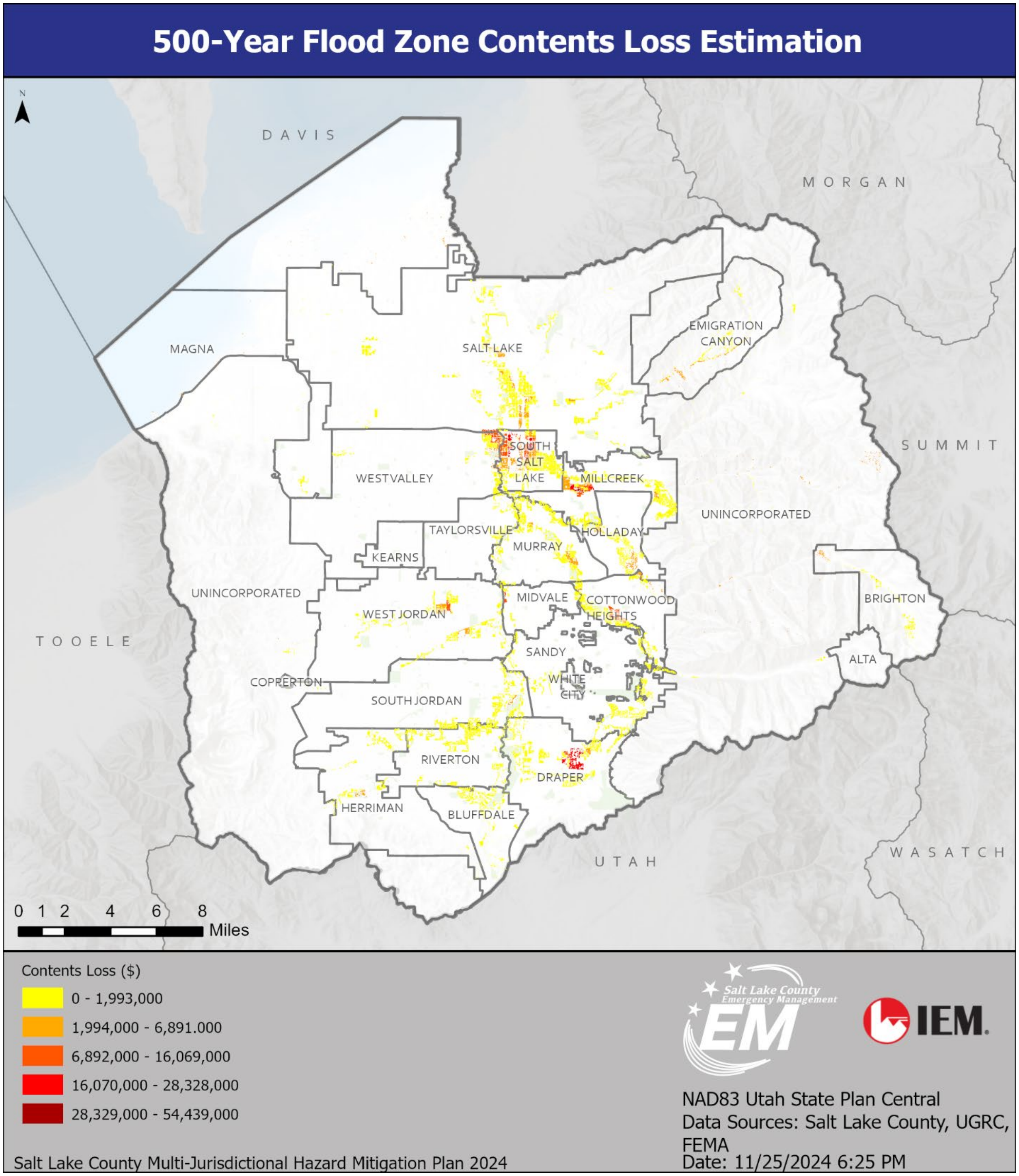


**Figure 113: Estimated Contents Losses for 500-Year Flood Scenario**

## DIRECT BUILDING DAMAGE AND LOSS

For a 100-year flood scenario, Hazus estimates that about 352 buildings will be at least moderately damaged and 30 will be completely destroyed. For a 500-year flood scenario, Hazus estimates that about 1,773 buildings will be at least moderately damaged and about 806 will be completely destroyed. Table

49–Table 52 show the number of buildings damaged by occupancy type and building type for both the 100-year and 500-year scenarios.

**Table 49: Expected Building Damage by Occupancy for the 100-Year Flood Scenario**

| | 1–10 | | 11–20 | | 21–30 | | 31–40 | | 41–50 | | >50 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Occupancy** | **Count** | **(%)** | **Count** | **(%)** | **Count** | **(%)** | **Count** | **(%)** | **Count** | **(%)** | **Count** | **(%)** |
| **Agriculture** | 1 | 33 | 2 | 67 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Commercial** | 6 | 33 | 7 | 39 | 1 | 6 | 0 | 0 | 0 | 0 | 4 | 22 |
| **Education** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Government** | 32 | 78 | 5 | 15 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 10 |
| **Industrial** | 5 | 45 | 3 | 27 | 3 | 27 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Religion** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Residential** | 81 | 20 | 151 | 37 | 80 | 20 | 49 | 12 | 21 | 5 | 22 | 5 |
| **Total** | **125** | | **168** | | **84** | | **49** | | **21** | | **30** | |

**Table 50: Expected Building Damage by Building Type for the 100-Year Flood Scenario**

| | 1–10 | | 11–20 | | 21–30 | | 31–40 | | 41–50 | | >50 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Occupancy** | **Count** | **(%)** | **Count** | **(%)** | **Count** | **(%)** | **Count** | **(%)** | **Count** | **(%)** | **Count** | **(%)** |
| **Concrete** | 15 | 88 | 1 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 6 |
| **Manufactured Housing** | 12 | 48 | 4 | 16 | 2 | 8 | 0 | 0 | 3 | 12 | 4 | 16 |
| **Masonry** | 22 | 22 | 39 | 39 | 18 | 18 | 12 | 12 | 3 | 3 | 7 | 7 |
| **Steel** | 9 | 82 | 2 | 18 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Wood** | 63 | 20 | 119 | 38 | 62 | 20 | 37 | 12 | 15 | 5 | 16 | 5 |

**Table 51: Expected Building Damage by Occupancy Type for the 500-Year Flood Scenario**

| | 1–10 | | 11–20 | | 21–30 | | 31–40 | | 41–50 | | >50 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Occupancy** | **Count** | **(%)** | **Count** | **(%)** | **Count** | **(%)** | **Count** | **(%)** | **Count** | **(%)** | **Count** | **(%)** |
| **Agriculture** | 1 | 33 | 2 | 67 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Commercial** | 40 | 26 | 36 | 24 | 2 | 1 | 6 | 4 | 0 | 0 | 69 | 45 |
| **Education** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Government** | 49 | 65 | 14 | 19 | 0 | 0 | 0 | 0 | 0 | 0 | 12 | 16 |
| **Industrial** | 114 | 48 | 83 | 35 | 39 | 16 | 2 | 1 | 0 | 0 | 1 | 0 |
| **Religion** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Residential** | 331 | 18 | 376 | 20 | 181 | 10 | 114 | 6 | 112 | 6 | 724 | 39 |
| **Total** | **535** | | **511** | | **222** | | **122** | | **112** | | **806** | |

**Table 52: Expected Building Damage by Building Type for the 500-Year Flood Scenario**

| | 1–10 | | 11–20 | | 21–30 | | 31–40 | | 41–50 | | >50 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Occupancy | Count | (%) | Count | (%) | Count | (%) | Count | (%) | Count | (%) | Count | (%) |
| **Concrete** | 47 | 57 | 22 | 27 | 10 | 12 | 0 | 0 | 0 | 0 | 3 | 4 |
| **Manufactured Housing** | 15 | 47 | 4 | 13 | 2 | 6 | 0 | 0 | 3 | 9 | 8 | 25 |
| **Masonry** | 170 | 23 | 153 | 21 | 67 | 9 | 31 | 4 | 28 | 4 | 277 | 38 |
| **Steel** | 29 | 60 | 14 | 29 | 3 | 6 | 0 | 0 | 0 | 0 | 2 | 4 |
| **Wood** | 263 | 19 | 309 | 22 | 136 | 10 | 88 | 6 | 81 | 6 | 510 | 37 |

As shown in Table 53 and Table 54, the total building-related losses for a 100-year flood event were $81.22 million. About 55% of the total estimated losses were related to business interruptions in the region. Residential occupancies made up 39.74% of the total loss. For a 500-year event, the total building-related losses were $227.77 million. About 59% of the total estimated losses were related to business interruptions in the region, and residential occupancies made up 36.39% of the total loss.

**Table 53: Building Related Economic Loss Estimates for a 100-Year Flood Event (In Millions of Dollars)**

| Category | Area | Residential | Commercial | Industrial | Other | Total |
|---|---|---|---|---|---|---|
| **Building Loss** | Building | $94.28 | $28.88 | $15.64 | $18.38 | $157.19 |
| | Content | $51.39 | $64.12 | $38.80 | $56.15 | $210.46 |
| | Inventory | $0.00 | $7.09 | $5.58 | $2.81 | $15.47 |
| | **Subtotal** | **$145.67** | **$100.09** | **$60.02** | **$77.34** | **$383.12** |
| **Business Interruption** | Income | $3.31 | $76.59 | $1.29 | $19.43 | $100.62 |
| | Relocation | $21.41 | $17.52 | $2.03 | $15.53 | $56.50 |
| | Rental Income | $14.20 | $13.15 | $0.39 | $4.22 | $31.96 |
| | Wage | $7.83 | $68.51 | $1.75 | $231.72 | $309.80 |
| | **Subtotal** | **$46.75** | **$175.77** | **$5.46** | **$270.90** | **$498.88** |
| **All** | **Total** | **$192.42** | **$275.86** | **$65.48** | **$348.24** | **$882.00** |

**Table 54: Building Related Economic Loss Estimates for a 500-Year Flood Event (In Millions of Dollars)**

| Category | Area | Residential | Commercial | Industrial | Other | Total |
|---|---|---|---|---|---|---|
| **Building Loss** | Building | $427.69 | $164.16 | $98.68 | $74.81 | $765.34 |
| | Content | $224.19 | $361.86 | $247.73 | $173.31 | $1,007.09 |
| | Inventory | $0.00 | $42.12 | $35.47 | $3.57 | $81.15 |
| | **Subtotal** | **$651.88** | **$568.14** | **$381.88** | **$251.69** | **$1,853.58** |
| **Business Interruption** | Income | $17.98 | $332.38 | $6.97 | $62.53 | $419.86 |
| | Relocation | $80.42 | $93.82 | $15.00 | $47.63 | $236.87 |

| Category | Area | Residential | Commercial | Industrial | Other | Total |
|---|---|---|---|---|---|---|
| | Rental Income | $47.33 | $66.60 | $2.71 | $11.66 | $128.32 |
| | Wage | $42.33 | $397.06 | $11.02 | $650.91 | $1,101.32 |
| | **Subtotal** | **$188.06** | **$889.86** | **$35.70** | **$772.73** | **$1,886.37** |
| **All** | **Total** | **$839.94** | **$1,458.00** | **$417.58** | **$1,024.42** | **$3,739.95** |

### DEBRIS REMOVAL

Table 55 shows how much debris would be generated by flooding and how many loads it would take to remove it, 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. At a weight-to-volume ratio of one ton per cubic yard, 50,000 tons would cover more than 10 acres to a depth of three feet.

For a 100-year flood, debris from finishes, structures, and foundations totals 12,464 tons. The debris significantly increases with all category types in a 500-year flood, resulting in 49,267 tons. This highlights the substantial increase in debris and the associated removal efforts required for more severe flood events within the county.

**Table 55: Debris Generation and Removal**

| Category | 100-year | 500-year |
|---|---|---|
| **Finishes** | 4,028 | 12,861 |
| **Structures** | 4,326 | 17,967 |
| **Foundations** | 4,110 | 18,438 |
| **Totals** | **12,4641** | **49,267** |

### SOCIAL IMPACT

Hazus estimates the number of households expected to be displaced from their homes due to the flood and the associated potential evacuation, as well as how many displaced individuals will require accommodations in temporary public shelters. Displacement includes households evacuated from within or very near the inundated area. For a 100-year flood event, the model estimates that 3,119 households (9,356 individuals) will be displaced due to the flood. Of these, 2,043 individuals will seek temporary shelter in public shelters. For a 500-year flood event, the model estimates that 11,720 households (35,159 individuals) will be displaced due to the flood, with 4,089 individuals seeking temporary shelter.

Major flooding can impact the community by displacing residents and business owners; damaging and disrupting infrastructure, including roads and bridges, water treatment facilities, and wastewater treatment facilities; and causing health risks due to contaminated public water supplies and private wells. Heavy rains, severe flooding, or other types of emergency events could damage sewer systems and cause an overflow of untreated wastewater into communities and the environment. Severe flooding can put drinking water wells at increased risk for contamination from floodwater that may contain sewage. In addition, floodwater and standing water can be dangerous and expose vulnerable populations to infectious diseases, chemical hazards, and injuries. Flooded homes may be contaminated with mold or sewage, which can cause health risks.[112]

Flooding can also lead to road closures. Banks can erode ground under roadways, which may cause long-term transportation disruptions while roads are rebuilt or repaired. Deaths and injuries typically occur when motorists become trapped in floodwaters. This can, though not always, occur when motorists ignore the advice of officials and drive through flooded areas. Flooding can also damage power, water, or communications infrastructure, causing further disruptions for residents and businesses.

## NFIP PARTICIPATION

Salt Lake County and all cities, except for a newly incorporated city, Brighton, and the metro townships, participate in the National Flood Insurance Program (NFIP). NFIP Zone A in Table 12 refers to a 100-year flood event. As shown in Table 56, 15 residential properties have experienced repetitive loss in the county, with an average loss of $16,418.40. The total amount paid was $246,276. As of 2023, there were no severe repetitive loss properties in the state.

**Table 56: Salt Lake County Repetitive Loss Properties as of January 2023[113]**

| Community Name | Number of Properties | Number of Claims | Total Paid |
|---|---|---|---|
| **Murray, City Of** | 2 | 6 | $87,576 |
| **Riverton, City Of** | 1 | 2 | $22,046 |
| **Salt Lake City, City Of** | 5 | 14 | $123,219 |
| **Salt Lake County** | 6 | 15 | $549,511 |
| **West Jordan, City Of** | 1 | 2 | $13,435 |
| **Total** | **15** | **39** | **$795,787** |

**Table 57: Salt Lake County 2023 NFIP Statistics by County[114]**

| Total Premium | Zone A | Number of Policies | Total Coverage | Total Claims Since 1978 | Total Paid Since 1978 |
|---|---|---|---|---|---|
| $629,443 | | 1,157 | 2,502,000 | 403 | 1,691,403 |

## NATIONAL RISK INDEX

The National Risk Index (NRI) includes data on the expected annual losses to individual natural hazards, historical loss, and overall risk at a county and census tract level. Salt Lake County's NRI expected

[112] Centers for Disease Control and Prevention. Floods, "Guidelines for Septic and Onsite Wastewater Systems." February 6, 2024. https://www.cdc.gov/floods/safety/guidelines-for-septic-and-onsite-wastewater-systems.html
[113] Utah 2024 State Enhanced Hazard Mitigation Plan. "Table 4-37-Utah Repetitive Loss Properties as of January 2023."
[114] Utah 2024 State Enhanced Hazard Mitigation Plan. "Table 4-36-Flood Insurance Statistics for Utah Counties."

annual loss (EAL) value for riverine flooding is $4.5 million, with a risk score of 92.7 and a rating of relatively moderate percentile compared with the rest of the United States (Figure 114).

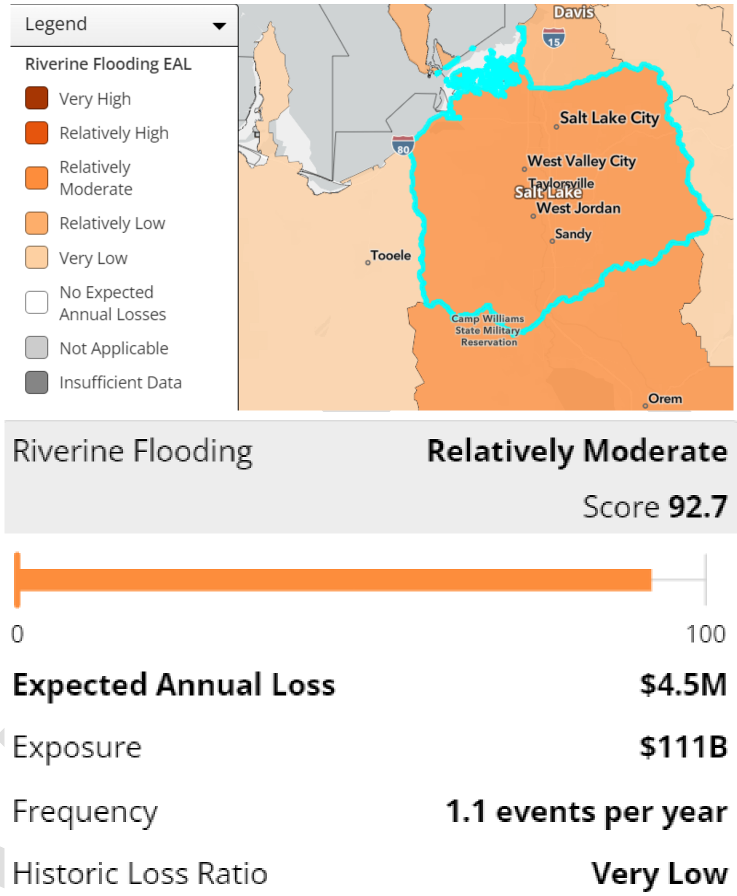


**Figure 114: FEMA National Risk Index Salt Lake County Expected Annual Loss from Riverine Flooding**[115]

## VULNERABLE POPULATIONS

The 2024 Utah State Enhanced Hazard Mitigation Plan states vulnerability to the impacts of flooding is not distributed evenly across the population. People living in floodplain areas are most vulnerable to displacement. Perhaps the most extreme example of this is unhoused people taking refuge in floodplain areas. These people are both physically exposed to hazards and defined as socially vulnerable. In addition, the current housing availability crisis and increasing homelessness have exposed a growing number of underserved individuals to this hazard.

Where flood damage is especially severe, it can also disrupt livelihoods. This may have a more significant impact on low-income households with fewer financial resources to sustain them following a disaster. They may also have more difficulty finding temporary living arrangements if displaced by flooding.

[115] FEMA, National Risk Index. “Salt Lake County Expected Annual Loss Riverine Flooding Risk Score, Map and Legend.” https://hazards.fema.gov/nri/map

Children are notoriously vulnerable to being swept away by floodwaters. Individuals with disabilities or access and functional needs may also have difficulty evacuating areas affected by flooding.

## COMMUNITY LIFELINES

Lifelines are the most fundamental services in the community that, when stabilized, enable all other aspects of society to function. Community lifelines are essential for the well-being of any community. They provide support and assistance to individuals who require help, especially during times of crisis. FEMA Community Lifelines are a critical component of emergency management in the United States. These lifelines are designed to address the essential needs of a community during and after a disaster. Community lifelines help create a sense of safety and security within a community. They provide a safety net for individuals who may be struggling and offer comfort and reassurance that help is available when needed. Without these lifelines, communities would be much more vulnerable to crises and emergencies. There are eight lifelines, each with its own focus and purpose.


**Figure 115: FEMA Community Lifelines[116]**

All lifelines are assigned to flooding because of the high impact of loss of life and property during these incidents. Law enforcement officers, emergency medical services, and rescue attempts may be delayed or impossible because of road flooding and blockage from debris. Due to these same problems, businesses and stores will be closed, causing food insecurities and preventing access to daily necessities. Power outages may make communication impossible, and some people will not be able to call for help. Hazardous materials may leak into the water and ground, causing current and future problems for people, crops, and livestock.

## CHANGES IN DEVELOPMENT

The Surplus Canal levee system provides protection for a large portion of Salt Lake City from approximately 2900 S to the Salt Lake City International Airport. The U.S. Army Corps of Engineers (USACE) conducted an inspection of this federally authorized levee system in 2019. Preliminary information suggests similar deficiencies found in the 2012 inspection. These deficiencies resulted in an

[116] FEMA. "Community Lifelines." https://www.fema.gov/emergency-managers/practitioners/lifelines

unacceptable rating for the levee systems in Salt Lake County. Through the Surplus Levee Deficiency Rehabilitation Project, Salt Lake County Flood Control (SLCo FC) is working to bring the Surplus Canal levee systems back into USACE compliance. To do so, it must address the unacceptable encroachment violations, including those on privately owned property. The project is currently working to determine all encroachments on property owned by the county or other government entities, acquire property within 10 feet of the land-side toe of the levee, relocate fences outside USACE jurisdiction, and remove all encroachments on the newly acquired property. Salt Lake County is taking a phased approach to acquire the property necessary to fully address the deficiencies. The project commenced the phased approach in 2017, with initial mapping, project development, and coordination with USACE and local agencies to bring the levee into compliance. The second phase (2018–2021) involved residential property acquisitions. Phase 3 (2021–2025) will conclude the project with commercial property acquisitions.[117] These flood mitigation measures may decrease future vulnerability to flood for the affected areas; however, population increases in the county have heightened vulnerability.

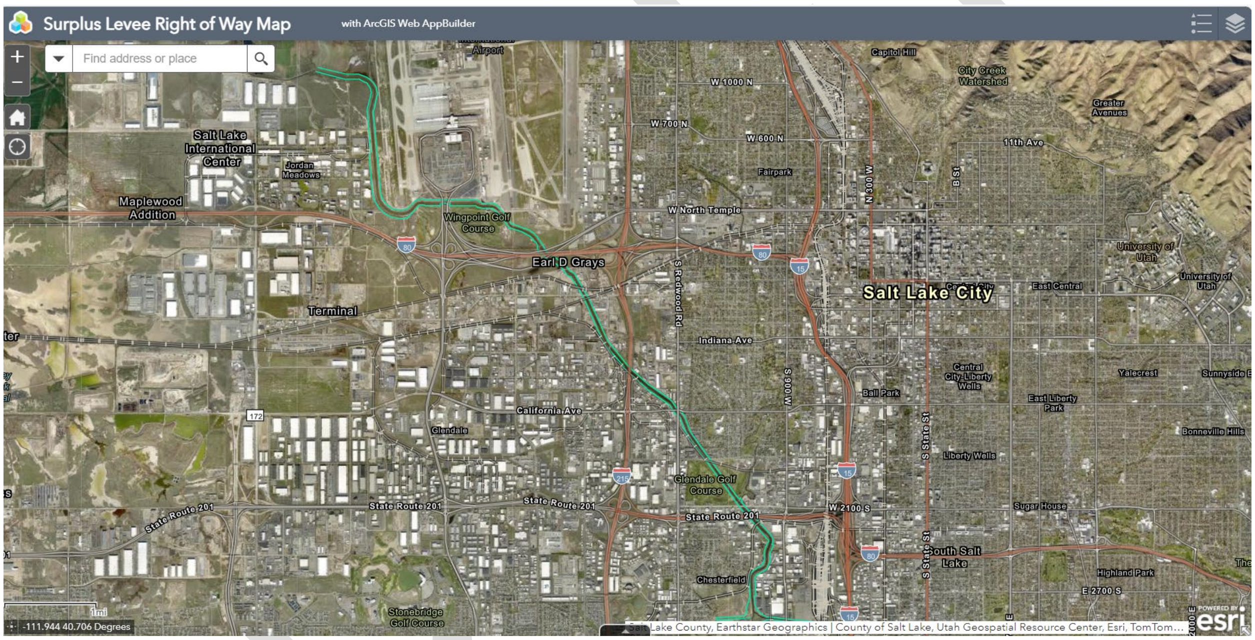


**Figure 116: Salt Lake County Surplus Levee Right of Way Map[118]**

## VULNERABILITY SCORE

To analyze the county's vulnerability to wildfire, the NRI was used as a primary tool during the 2024 Hazard Identification and Risk Assessment (HIRA) update. The NRI defines risk as the potential for negative impacts as a result of a natural hazard and determines a community's risk relative to other communities by examining the expected annual loss and social vulnerability in a given community in

[117] Salt Lake County. "Flood Control, Surplus Canal Deficiency Rehabilitation Project." 2024. https://www.saltlakecounty.gov/flood-control/surplus-canal-deficiency-rehabilitation-project/
[118] Salt Lake County. "Surplus Levee Right of Way Map." 2024. https://slco.maps.arcgis.com/apps/webappviewer/index.html?id=ef1f645b00a54ba1931c6d73871495df

relation to that community's resilience. Salt Lake County's NRI riverine flooding risk rating is shown in Figure 117. Salt Lake County has relatively moderate riverine flooding risk and a risk score of 93.

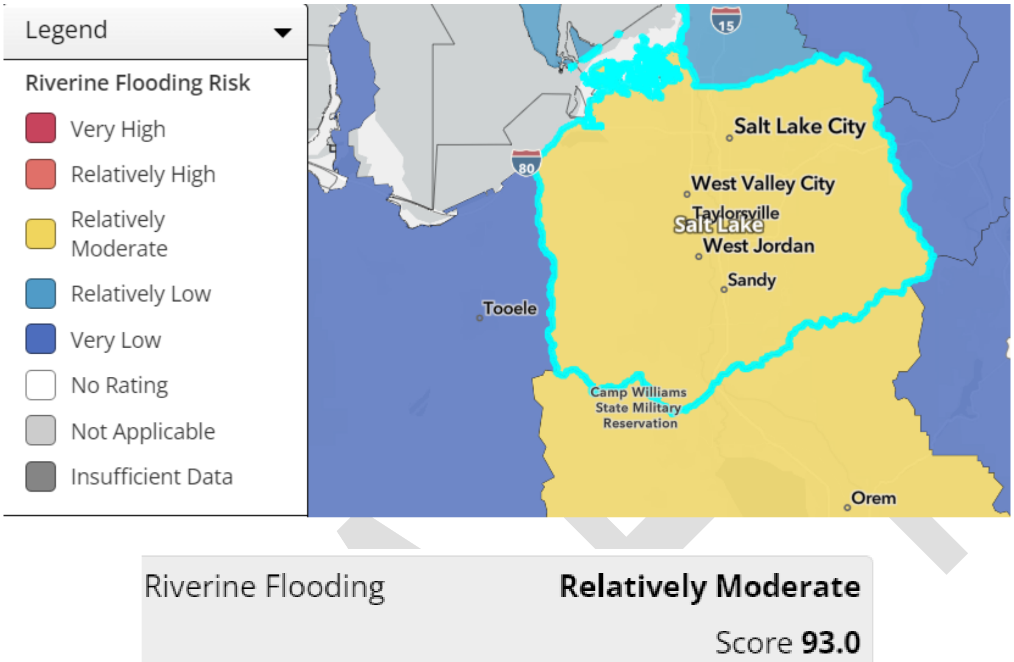


Figure 117: National Risk Index Riverine Flooding Risk Map, Legend and Score for Salt Lake County[119]



[119] FEMA, National Risk Index. "Salt Lake County Riverine Flooding Score, Map and Legend." https://hazards.fema.gov/nri/map

# Heavy Rain

## Hazard Description

Heavy amounts of precipitation from rain 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. 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 alluvial fans, damaging residential and 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 sixth wettest day since records began in 1874.

According to the National Oceanic and Atmospheric Administration, atmospheric rivers are narrow channels of wind pulling a large, condensed amount of moisture from the ocean before dumping it all once it reaches land. In the western United States, California gets the brunt of the moisture dump. As the storm makes its way over the Sierra Nevada Mountains and further east, Utah will typically see a good amount of precipitation from what is left.[120]



## Hazard Profile

| | | | | | |
|---|---|---|---|---|---|
| **Potential Impact** | | Catastrophic | **Probability** | X | Highly Likely |
| | X | Critical | | | Likely |
| | | Limited | | | Occasional |
| | | Negligible | | | Unlikely |
| **Location** | Can occur in areas throughout the entire county | | | | |
| **Seasonal Pattern** | Year round | | | | |
| **Conditions** | Vary based on latitude, elevation, aspect, and landforms | | | | |
| **Duration** | Heavy rain generally lasts hours; some conditions can persist for days | | | | |
| **Secondary Hazards** | Flooding | | | | |
| **Analysis Used** | National Climatic Data Center, National Weather Service, Utah Avalanche Center, UDEM, local input, and review of historic events and scientific records | | | | |

## Magnitude/Extent

The rainfall rate is a measure of the amount of rain that falls during a period of time, such as millimeters or inches per hour. The Manual of Surface Weather Observation Standards includes the following general categories to classify rainfall intensity.[121]

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[120] Fox, Derick. "What is an Atmospheric River and What can Utahns Expect?" ABC4. February 1, 2024. https://www.abc4.com/utah-weather/utah-weather-stories/atmospheric-river-explained/

[121] "Rain Rate Intensity Classification." Barani. January 19, 2020. https://www.baranidesign.com/faq-articles/2020/1/19/rain-rate-intensity-classification

**Table 58: Rainfall Intensity Scale**

| Description | Rate |
|---|---|
| Light Rain | Less than 0.1"/hour |
| Moderate Rain | 0.1 to 0.3"/hour |
| Heavy Rain | 0.3 to 2"/hour |
| Violent Rain | >2"/hour |

## Location

The entire area of Salt Lake County can be affected by most heavy rain events; however, low-lying areas and valleys are most prone to the effects. Communities with poor, obstructed, or limited stormwater drainage systems are at greater risk during heavy rain events. Heavy 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. Snow may also melt due to rainfall, which primarily occurs in the southern half of the state.

## Historical Events and Probability of Future Occurrences

Based on the FEMA Disaster Declarations Database, Salt Lake County has received no designation for heavy rain disaster declarations since the last plan update.

According to the National Weather Service, historical rainfall data for Salt Lake City shows an average of 1.71 inches in October with 13 average rain days, 1.77 inches in November with 16 average rain days, and 2.07 inches in December with 19 average rain days.

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 National Centers for Environmental Information (NCEI) records have occurred 9 times from 1996 to 2024, approximately 1 event every 3 years, a rate likely to continue. The probability of future occurrences is high. Total property damage from these 9 events is $1,567,000 and $12,000 in crop damage.

On August 13–14, 2024, two days of intense thunderstorms and heavy rainfall caused flooding across the Salt Lake City metro area. The Utah Department of Transportation (UDOT) reported flooding across northern Utah. Streets in metro Salt Lake City turned into rivers as numerous storms brought heavy rain, and hail caused numerous road closures in Salt Lake and Wasatch counties.

On August 18, 2021, the National Weather Service issued a Flood Warning for urban and small stream flooding in the valley, and the downpour caused Utah Highway Patrol to close Interstate 215 at 3300 South and 700 East due to “significant flooding” in the area. Crews waded into the nearly knee-high pool of rainwater and used industrial pumps to remove it from the road.

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 sixth wettest day since records began in 1874.

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.

## Climate Change Considerations

The 2024 State Enhanced Hazard Mitigation Plan states climate models consistently indicate that increased convective storms are a likely outcome of climate change, with worsening severe storm activity increasing with worsening climate change.

## Secondary Hazards

The most significant secondary hazard associated with heavy rain events is localized flooding. Heavy rain can also be accompanied by high wind, which can result in falling and downed trees, 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.

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 extreme cases, power outages have lasted a few days or even weeks. Severe weather-induced power failures may come from rain that damages insulators and other components vital for maintaining a functioning circuit.

## Vulnerability Assessment

Weather events are inherently unpredictable, with the severity and precise locations of an event subject to change. Conditions can evolve quickly, making it challenging to pinpoint specific areas, facilities, structures, or systems that may be affected by heavy rain. Due to the broad reach of this hazard, heavy rains have the potential to impact all populations, structures, critical facilities, infrastructure, and the economy. The extent of the impact and the severity of the damage will vary considerably from one event to another.

Heavy rain can cause localized flooding and subsequent water damage to nearby structures. Prolonged heavy rain can overwhelm storm drainage systems, causing further damage. Low-lying areas, such as bridge underpasses, may be more likely to experience flooding. Vehicles may lose traction or be unable to travel roadways safely. Flooding or unsafe driving conditions may require road closures, potentially blocking major transportation routes. Transportation disruptions may also delay emergency response.

Power outages and other service disruptions may occur as a secondary effect of heavy rainstorms. These outages negatively impact county residents and business operations, resulting in economic losses. Critical facilities may require backup power systems to continue operations during power outages.

Attendees at outdoor events such as sporting or recreation activities, farmers markets, or other community events may have difficulty finding shelter during fast-moving storm events.

## ESTIMATED IMPACT AND POTENTIAL LOSSES

The National Risk Index (NRI) does not include data on the expected annual losses for heavy rain. Based on the past damages recorded in NCEI, $1,579,000 in losses have been incurred in the last 28 years within Salt Lake County. This averages approximately $56,393 per year.

## VULNERABLE POPULATIONS

The following populations are most vulnerable to a heavy rain event, face isolation and exposure during these events, or could suffer more secondary effects of the hazard.

Severe weather, like heavy rain, typically affects people who are outdoors. Those without access to shelter, such as outdoor workers in construction or agriculture, are particularly affected. Individuals who are unhoused are especially vulnerable to the dangers posed by heavy rains.

Those dependent on powered medical devices are also particularly vulnerable to power outages caused by severe weather events. Elderly residents or those with disabilities or mobility difficulties may have difficulty seeking shelter or addressing damage caused by heavy rain. Individuals with low incomes may face more significant challenges recovering if their residences are damaged or if they lose wages from business or other economic impacts of storms.

## COMMUNITY LIFELINES

Lifelines are the most fundamental services in the community that, when stabilized, enable all other aspects of society to function. Community lifelines are essential for the well-being of any community. They provide support and assistance to individuals who require help, especially during times of crisis. FEMA Community Lifelines are a critical component of emergency management in the United States. These lifelines are designed to address the essential needs of a community during and after a disaster. There are eight lifelines, each with its own focus and purpose (Figure 118). Heavy rain can potentially disrupt transportation and energy lifelines.


**Figure 118: Community Lifelines**[122]

The importance of these lifelines cannot be overstated. In a disaster, communities can be left without access to necessities such as food, water, and shelter. The lifelines help ensure that these needs are met and that people have the resources they need to survive. By providing access to medical care, public health services, and transportation, the lifelines help ensure that people can receive the care they need and safely evacuate if necessary. In addition, the Hazardous Materials lifeline helps to ensure that dangerous materials are managed safely, reducing the risk of further harm.

Community lifelines help create a sense of safety and security in a community. They provide a safety net for individuals who may be struggling and offer comfort and reassurance that help is available when needed. Without these lifelines, communities would be much more vulnerable to crises and emergencies.

## CHANGES IN DEVELOPMENT

Potential impact from heavy rains includes loss of life/property and flooding. Rain combined with snow-melt runoff can contribute to potential flooding. Also, population growth, new construction of homes and businesses, and construction or changes in transportation routes provide new economic opportunities but may also indicate an increase in exposure to heavy rain. Changes in land use and development may be impacted as residential zoning may change for areas experiencing significant precipitation. Overall, vulnerability to heavy rain has increased since the last plan update.

## VULNERABILITY SCORE

The NRI does not provide data to define risks associated with a heavy rain hazard.

[122] FEMA. “Community Lifelines.” https://www.fema.gov/emergency-managers/practitioners/lifelines

# High Wind

## Hazard Description

High wind can occur with or without a storm and are unpredictable. According to the National Weather Service (NWS), “High wind has sustained winds speeds of 40 miles per hour (mph) lasting for 1 hour or longer, or wind of 58 mph or greater for any duration.”[123] Salt Lake County has experienced high winds in the past and can expect future events.

According to the NWS definition, straight line winds are defined as “any wind that is not associated with rotation, used mainly to differentiate them from tornadic winds.”[124] Straight-line winds are responsible for most thunderstorm wind damage, and their speeds can exceed 125 miles per hour (mph). Other damaging winds originating from thunderstorms include downbursts and microbursts. Utah has also experienced downslope wind events, which occur when wind generated as a deep layer of air is forced over a barrier. According to the NWS, a downslope flow is defined as “a thermally driven wind directed down a mountain slope and usually occurring at night, part of the along-slope wind system.”[125] Winds accelerate down mountain slopes and generate high winds in a wave region formed at the base of the terrain. A downslope 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. In October 2020, a severe windstorm with wind gusts reaching up to 89 miles per hour caused extensive damage across Salt Lake County leading to power outages for many residents, with some lasting over a week. The State of Utah declared a state of emergency due to the situation. Tragically, one individual in South Salt Lake lost their life. 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 resulting in loss of electricity in homes and businesses. Winds have also damaged roofs, destroyed and knocked down large trees and fences, overturned tractor trailers and railroad cars, as well as resulting in downing small airplanes.

[123] National Oceanic and Atmospheric Administration (NOAA), National Weather Service (NWS). “National Weather Service Glossary.” https://forecast.weather.gov/glossary.php
[124] Ibid.
[125] Ibid.

Figure 119: Wind Damage in Salt Lake County Following 2020 Storm

## Hazard Profile

| | | | | | |
|---|---|---|---|---|---|
| **Potential Impact** | | Catastrophic | **Probability** | X | Highly Likely |
| | X | Critical | | | Likely |
| | | Limited | | | Occasional |
| | | Negligible | | | Unlikely |
| **Location** | High wind can occur in areas throughout the entire county. | | | | |
| **Seasonal Pattern** | High wind can occur year-round. | | | | |
| **Conditions** | High winds vary based on latitude, elevation, aspect and landforms. | | | | |
| **Duration** | High Wind hazard generally lasts hours; some conditions can persist for days. | | | | |
| **Secondary Hazards** | Potential secondary hazards include wildfire and flooding. | | | | |
| **Analysis Used** | National Climate Data Center, National Weather Service, Utah Avalanche Center, Utah Division of Emergency Management (UDEM), local input, and review of historic events and scientific records | | | | |

## Extent/Magnitude

The Beaufort Wind Scale was developed to estimate wind speeds based on their effects via visual observations. Initially used by sailors based on sea conditions, it is still in use today to estimate wind strengths.

**Table 59: Beaufort Wind Scale[126]**

| Force | Speed (mph) | Speed (knots) | Description | Specifications |
|---|---|---|---|---|
| 0 | 0-1 | 0-1 | Calm | Calm; smoke rises vertically |
| 1 | 1-3 | 1-3 | Light Air | Direction of wind shown by smoke drift, but not by wind vanes |
| 2 | 4-7 | 4-6 | Light Breeze | Wind felt on face; leaves rustle; ordinary vanes moved by wind |
| 3 | 8-12 | 7-10 | Gentle Breeze | Leaves and small twigs in constant motion; wind extends light flag |
| 4 | 13-18 | 11-16 | Moderate Breeze | Raises dust and loose paper; small branches are moved |
| 5 | 19-24 | 17-21 | Fresh Breeze | Small trees in leaf begin to sway; crested wavelets form on inland waters |
| 6 | 25-31 | 22-27 | Strong Breeze | Large branches in motion; whistling heard in telegraph wires; umbrellas used with difficulty |
| 7 | 32-38 | 28-33 | Near Gale | Whole trees in motion; inconvenience felt when walking against the wind |
| 8 | 39-46 | 34-40 | Gale | Breaks twigs off trees; generally, impedes progress |
| 9 | 47-54 | 41-47 | Severe Gale | Slight structural damage occurs (chimneypots and slates removed) |
| 10 | 55-63 | 48-55 | Storm | Seldom experienced inland; trees uprooted; considerable structural damage occurs |
| 11 | 64-72 | 56-63 | Violent Storm | Very rarely experienced; accompanied by wide-spread damage |
| 12 | 72-83 | 64-71 | Hurricane | See Saffir-Simpson Hurricane Scale. |

## Location

The entire region of Salt Lake County can be affected by most high wind events and their effects. Wind events are most damaging to areas that are heavily wooded and areas with exposed property and above-ground utility lines.

## Historical Events and Probability of Future Occurrences

Based on the FEMA Disaster Declarations Database, in October 2020, a severe windstorm with gusts up to 89 miles per hour caused extensive damage and prolonged power outages in Salt Lake County, leading the State of Utah to declare a state of emergency. About 1,000 trees were knocked down in Salt Lake City alone. As many as 170,000 homes and businesses lost power. Areas with the most power

[126] NOAA, NWS. "Beaufort Wind Scale." https://www.weather.gov/mfl/beaufort

outages included Millcreek, northeast Salt Lake City, South Salt Lake, Murray, Holladay, and northern Taylorsville.[127]

National Oceanic and Atmospheric Administration (NOAA) data records indicate that the highest wind event recorded in the county occurred on January 8, 2005, with gusts up to 99 knots (or 113.93 mph), This level of wind exceeds the limits of the Beaufort Wind Scale.

According to NOAA National Centers for Environmental Information (NCEI) data, there have been 264 days with high wind events from 1956 to 2024 (68 years), totaling $10.6 million in property damage and $365,800 in crop damage. These also resulted in 2 deaths and 48 injuries. There were 8 strong wind events resulted in $36,000 in damage. The FEMA National Risk Index (NRI) defines “strong wind” as consisting of “winds, often originating from thunderstorms that are classified as exceeding 58 mph.”[128] 186 thunderstorm wind event days caused 15 injuries and resulted in over $5 million in property damage and $65,600 in crop damage. Total damages of $16,127,400 average to approximately $237,168 in losses per year. 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, although the majority of events caused little to no property damage.

Since 2019, the time of the last mitigation plan update, 103 wind events have been recorded, totaling $4,929,000 and resulting in 1 death and 12 injuries. Most of these were from a single event in September 2020, described below. Figure 121 indicates the location and strength of past wind events in the county.

On September 8, 2020, a weather pattern abnormal for September developed, triggering a significant downslope flow wind event. Based on climatology and previous case study findings, this type of event most commonly occurs during the winter months. Downslope wind events are often confined to areas near canyon mouths and usually impact only isolated areas with extreme winds. This event was unusual in both the early fall timing and extensive spatial coverage of the damage. High winds were reported as far south as the Tooele Valley, with high wind reports all along the Interstate 15 corridor stretching north into the Cache Valley. Because trees still had their full canopy, the tree damage all along the Wasatch Front was extreme, with an estimated 4,500 trees damaged in Salt Lake County alone. Current estimates put the cost at $8.9 million for the region. The storm led to 1 fatality, 20 direct injuries, and 4 indirect injuries. Over 180,000 power outages were reported along the Wasatch Front, with power restorations taking up to a week in some locations due to extensive damage. Schools and recreation facilities were closed.

[127] Gonzalez, Norma, Taylor Stevens, and Sean P. Means. “Utah declares state of emergency after windstorm knocked down thousands of trees.” The Salt Lake Tribune. September 9, 2020. https://www.sltrib.com/news/2020/09/09/utahs-winds-are-dying/

[128] FEMA, National Risk Index. “Strong Wind.” https://hazards.fema.gov/nri/strong-wind

Figure 120: September 2020 Windstorm Damage[129]

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 mph to 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 damage was 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 the 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 million.

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

[129] Photo provided by Salt Lake County Emergency Management

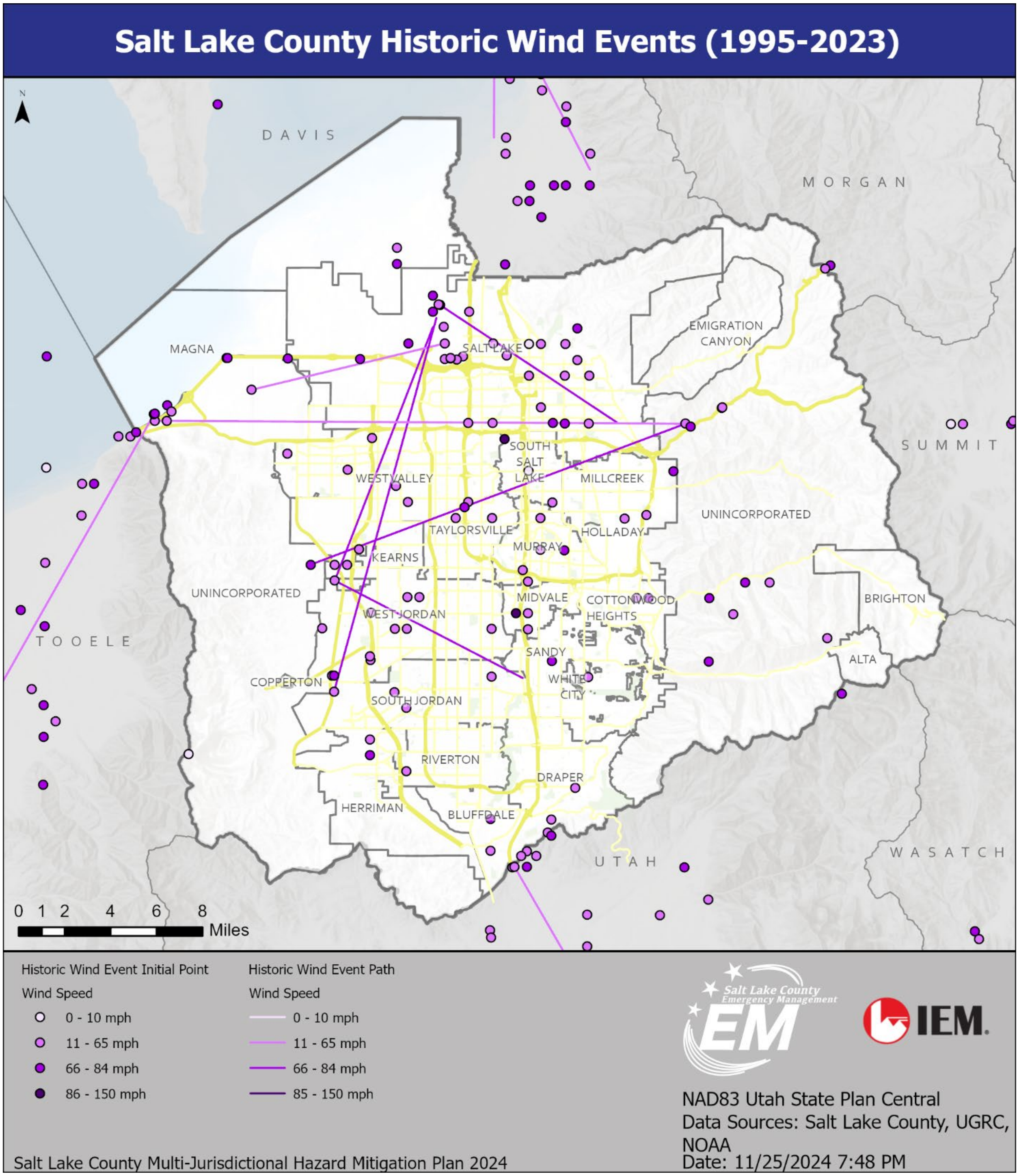


**Figure 121: Historic Wind Events**

## Climate Change Considerations

The 2024 State Enhanced Hazard Mitigation Plan states that research on climate change and its effects on severe weather in Utah does not provide clear evidence of how increased convective activity will impact future wind events. However, climate models consistently indicate that increased convective storms are a likely outcome of climate change, with worsening tornado activity, and strong evidence exists that extreme heat will continue to increase with worsening climate change.

## Secondary Hazards

The most significant secondary hazards associated with high winds are fallen trees, downed power lines, and the resulting power outages. According to the Commonwealth Edison, “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:

- High and moderate winds lead to power outages by blowing objects into power lines and other components, causing an interruption of services. Both high winds (more than 55 mph) and moderate winds (35 to 55 mph) may be sufficient to cause power outages.
- Momentary outages may occur if an object, such as a tree limb, is blown onto a power line, disrupting electrical services. If high wind coincides with warm temperatures and low humidity, it can pose an increased risk of fire danger. A Red Flag Warning may be issued to warn fire officials, firefighters, and the public of potentially dangerous fire weather conditions that may affect power lines.

## Vulnerability Assessment

Residents can face injury or death related to high wind events, most often caused by trees or limbs falling on homes or vehicles. People residing in mobile homes or RV parks are particularly vulnerable to injury or death from high wind events. People who are outdoors may be harmed by wind-driven debris. Others face isolation and exposure during severe storms or could suffer from secondary effects of the hazard.

Trees uprooted by winds or fallen limbs can cause significant damage to homes and other structures and vehicles. Mobile and manufactured homes are particularly vulnerable to damage. High wind can damage roof materials, gutters, or other exterior fixtures. Windows can be broken by windblown debris.

Critical facilities may experience damage by wind-driven debris or downed trees. They may also be affected by wind-driven damage to power lines producing power outages that cause disruptions to operations. Additionally, response times can be delayed by interruptions to transportation networks.

Power infrastructure, particularly above ground power line and substations, are particularly vulnerable to damage during high winds. Other utility facilities, such as water or communications systems, may be disrupted while power is out. Debris can block roadways, and power outages can disable traffic signals, which can create difficulty navigating transportation networks.

Wind-related damage and secondary hazards such as utility disruption can also have negative impact on businesses. Significant economic impacts can result from physical damage to structures, building contents, and revenue and wage losses when businesses are inoperable due to power and/or communication outages. Debris removal can be costly to local governments and may strain local resources.

## ESTIMATED IMPACT AND POTENTIAL LOSSES

The National Risk Index (NRI) includes data on the expected annual losses to individual natural hazards, historical loss, and overall risk at a county and census tract level. Salt Lake County's NRI expected annual loss (EAL) value for strong wind is $741 thousand with a risk score of 76.6 and a rating of relatively moderate percentile compared with the rest of the United States (Figure 122).

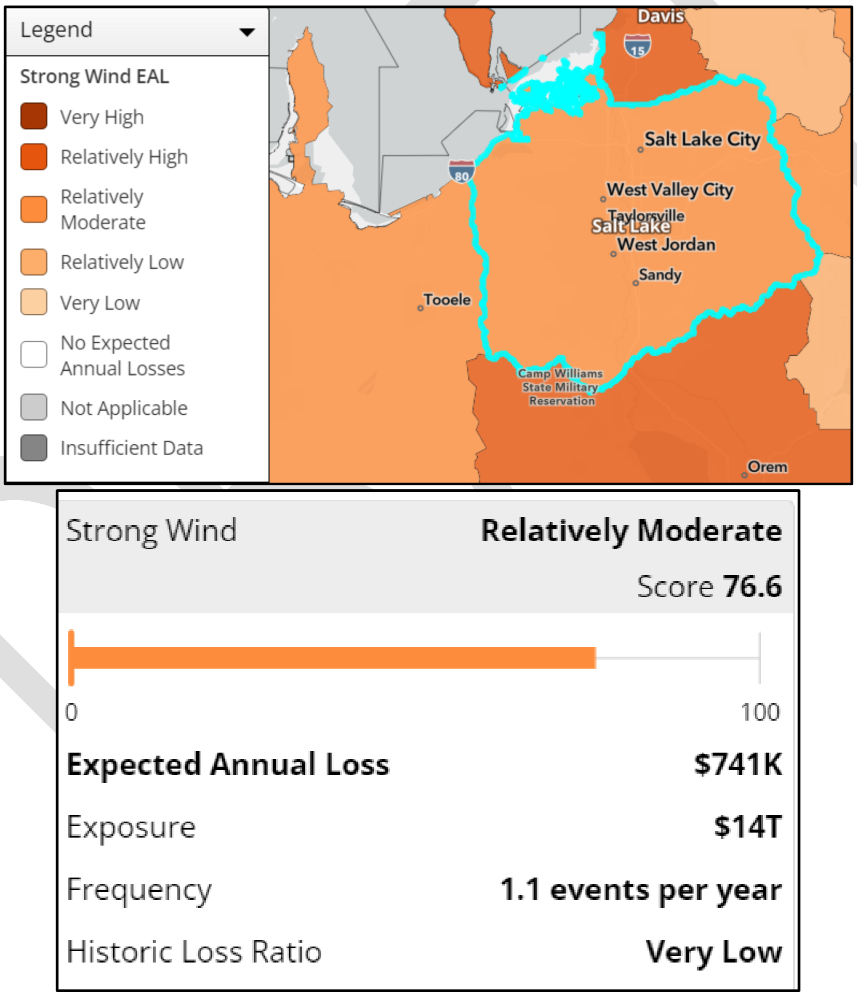


**Figure 122: FEMA National Risk Index Salt Lake County Expected Annual Loss from Strong Wind**[130]

[130] FEMA, National Risk Index. "Salt Lake County Expected Annual Loss Strong Wind Risk Score, Map and Legend." https://hazards.fema.gov/nri/map

## VULNERABLE POPULATIONS

The 2024 State Enhanced Hazard Mitigation Plan states that people living in less-wind resistant housing, such as mobile homes, are more vulnerable to wind hazard. Outdoor workers, outdoor recreationists, or unhoused populations may have difficulty seeking adequate shelter during a wind event and are vulnerable to injury from wind effects. Elderly residents or people with disabilities may be negatively affected by power outages if they rely on power for medical devices or for ingress and egress to their homes. They may be isolated from critical support services if debris or other damage leads to roadway closures. They may have difficulty addressing debris cleanup.

## COMMUNITY LIFELINES

FEMA Community Lifelines are the most fundamental services in the community that, when stabilized, enable all other aspects of society to function. Community Lifelines are essential for the well-being of any community. They provide support and assistance to individuals who require help, especially during times of crisis. FEMA Community Lifelines are a critical component of emergency management in the United States. These lifelines are designed to address the essential needs of a community during and after a disaster. There are eight lifelines, each with its own focus and purpose (Figure 123). High winds can disrupt safety and security, energy, transportation, and food, hydration and shelter lifelines.


**Figure 123: Community Lifelines**[131]

The importance of these lifelines cannot be overstated. In a disaster, communities can be left without access to necessities such as food, water, and shelter. The lifelines help ensure that these needs are met, and that people have the resources they need to survive. By providing access to medical care, public health services, and transportation, the lifelines help ensure that people can receive the care they need and safely evacuate if necessary. In addition, the Hazardous Materials lifeline helps to ensure that dangerous materials are managed safely, reducing the risk of further harm.

[131] FEMA. "Community Lifelines." https://www.fema.gov/emergency-managers/practitioners/lifelines

Community Lifelines help create a sense of safety and security in a community. They provide a safety net for individuals who may be struggling and offer comfort and reassurance that help is available when needed. Without these lifelines, communities would be much more vulnerable to crises and emergencies.

### CHANGES IN DEVELOPMENT

Potential impacts from increase in high wind vulnerability include loss of life and property, power failure, and decreased air quality. Overall growth in population and new building construction in Salt Lake County results in a higher number of people potentially exposed to high wind. Changes in local economies may affect whether a community is financially able to recover from a high wind event. In 2020, the county had a high wind event that caused extensive damage throughout the county with debris in roads, trees down, and power failures (in some areas for over a week), forcing county employees to miss work. Changes in land use and development may require stricter building codes for new builds to withstand extreme weather events. Overall vulnerability high wind has increased since the last plan update.

### VULNERABILITY SCORE

In order to analyze the county's vulnerability to severe weather, the NRI was used as a primary tool during the 2024 Hazard Identification and Risk Assessment update. The NRI defines risk as the potential for negative impacts as a result of a natural hazard and determines a community's risk relative to other communities by examining the expected annual loss and social vulnerability in a given community in relation to that community's resilience. Salt Lake County's NRI strong wind risk rating is shown in Figure 124. Salt Lake County has relatively moderate strong wind risk and a risk score of 72.6.

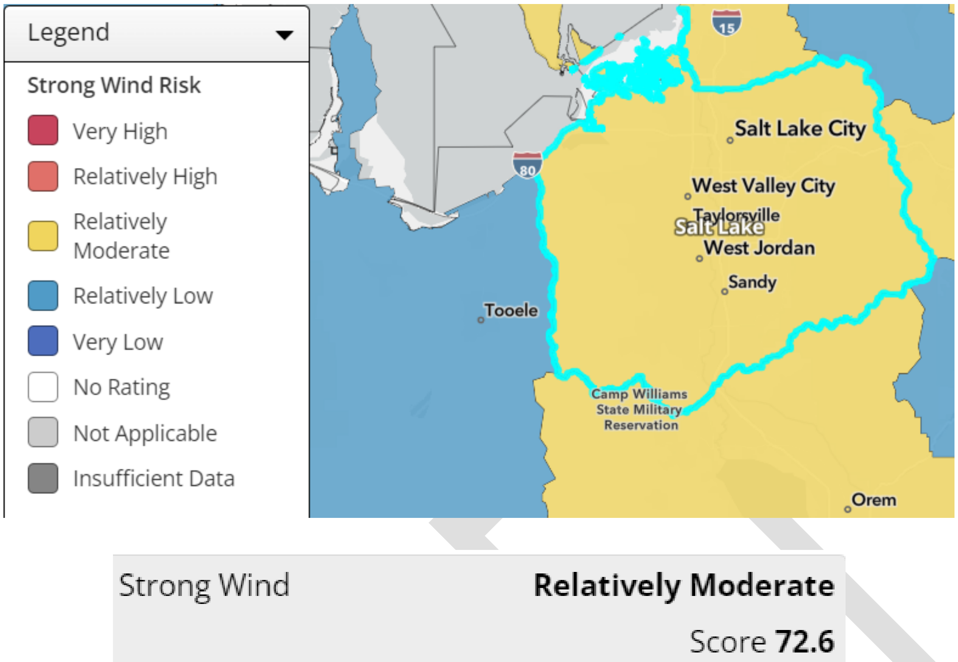


**Figure 124: National Risk Index Strong Wind Risk Map, Legend, and Score for Salt Lake County, Utah[132]**

[132] FEMA, National Risk Index. "Salt Lake County Strong Wind Score, Map and Legend." https://hazards.fema.gov/nri/map

# Landslide/Slope Failure

## Hazard Description

Slope failure is any ground disturbance on a sloped surface. Slope failures, also known as landslides, 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 slope failures in Utah include rock falls, rock topples, debris slides, debris flows, earth slides, and earth flows.

A landslide is a mass of earth or rock that moves downslope by flowing, spreading, sliding, toppling, or falling. Landslides are one of Utah's most common natural hazards, primarily located in areas with moderate to steep slopes or weak slope materials. Most landslides are associated with precipitation events with 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 slopes or increasing soil moisture through landscape irrigation, can also trigger landslides.


**Figure 125: Diagram of an Idealized Landslide Showing Commonly Used Terminology**[133]

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, or steep bedrock road cuts. The most significant damage from rock falls is to roads, railroads, and aboveground pipelines.

[133] Beukelman, Gregg. "Landslide Hazards in Utah." Utah Geological Survey. 2011. https://ugspub.nr.utah.gov/publications/public_information/pi-98.pdf

Debris slides and flows occur in steep mountainous areas and involve 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 outward from canyon mouths for a considerable distance, potentially damaging buildings, bridges, roads, railroads, and pipelines. Areas impacted by wildfires may be more likely to experience debris flows because vegetation no longer holds soils in place.

Earth slides and flows are composed of fine-grained material; earth slides contain less water than earth flows. Earth slides and flows vary in size, including some of the largest earth slides in Utah's history. Like other landslides, earth slides and flows have the potential to damage anything in their path.

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

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

## Hazard Profile

| | | | | | |
|---|---|---|---|---|---|
| **Potential Impact** | | Catastrophic | **Probability** | | Highly Likely |
| | | Critical | | X | Likely |
| | X | Limited | | | Occasional |
| | | Negligible | | | Unlikely |
| **Location** | Typically in canyon mouths and foothills and areas of recent wildfire activity | | | | |
| **Seasonal Pattern** | Spring and summer months | | | | |
| **Conditions** | Typically 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 | | | | |

## Magnitude/Extent

The Rio Tinto Landslide was the single largest natural disaster in Salt Lake County's history. The North Salt Lake City landslide was categorized as a "major" landslide. Due to the nature of Salt Lake County's topography and development encroaching into steeper areas, the magnitude of damage is likely 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 cost hundreds of thousands of dollars to hundreds of millions of dollars in damage.

## Location

Landslides and debris flows are most common in the foothills along the base of the Wasatch Mountain Range and are caused by 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. Figure 126–Figure 131 show the locations of critical facilities in relation to landslide susceptibility within the county.

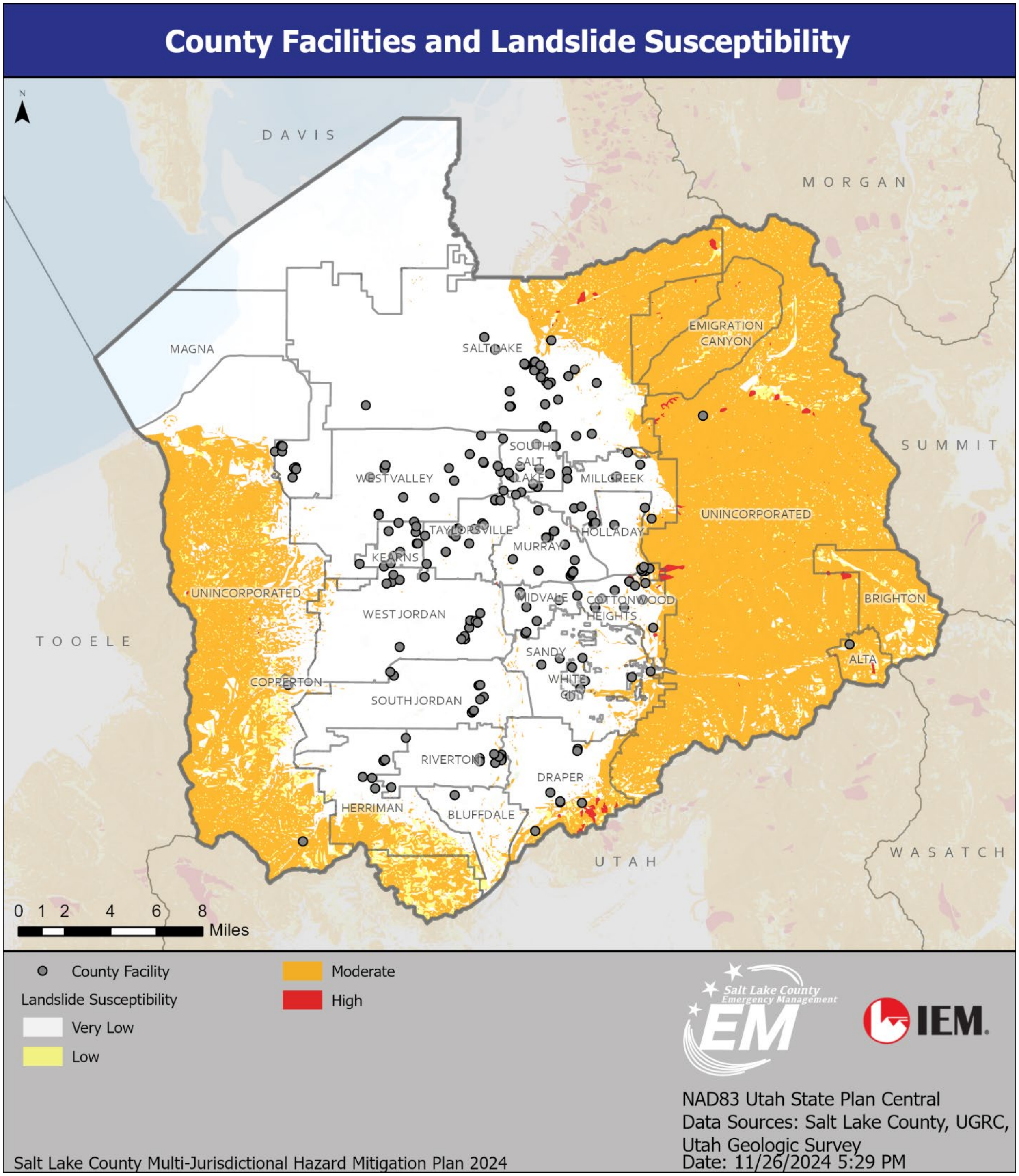


**Figure 126: County Facilities in Areas Susceptible to Landslides**

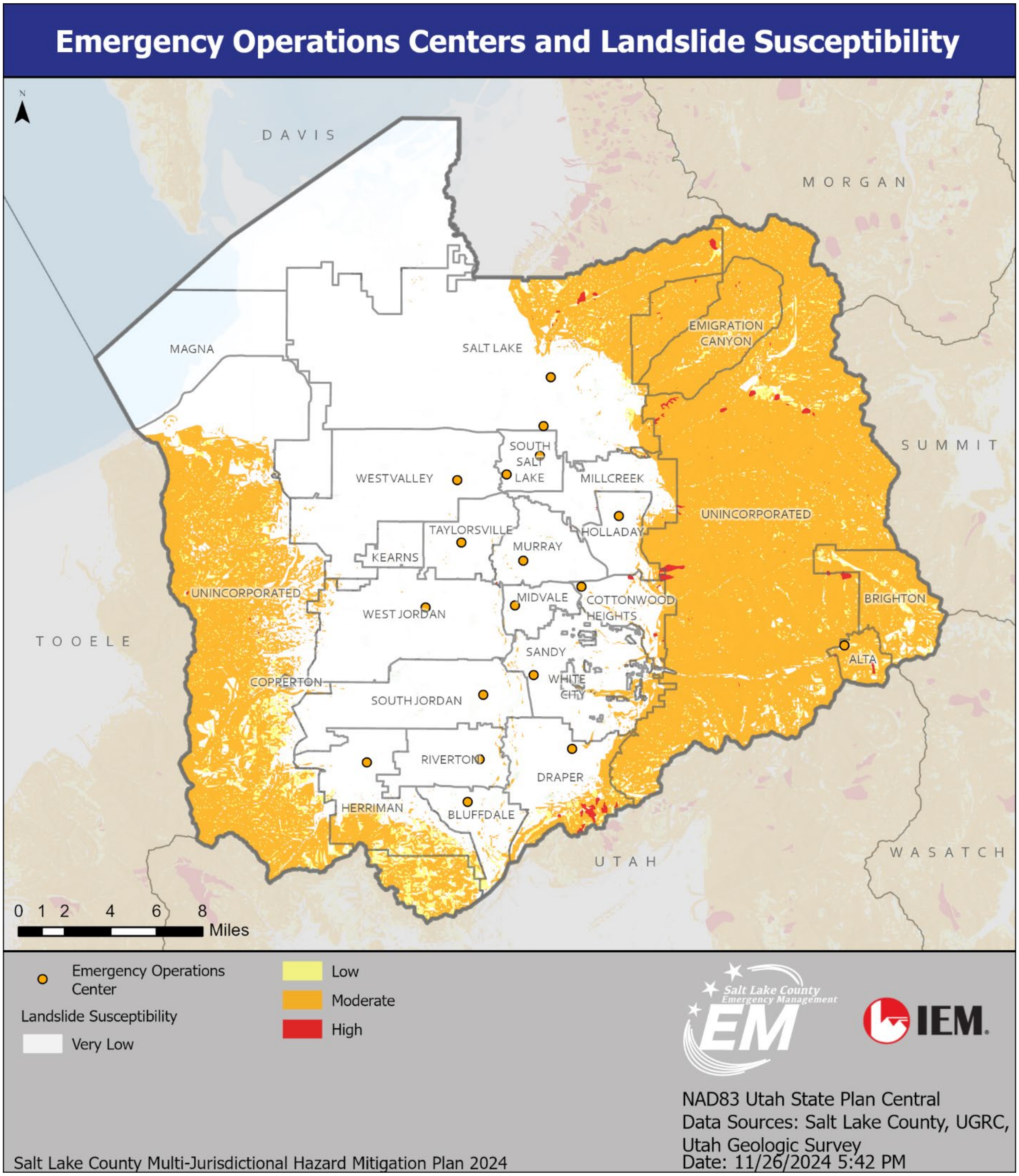


Figure 127: EOCs in Landslide Susceptible Areas

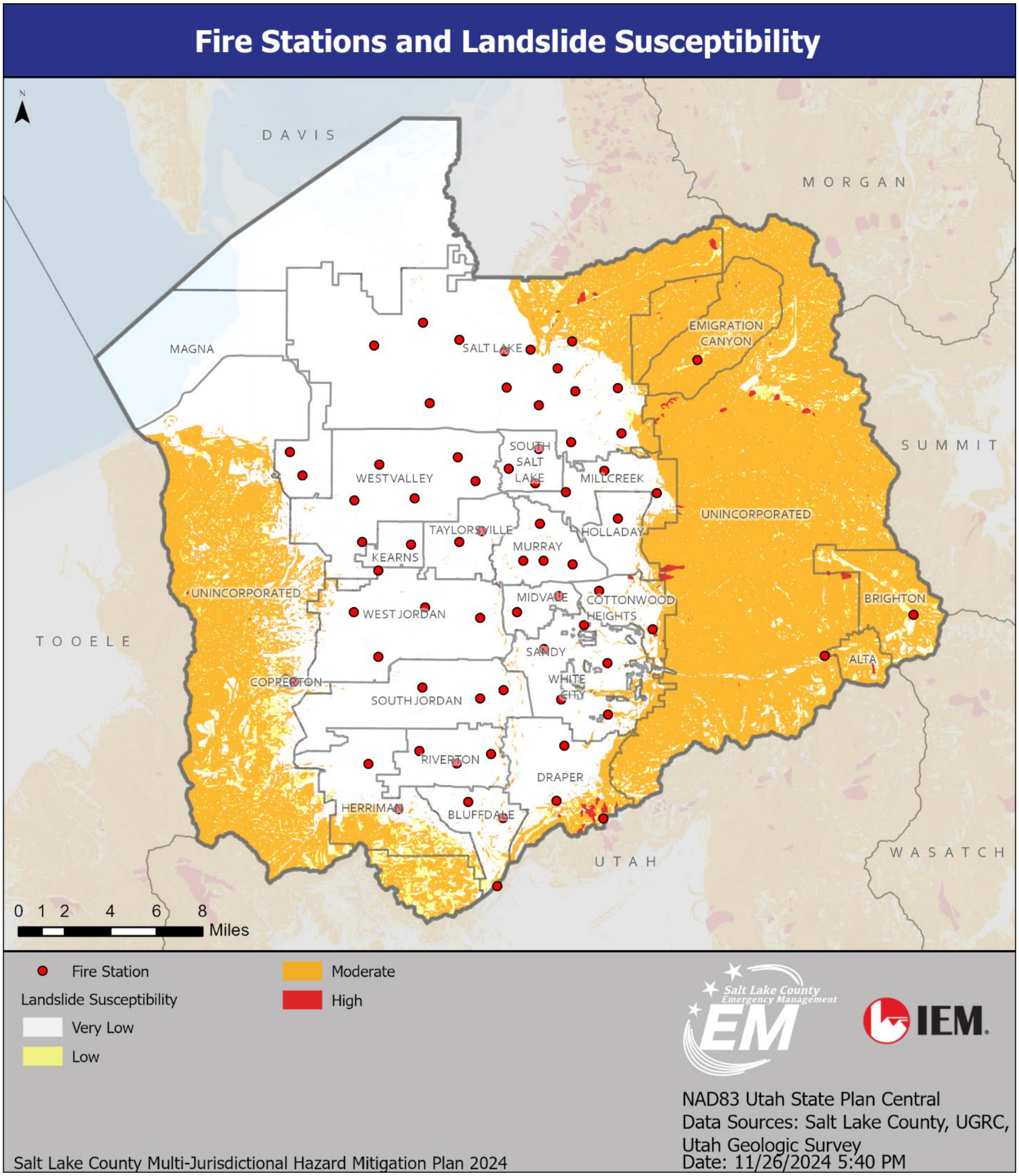


**Figure 128: Fire Stations in Areas Susceptible to Landslides**

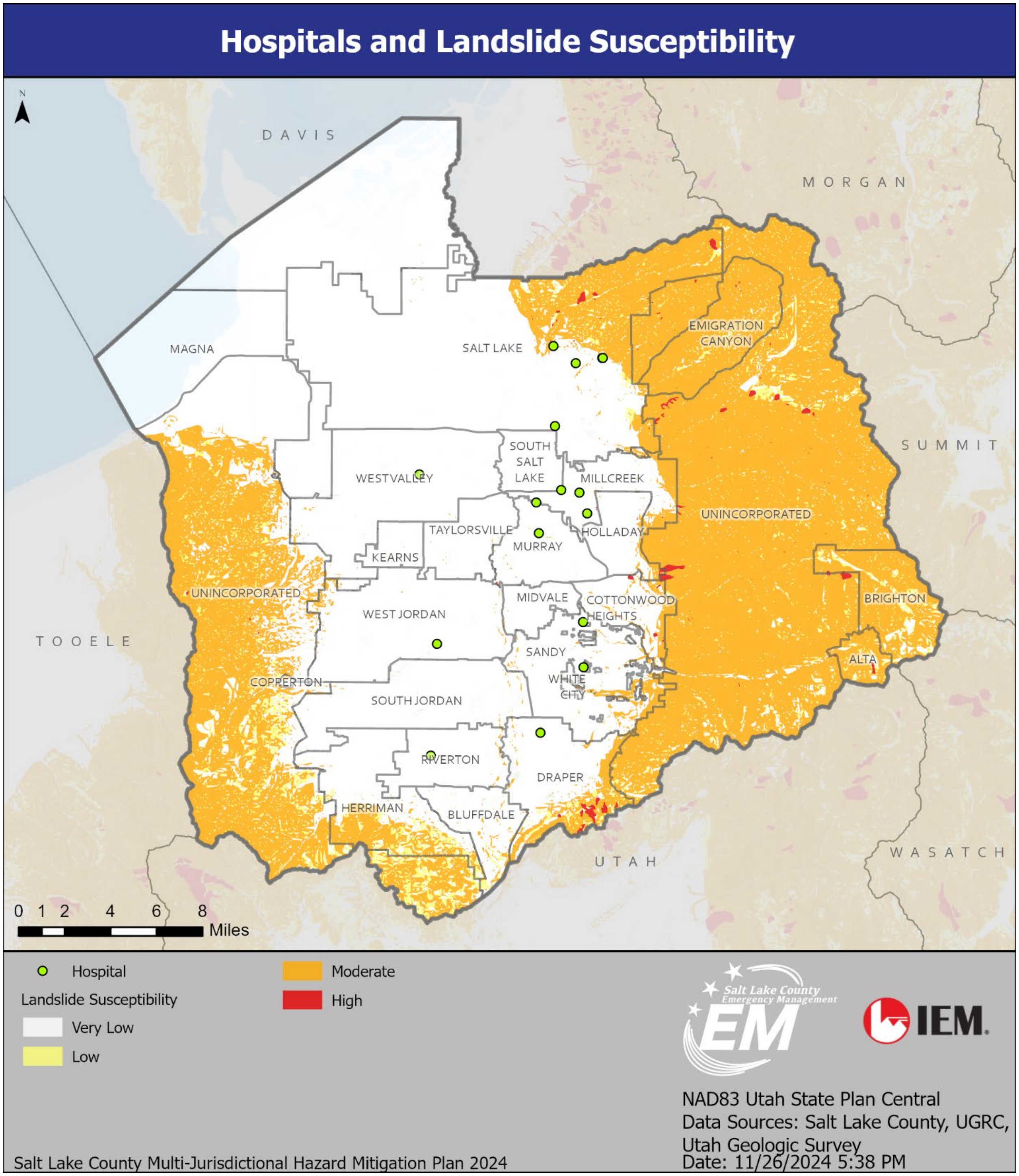


**Figure 129: Hospitals in Areas Susceptible to Landslides**

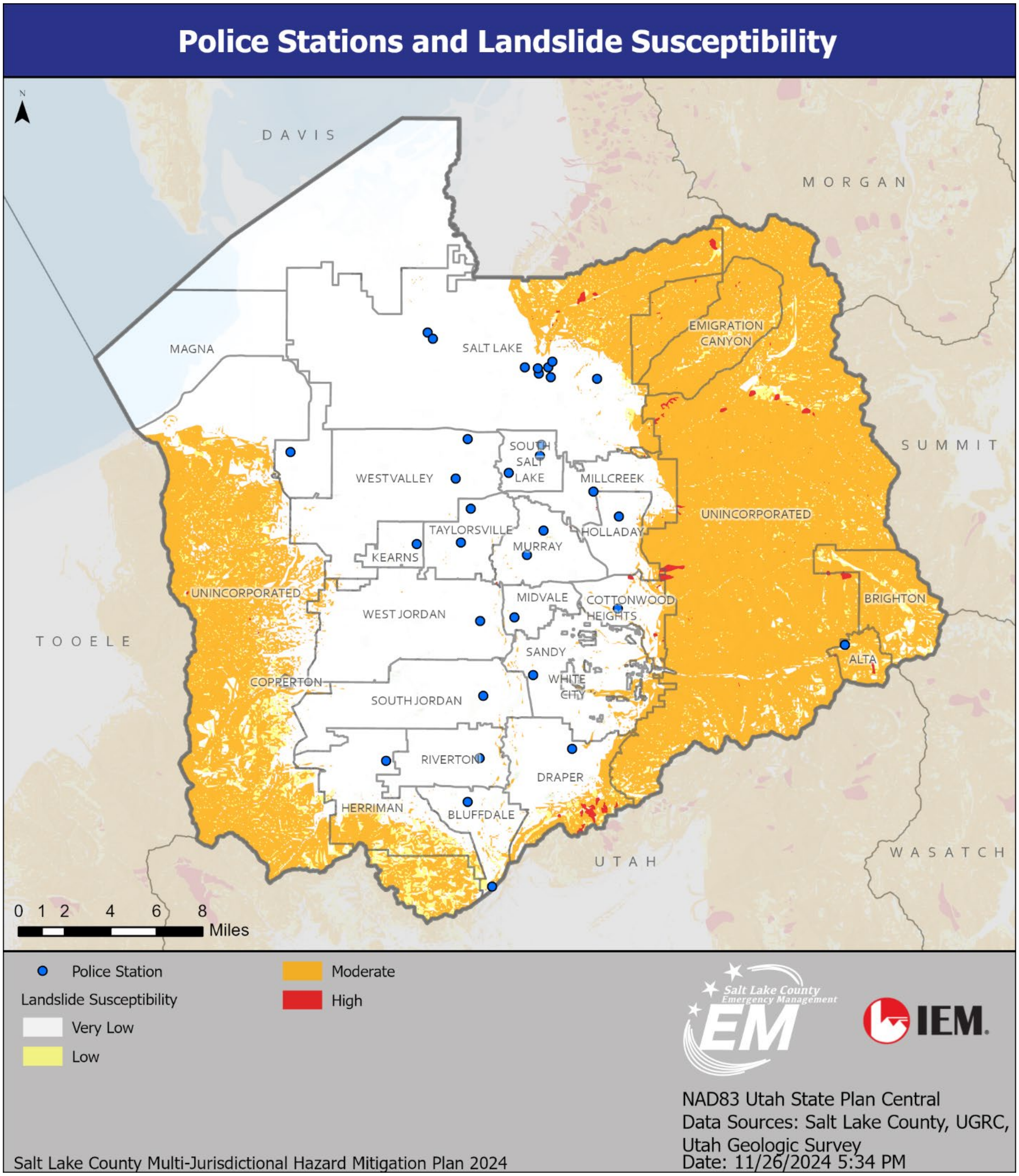


**Figure 130: Police Stations in Areas Susceptible to Landslides**

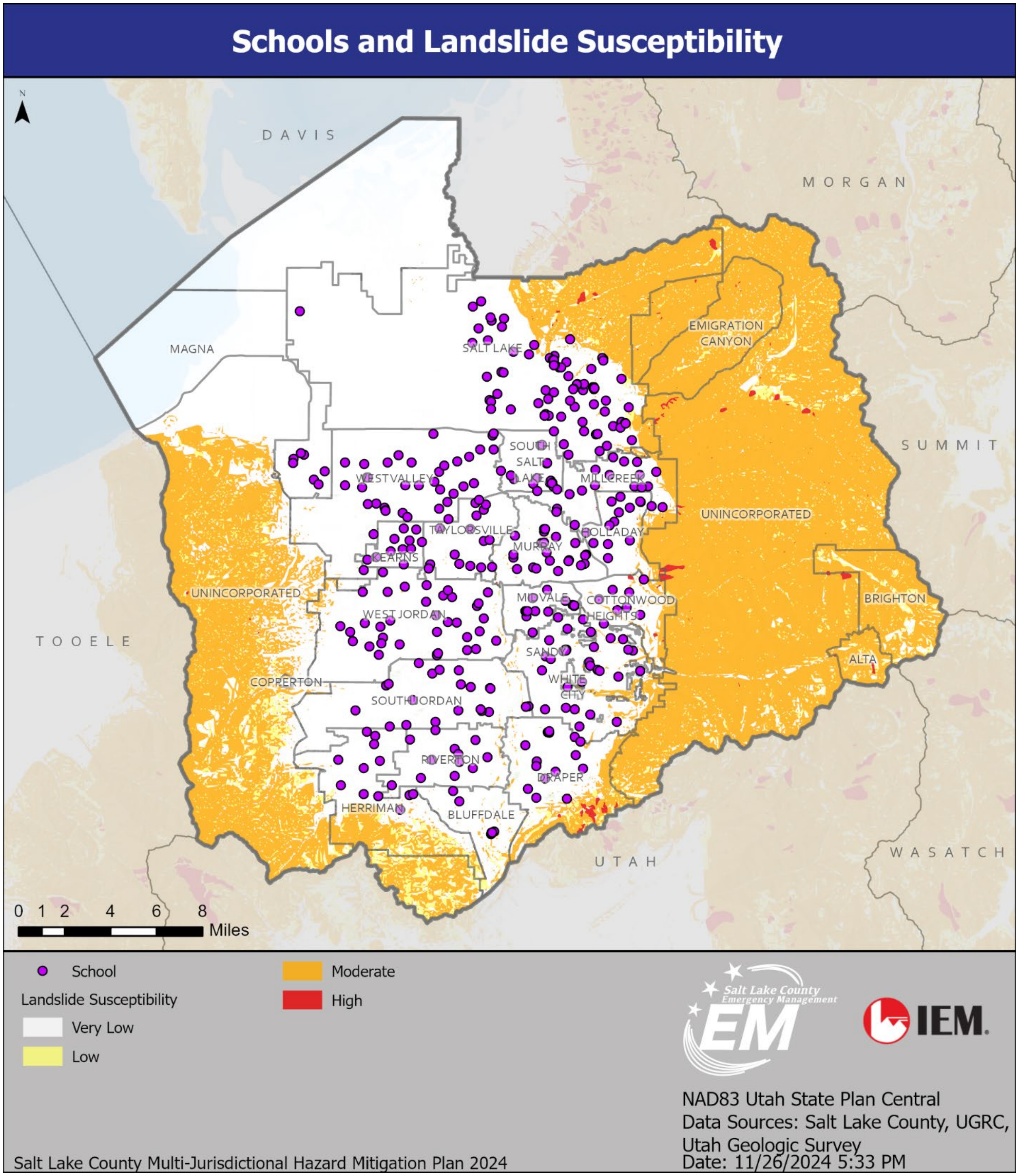


**Figure 131: Schools in Areas Susceptible to Landslides**

According to the 2019 Utah State Hazard Mitigation Plan, 56% of all slope failures in Salt Lake County occurred on hillsides with slopes of 31–60%. In addition, 1.63 square miles of the County are categorized as “High Hazard” in terms of landslide susceptibility, 320 square miles are “Moderate,” 25 square miles are “Low,” and 373.9 square miles are “Very Low.”

## Historical Events and Probability of Future Occurrences

Based on the FEMA Disaster Declarations Database, there have not been any slope failure disaster declarations in Salt Lake County for landslide and slope failure since the last plan update.

Based on the frequency of past events, landslides and slope failures are likely to continue to occur periodically within Salt Lake County. In addition, subsidence may occur in City Creek, Emigration, Parley's, and Big Cottonwood Canyons due to the prevalence of dissolvable limestone. Subsidence may also occur in the Avenues area of Salt Lake City and the Taylorsville- Kearns area due to collapsible soils that are compactable upon wetting (Mulvey 1992).

**Little Cottonwood Canyon Landslide:** A landslide occurred on Tuesday afternoon, May 2, 2023, in Little Cottonwood Canyon, covering the entire roadway on SR-210 near mile marker 7. A second landslide from the same source occurred on top of the first approximately one hour later. The road was closed all day on May 2nd for avalanche mitigation, meaning that no cars were on the road, and therefore no injuries were reported. The type of landslide was debris flow, approximately 100 feet wide and 4 feet deep, according to the Utah Department of Transportation. Elevated groundwater levels from the melting of above-normal snowpack led to spring flow at the source. The impacts from the landslide included minor damage to the road and damaged or destroyed guard rails. No people were injured, and no buildings were damaged.


**Figure 132: Landslide in Big Cottonwood Canyon, Aug 2021**[134]

**Draper Springtime Road Landslide:** On Saturday morning, April 22, 2023, a landslide occurred on Springtime Road in Draper, Salt Lake County. Two homes collapsed when the hill they were on slid and fell into the small valley below; fortunately, these homes were evacuated in October 2022 due to unstable slope conditions. The landslide was reported to be the width of two tennis courts at the top, with a length

[134] Photograph provided by Salt Lake County Emergency Management/Unified Fire Authority

of more than three football fields. The homes were not built on natural slopes, rather they had been constructed on building pads engineered to fill the ravine. In addition to the two that were damaged, two additional homes were ordered to evacuate. The landslide and debris fell onto Ann's Trail, which remains closed.

**Emigration Canyon Landslides:** Record snowpack and subsequent warmer weather caused flooding and 10–15 landslides through April 2023 in Emigration Canyon, along with several small snow avalanches. A local emergency was declared in the Emigration Canyon Metro Township on April 13th. The earthflow landslide caused damage to two homes, one of which had considerable damage. Emigration Canyon Road was closed periodically during the spring months of 2023 due to avalanches and landslides.

**City Creek Canyon Landslides:** A cluster of historical landslides remains 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 the movement of the largest and most destructive of these landslides since June 1998. Over that time, the toe of the landslide has moved intermittently a total of approximately 24 feet, and the main scarp has offset the ground surface by nearly 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 melting of the snowpack. Four houses at the top of the slide are threatened, and efforts to protect one house have cost over $300,000 to date. In 2006, the landslide reactivated again, moving approximately 2 feet, despite drier-than-normal conditions in Salt Lake City.[135]

**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. This is the largest recorded 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.[136]

## Climate Change Considerations

The 2024 State Enhanced Hazard Mitigation Plan states climate change will continue to alter the landslide risk in Utah. The amount, timing, and type of precipitation in Utah are expected to change throughout the remainder of the twenty-first century. In general, projections of precipitation suggest that by 2100, northern Utah will receive increased precipitation. More important to landslide risk, the timing and type of precipitation is likely to change. A shift from snow-dominated precipitation to rain-dominated precipitation is well underway and expected to continue. Increased winter temperatures may increase the likelihood of landslides. Warmer winter temperatures reduce the extent of frozen soil, even if the snowpack exists. If heavy rain falls on snow at low- to mid-elevations when the snowpack is present and

[135] 2019 Utah State Hazard Mitigation Plan
[136] Ibid.

the soil is not frozen, there is a greater landslide risk. In addition, the projected increase in extreme precipitation events, in both summer and winter, will increase the landslide risk.[137]

## Secondary Hazards

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

## Vulnerability Assessment

The 2024 State Enhanced Hazard Mitigation Plan affirms the assessment of the vulnerability of assets to geologic hazards is limited by data availability. Ideally, the vulnerability of assets to geologic hazards would be based on the type, location, construction, height, and age of assets.

Landslides may occur in the Wasatch Mountains in eastern Salt Lake County, the Oquirrh Mountains in the western part of the county, and the Traverse Mountains to the south. As shown in the landslide susceptibility maps, the cities along the east bench of the Wasatch Mountains, including Salt Lake City, Emigration Canyon, Millcreek, Holladay, Cottonwood Heights, Sandy, Draper, the canyon communities of Brighton and Alta, and the southern part of Herriman City, all have areas of moderate-to-high landslide susceptibility. The western part of the county has less area within incorporated cities at risk of landslides. Smaller areas of susceptibility are found along the Jordan River and creeks in Cottonwood Heights and Sandy. Structures in these areas are primarily residential; homes and other structures near these areas may be at risk of damage from landslides. Swift-moving slope failures can cause injury or death for those in the affected area.

Landslides have the potential to damage or block major roadways, including I-80, Emigration Canyon Rd., Hwy 190 in Big Cottonwood Canyon, and Hwy 210 in Little Cottonwood Canyon. City Creek Canyon Rd, Mill Creek Canyon Rd., or Wasatch Boulevard could also be affected. Several of these routes have only one outlet, so residents or recreationists above the slide could become isolated until roadways are cleared. Many residential streets in the foothills are small, dead-end spur roads that may be difficult to access following a landslide; this could cause the emergency response to be delayed due to transportation limitations.

Landslides can also damage above-ground utility infrastructure including power lines or substations, water treatment facilities, or water lines. Disruption of these services can affect residents and businesses beyond the area directly impacted by the landslide. Much of the eastern mountains of Salt Lake County

[137] 2024 Utah State Hazard Mitigation Plan

are part of the Salt Lake City watershed; landslides in this area could impact the water supply for residents.

Prolonged closure of roads can have significant economic impacts due to reduced access to recreation areas. Recreation areas, parking lots, trails, or other improvements can also be damaged by landslides. This may reduce tourism to the area and strain budgets to repair amenities.

## ESTIMATED IMPACT AND POTENTIAL LOSSES

The following tables provide the potential estimated impacts to Salt Lake County from landslide and slope failure. This data is taken from the previous plan due to time constraints and the assumption that the change in hazard risk is minimal. Four fire stations and two county facilities are within moderate susceptibility zones. The daytime population in the County within high or moderate landslide-susceptibility areas is approximately 23,573 people; the total nighttime population within high or moderate landslide-susceptibility areas is approximately 24,443 people.

Table 60,Table 61, and Table 62 provide estimated values for infrastructure, populations, and residences vulnerable to landslides, respectively, in incorporated and unincorporated Salt Lake County. The tables include the number of units or total length of the vulnerable infrastructure and the estimated replacement costs as provided by HAZUS- MH lost estimation software. The tables also provide estimates for the total area, population, and buildings vulnerable to landslides for individual cities, although not all identifiable areas are specifically listed. Note that replacement costs have likely increased from the time this analysis was completed.

**Table 60: 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 bridge | $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** |

**Table 61: Vulnerability Assessment for Landslides, Incorporated Salt Lake County**

| Incorporated Areas | Acres Affected | Population Affected | Structures in Areas of Moderate or Greater Hazard | |
|---|---|---|---|---|
| | | | Residential Structures (Replacement Value) | Commercial Structures (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 |

| Incorporated Areas | Acres Affected | Population Affected | Structures in Areas of Moderate or Greater Hazard | |
|---|---|---|---|---|
| | | | Residential Structures (Replacement Value) | Commercial Structures (Annual Sales) |
| **Taylorsville** | 19 | 179 | 55<br>($11,253,000) | 2<br>($346,531) |
| **West Jordan** | 368 | 439 | 171<br>($34,986,600) | 0 |
| **West Valley City** | 65 | 59 | 17<br>($3,478,200) | 0 |

**Table 62: Vulnerability Assessment for Landslides, Unincorporated Salt Lake County**

| Unincorporated Areas | Acres Affected | Population Affected | Structures in Areas of Moderate or Greater Hazard | |
|---|---|---|---|---|
| | | | Residential Structures (Replacement Value) | Commercial Structures (Annual Sales) |
| **Big Cottonwood Canyon** | 32,822 | 4,635 | 1,543<br>($315,697,800) | 0 |
| **Camp Williams** | 9,746 | 5,475.0 | 1,571<br>($321,426,600) | 2<br>($724,308) |
| **Canyon Rim** | 168 | 2,865 | 928<br>($189,868,800) | 0 |
| **East Millcreek** | 18 | 162 | 57<br>($11,662,200) | 1<br>($27,753) |
| **Granite** | 17,372 | 8,817 | 2,724<br>($557,330,400) | 6<br>($2,300,292) |
| **Mount Olympus** | 18,263 | 5,226 | 1,706<br>($349,047,600) | 39<br>($9,634,013) |
| **Parley's Canyon** | 31,744 | 6,188 | 2,245<br>($459,327,000) | 1<br>($530,390) |
| **Sandy Hills** | 1 | 7 | 2<br>($409,200) | 0 |
| **Southwest** | 15,295 | 2,383 | 656<br>($134,217,600) | 7<br>($5,411,633) |
| **Willow Canyon** | 5 | 45 | 11<br>($2,250,600) | 1<br>($387,562) |

The National Risk Index (NRI) includes data on the expected annual losses to individual natural hazards, historical loss, and overall risk at the county and Census tract level. Salt Lake County's NRI expected annual loss (EAL) value for Landslide is $440K with a risk score of 97.3 and a "Relatively High" rating compared with the rest of the United States (Figure 133).

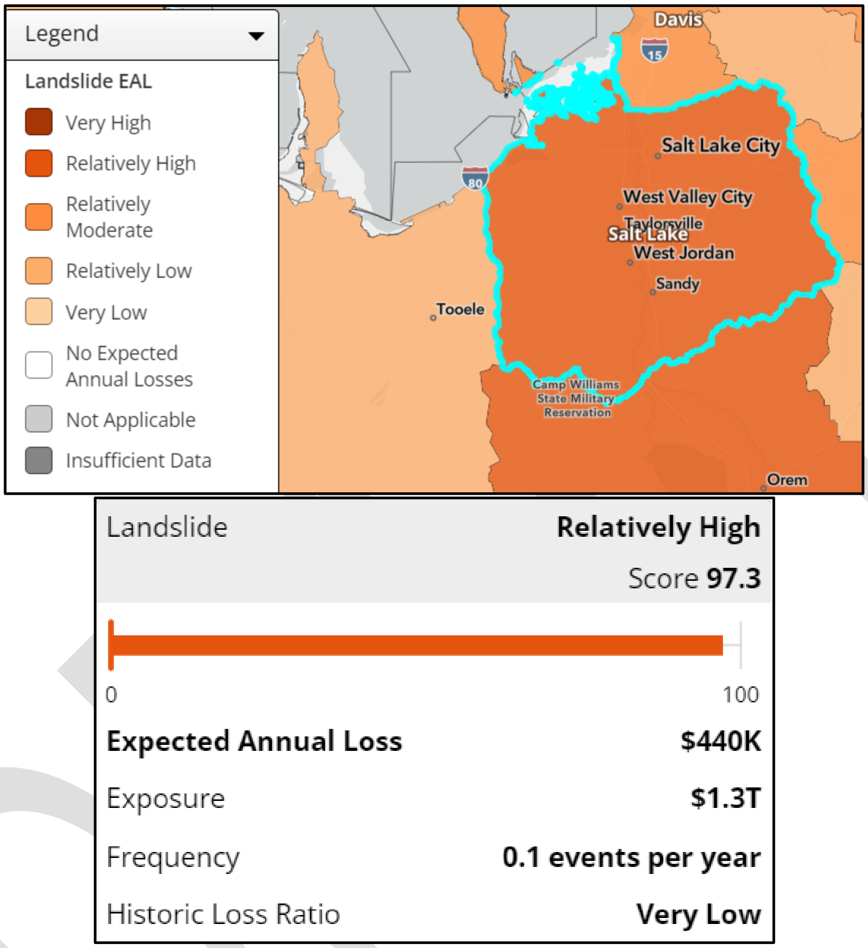


**Figure 133: FEMA National Risk Index Salt Lake County Expected Annual Loss from Landslides**[138]

## VULNERABLE POPULATIONS

All populations in the planning area located near identified hazard areas are at risk. Elderly residents or those with mobility limitations or other disabilities will likely have more difficulty evacuating from an imminent landslide.

## COMMUNITY LIFELINES

Community Lifelines are the most fundamental services that, when stabilized, enable all other aspects of society to function. Community Lifelines are essential for the well-being of any community; they provide support and assistance to individuals who require help, especially during times of crisis. FEMA

[138] FEMA, National Risk Index. https://hazards.fema.gov/nri/map

Community Lifelines are a critical component of emergency management in the United States. These lifelines are designed to address the essential needs of communities during and after a disaster. There are eight FEMA Community Lifelines, each with a specific focus and purpose (Figure 134). Landslides can disrupt food, hydration, and shelter if a slide damages residences. Transportation, energy, water, and communication lifelines can also be impacted.


**Figure 134: FEMA Community Lifelines[139]**

These lifelines are of critical importance. In a disaster, communities may lose access to necessities such as food, water, and shelter. Lifelines help ensure that these needs are met, and that people have the essential resources they need to survive. By providing access to medical care, public health services, and transportation, the lifelines help ensure that people receive the care they need and safely evacuate if necessary. In addition, the Hazardous Materials Lifeline helps to ensure that dangerous materials are managed safely, reducing future risk.



## CHANGES IN DEVELOPMENT

The population of Salt Lake County is predicted to grow over the next 30 years, reaching almost 5 million by 2050. This growth necessitates the development of key infrastructure elements guided by long-range planning. To address the challenges of population growth on housing availability, many communities have updated their plans and implemented the Wasatch Choice Vision (previously known as Wasatch Choices 2040 and Wasatch Choice 2050) in unique and meaningful ways, including coordinating the planning and location of land use, housing, transportation, economic development, and open space to increase the quality of life. These efforts may reduce the risk of landslide and slope failure and the county's future vulnerability in areas of new development.[140] However, risk remains where development has already occurred, and it is not always known where landslides may occur prior to development. Due to population growth and new construction, the overall vulnerability to landslide and slope failure has increased since the last plan update.

[139] FEMA. "Community Lifelines." https://www.fema.gov/emergency-managers/practitioners/lifelines
[140] Wasatch Choice Vision. 2024. https://wasatchchoice.org/

## VULNERABILITY SCORE

To analyze the County's vulnerability to landslides, the NRI was used as a primary tool during the 2024 HIRA update. The NRI defines risk as the potential for negative impacts as a result of a natural hazard and determines a community's risk relative to other communities by examining the expected annual loss and social vulnerability in a given community in relation to that community's resilience. Salt Lake County's NRI landslide risk rating is shown in Figure 135. Salt Lake County has a relatively high landslide risk and a risk score of 95.9.

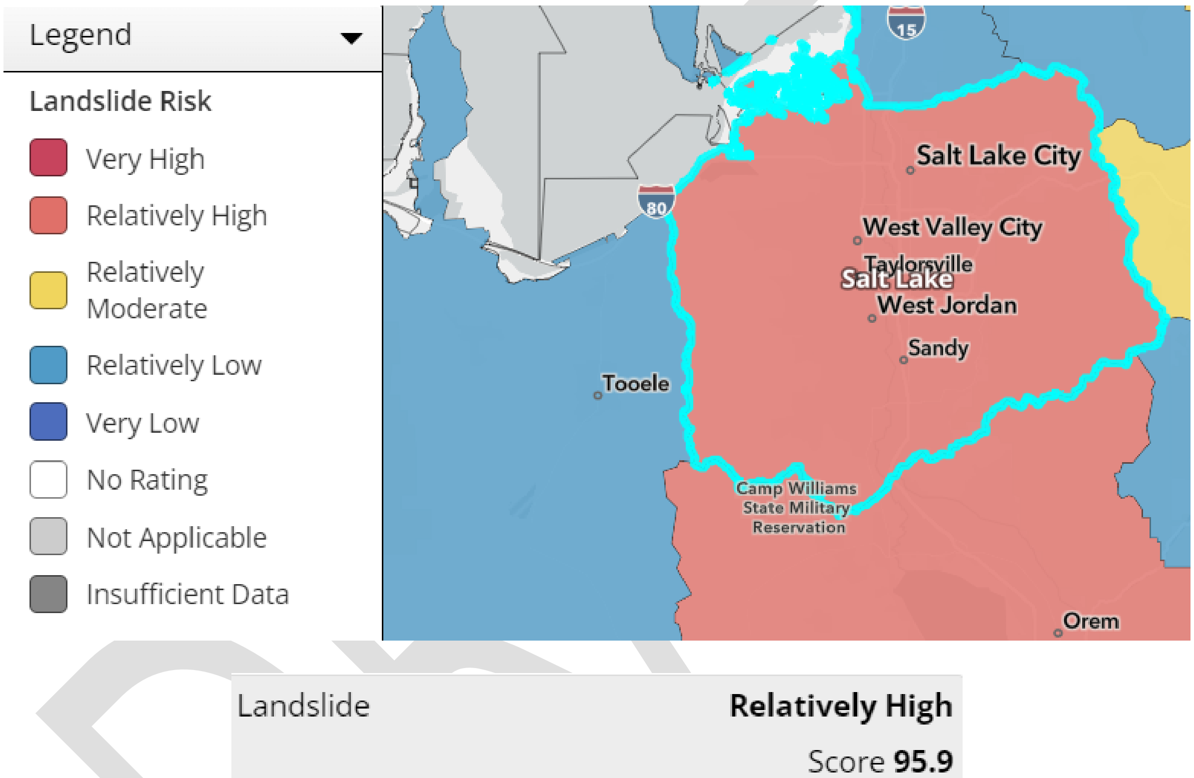


**Figure 135: National Risk Index Landslide Risk Map and Score for Salt Lake County**[141]

[141] FEMA, National Risk Index. "National Risk Index Salt Lake County Landslide Score, Map and Legend." https://hazards.fema.gov/nri/map

# Lightning

## Hazard Description

Lightning is the discharge of atmospheric electricity from a thunderstorm. It can travel at speeds up to 140,000 miles per hour and reach temperatures approaching 54,000 degrees Fahrenheit.[142] Lightning is often perceived as a minor hazard. According to the National Weather Service (NWS), lightning is a major cause of storm-related deaths in the United States. NWS Storm Data recorded an average of 43 reported lightning fatalities per year in the United States between 1989–2018.[143] Additionally, lightning can produce damage to both infrastructure and buildings.

## Hazard Profile

| | | | | | |
|---|---|---|---|---|---|
| **Potential Impact** | | Catastrophic | **Probability** | X | Highly Likely |
| | X | Critical | | | Likely |
| | | Limited | | | Occasional |
| | | Negligible | | | 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, power outage | | | | |
| **Analysis Used** | National Climate Data Center, National Weather Service, Utah Avalanche Center, UDEM, local input, and review of historic events and scientific records | | | | |

## Magnitude/Extent

Lightning routinely occurs without causing significant damage. However, in 1997, lightning resulted in $300,000 in property damage in Salt Lake County. Damage of this magnitude is considered rare and has not occurred since.

## Location

The entire region of Salt Lake County can be affected by lightning events. Although the number of strikes is relatively low, lightning does occur regularly in the planning area.



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[142] International Association of Wildland Fire. “Advise on Lightning Safety and Firefighting.” https://www.iawfonline.org/article/advice-on-lightning-safety-and-firefighting-2/

[143] National Weather Service (NWS). “How Dangerous Is Lightning?” https://www.weather.gov/safety/lightning-odds

## Historical Events and Probability of Future Occurrences

Based on the FEMA Disaster Declarations Database, Salt Lake County has received no designation for lightning disaster declarations since the last plan update.

Lightning routinely strikes without causing significant damage, but 11 events recorded from 1996 to 2018 have caused significant damage, injury, or death. During this time span, the National Oceanic and Atmospheric Administration (NOAA) National Centers for Environmental information (NCEI)[144] recorded 4 deaths, 10 injuries, and $351,200 in property damage. NCEI did not indicate any new events since the last plan update in 2019. It is certain that lightning events will continue to strike routinely within the county. Based on a recurrence interval of one significant event every two years, future probability is likely.

"On May 24, 2000, an 11-year-old girl was killed, and six other children were injured when lightning struck them as they were leaving 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 children suffered minor injuries. Shortly afterward, also in Midvale, a 36-year-old man was injured by lightning as he left the shelter of his home for his car.[145]

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, $300,000 in total.[146]

## Climate Change Considerations

The 2024 State Enhanced Hazard Mitigation Plan[147] states that research related to climate change and impacts on severe weather in Utah presents no clear indications to identify the impact of what increased convective storm activity means to lightning.

## Secondary Hazards

Lightning often occurs along with wind and heavy rain associated with thunderstorms. The most significant secondary hazards associated with these severe storms are falling and downed trees as well as downed power lines and associated power outages.

According to the Edison Electric Institute, "70% of power outages in the U.S. are weather related."[148] 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. Thunderstorms increase the chance of lightning

[144] NOAA, NCEI. Storm Events Database. "Salt Lake City." https://www.ncdc.noaa.gov/stormevents/eventdetails.jsp?id=5178474
[145] Ibid.
[146] Ibid.
[147] Utah Enhanced State Mitigation Plan. 2024. https://hazards.utah.gov/state-of-utah-hazard-mitigation-plan/
[148] Generator Source. "The Many Causes of Power Failure." https://www.generatorsource.com/Causes_of_Power_Failures.aspx

striking a vital part of a power grid. Rain may damage components vital for maintaining a functioning circuit.

Lightning can also ignite wildfires. Utah experiences a monsoon season from July into September, during which seasonal wind and pressure changes result in warm, moist air flowing into Utah. Hot, unstable air rises and can result in thunderstorms along with lightning. Monsoon season coincides with wildfire season. Hot summer temperatures begin to dry out fuels which can easily be ignited by a lightning strike.

## Vulnerability Assessment

Lightning strikes only impact a small area, but it is impossible to know where ahead of time. A large area is at risk of potential lightning strike during every thunderstorm. If thunder can be heard, lightning is close enough to strike and shelter should be sought.

The 2024 State Enhanced Hazard Mitigation Plan states that lightning is one of the deadliest severe weather events in Utah, cumulatively killing more people than any other hazard and injuring roughly twice as many people as any other severe weather hazard.

The primary concern for lightning is risk of injury or death. The majority of injuries and deaths associated with lightning strikes occur when people are outdoors. This can affect outdoor workers, outdoor recreationists, or those without stable housing. However, almost one-third of lightning-related injuries occur indoors. Males are four times more likely than females to be struck by lightning, and the average age of a person struck by lightning is 37 years.[149]

Lightning can contribute to damage to power lines and other power infrastructure. Power outages can affect operations for emergency responders, medical facilities, and homes and businesses. Lightning can also cause damage to communication towers and antennas.

### ESTIMATED IMPACTS AND POTENTIAL LOSSES

The National Risk Index (NRI) includes data on the expected annual losses to individual natural hazards, historical loss, and overall risk at a county and census tract level. Salt Lake County's NRI expected annual loss (EAL) value for lightning is $676K with a risk score of 92.0 and a rating of "relatively high" compared with the rest of the United States (Figure 136).

[149] Center for Disease Control (CDC). "Lightning Strike Victim Data." April 2024. https://www.cdc.gov/lightning/data-research/index.html

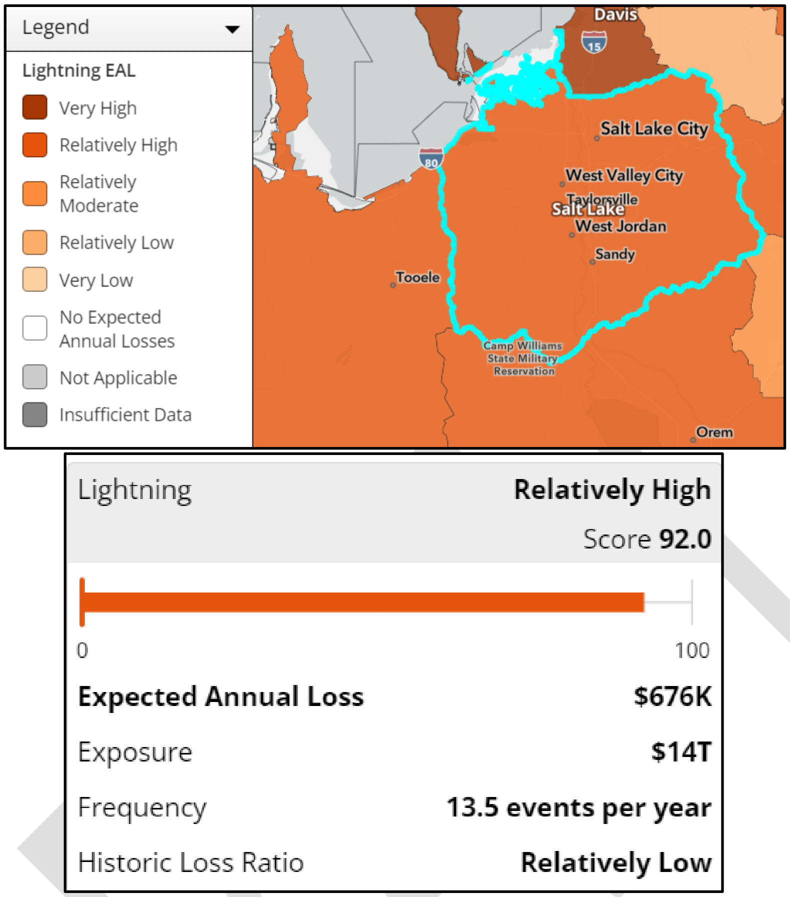


**Figure 136: FEMA National Risk Index Salt Lake County Expected Annual Loss from Lightning[150]**

## VULNERABLE POPULATIONS

In addition to outdoor workers or other people without shelter during a storm, individuals with disabilities may face challenges seeking shelter during storms, and the elderly may require additional support and assistance during and after the storm.

## COMMUNITY LIFELINES

FEMA Community Lifelines are the most fundamental services in the community that, when stabilized, enable all other aspects of society to function. Community Lifelines are essential for the well-being of any community. They provide support and assistance to individuals who require help, especially during times of crisis. FEMA Community Lifelines are a critical component of emergency management in the United States. These lifelines are designed to address the essential needs of a community during and after a disaster. There are eight lifelines, each with its own focus and purpose (Figure 137).



[150] FEMA. National Risk Index. "Salt Lake County Expected Annual Loss Lightning Risk Score, Map and Legend." https://hazards.fema.gov/nri/map


**Figure 137: Community Lifelines[151]**

Lightning can impact several FEMA Community Lifelines. Safety and Security may be compromised due to potential injury from lightning and disruption to emergency response in the case of power outages. Health and Medical services may also be affected by power outages, which can disrupt medical facilities and individuals reliant on electricity-powered medical equipment. Lightning also can disrupt the Energy lifeline by contributing to power outages, which impacts services for residents and businesses. The Communications lifeline can be affected by lightning producing damage to infrastructure, including 911, dispatch, and responder communications abilities.[152]

## CHANGES IN DEVELOPMENT

Potential impacts from an increase in vulnerability to lightning could result in loss of life/property and power failure from increase in severe storms related to climate change. Increased population patterns may result in more people participating in outside recreation, thus increasing vulnerability to lightning strikes. Overall vulnerability to lightning has remained the same since the last plan update.

## VULNERABILITY SCORE

To analyze the county's vulnerability to severe weather, the NRI was used as a primary tool during the 2024 Hazard Identification and Risk Assessment (HIRA) update. The NRI defines risk as the potential for negative impacts because of a natural hazard and determines a community's risk relative to other communities by examining the expected annual loss and social vulnerability in a given community in relation to that community's resilience. Salt Lake County's NRI lightning wave risk rating is shown in Figure 138. Salt Lake County has relatively high lightning risk, and a risk score of 90.3.



151 FEMA. "Community Lifelines." https://www.fema.gov/emergency-managers/practitioners/lifelines
152 FEMA. "Community Lifelines Implementation Toolkit," Version 2.0. November 2019. https://www.fema.gov/sites/default/files/2020-05/CommunityLifelinesToolkit2.0v2.pdf

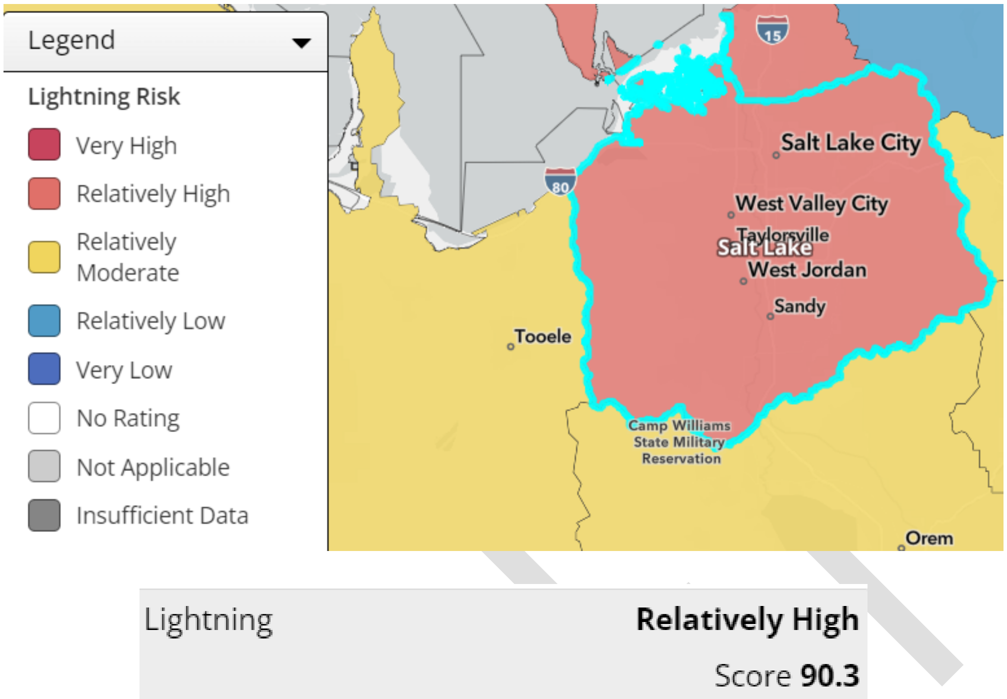


**Figure 138: National Risk Index Lightning Risk Map, Legend, and Score for Salt Lake County Utah[153]**



[153] FEMA, National Risk Index. “Salt Lake County Lightning Score, Map and Legend.” https://hazards.fema.gov/nri/map

# Public Health/Epidemic/Pandemic

## Hazard Description

An epidemic is a sudden increase in disease cases above what is typically expected in a specific geographic area. It often occurs within a community or region and can spread quickly among the population.

A pandemic is an epidemic that has spread over multiple countries or continents, affecting many people. It typically involves a new infectious agent against which the population has little or no immunity, leading to widespread transmission.

Based on their characteristics and ability to spread, the following human diseases could also contribute to a severe epidemic or pandemic and should be noted:

- Methicillin-resistant staphylococcus
- West Nile virus
- H1N1 influenza
- Severe acute respiratory syndrome
- Measles
- Hepatitis
- Tuberculosis
- E. coli
- Lyme disease
- Hantavirus
- Leptospirosis
- COVID-19

## Hazard Profile

| | | | | | |
|---|---|---|---|---|---|
| **Potential Impact** | X | Catastrophic | **Probability** | | Highly Likely |
| | | Critical | | X | Likely |
| | | Limited | | | Occasional |
| | | Negligible | | | Unlikely |
| **Location** | The entire county could potentially be affected. Higher-density areas may be more vulnerable. | | | | |
| **Seasonal Pattern** | Some are seasonal, such as West Nile Virus in warmer months, while others may occur year-round. | | | | |
| **Conditions** | Disease may spread faster in areas where people congregate. Some populations may be more susceptible or experience more severe consequences. | | | | |
| **Duration** | Outbreak can last weeks, months, or years. | | | | |
| **Secondary Hazards** | Supply chain interruption and/or shortages and economic losses; healthcare systems and supplies may be overwhelmed. | | | | |
| **Analysis Used** | Review of historic events, hazard analysis plans, local input, and other information provided by the UDEM | | | | |

## Magnitude/Extent

The potential magnitude of pandemics or epidemics in Salt Lake County can vary widely depending on factors such as the disease's transmissibility, population density, and public health measures in place. In mild cases, effective interventions and vaccination could limit the impact to a few hundred manageable cases. However, a moderate outbreak might lead to thousands of infections, strain healthcare services, and increase morbidity. In severe scenarios, a highly transmissible and lethal pathogen could overwhelm the healthcare system, resulting in tens of thousands of cases and significant fatalities, prompting quarantines and long-term economic disruptions. Beyond immediate health impacts, such events can have lasting effects on mental health, job stability, and access to healthcare, highlighting the importance of preparedness and community cooperation in addressing public health crises.

The Pandemic Severity Index (PSI) measures the severity of potential pandemics and their potential global health impact, focusing primarily on influenza. It assesses diseases based on factors like the severity of illness caused, the transmissibility of the virus, and the impact on healthcare systems.

| | 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 |

Figure 139: Pandemic Severity Index

## Location

Epidemics and pandemics can emerge in various locations, often influenced by several factors that affect susceptibility. In Utah, specific locations may be more susceptible to epidemics and pandemics due to population density, travel patterns, and healthcare access. Urban centers such as Salt Lake City, Provo, and Ogden have higher population densities, making them more vulnerable to the rapid spread of infectious diseases, especially during crowded events. College campuses, such as the University of Utah and Salt Lake Community College, can also be hotspots for outbreaks due to the concentration of students in communal living spaces. Additionally, popular tourist areas, such as Park City and Zion National Park, face increased risks from visitors who may introduce various pathogens. Regions with fewer healthcare facilities may struggle to manage outbreaks effectively, while rural areas, despite lower population densities, could face challenges due to limited access to medical resources. Lastly, transportation hubs near significant highways or airports can facilitate individual interactions, increasing the risk of disease transmission.

## Historical Events and Probability of Future Occurrences

Table 63 provides information on historical health outbreaks in Utah.[154]

**Table 63: Historical Health Incidents, Utah**

| Disease | Date | Deaths/Cases | Etiology |
|---|---|---|---|
| **Diphtheria** | 1880 | 749 deaths | *Corynebacterium diphtheriae*; poor hygiene practices |
| **Spanish Flu**[155] | 1918 | 2915 deaths | H1N1 virus with genes of avian origin |
| **Rheumatic Fever** | 1985–1986 | 136 cases | Streptococcus bacteria; untreated strep throat |
| **Hantavirus** | 1993–2017 | 38 cases | Infected rodents |
| **West Nile Virus**[156] | 1999–2023 | 497 cases | Mosquitos |
| **Measles** | 2011 | 13 cases | Morbillivirus |
| **Hepatitis C** | 2013 | 4800 potentially exposed, seven infected | Exposure to blood from unsafe injection practices; unsafe health care; unscreened blood transfusions; injection drug use; sexual practices that lead to exposure to blood |
| **Hepatitis A** | 2018 | 295 cases, two deaths | Ingestion of food or water contaminated by an infected person's feces |

[154] DeBry, Robert J. & Associates. “7 Serious Disease Outbreaks in Utah History.” KSL.com. March 19, 2020. https://www.ksl.com/article/46727920/7-serious-disease-outbreaks-in-utah-history
[155] Fields, Lauren. “The 1918 Spanish Flu Killed 50 Million People Worldwide. Here’s How it Affected Utah.” Deseret News. December 22, 2018. https://www.deseret.com/2018/12/23/20661936/1918-flu-utah-spanish-influenza-pandemic/
[156] Centers for Disease Control and Prevention. “West Nile Virus.” https://www.cdc.gov/west-nile-virus/data-maps/historic-data.html

| Disease | Date | Deaths/Cases | Etiology |
|---|---|---|---|
| **COVID-19**[157] | 2020–2022 | 1,090,346 cases, 5,293 deaths | Exposure to coronavirus2, also called SARS-CoV-2 |

**Salt Lake County Specific:** Like many other US cities during the late 19th and early 20th centuries, Salt Lake City was a hotbed for **typhoid**. People hunted, camped, picnicked, and polluted near the seven mountain streams that provided the city with most of its water. Sheep and cattle grazed near the watershed, barnyards were built near water sources, and flies had easy access to the open privies and manure piles.

Typhoid was also quickly passed by finger contamination when an ill person or even a recovered victim handled food and did not wash his or her hands carefully after using the restroom. In 1923, a Salt Lake City woman working in a delicatessen was ill with what was later diagnosed as “walking typhoid.” She had diarrhea and was getting weaker, but she did not want to leave her boss shorthanded; she also needed the money. She stayed on the job, serving food between her frequent trips to the lavatory and her less frequent or thorough handwashing. One day, four adults and two young people came into town from their westside farm to see a double feature at a movie theater. Afterward, they visited the delicatessen and bought some food to take home for their evening meal. The young people left on dates while the adults shared the deli food. The four adults came down with typhoid, and two died.

Some 188 cases of typhoid (13 deaths) were traced to the woman carrier, but no one knows for sure how many people contracted the disease, took it home, possibly to another state, and spread it even further. The problem was compounded by the fact that a drugstore near Salt Lake’s tourist district bought food from the delicatessen and served it to countless people. Eventually, the deli was tracked down as the outbreak's source and quarantined. Reports of typhoid soon subsided.

Before 1900, doctors had seen more typhoid fever than any other disease and treated it in various ways. Some felt it was best to starve the patient; others felt hot water was the cure. Salt Lake City Cemetery records from 1850 to 1894 record 924 deaths due to typhoid, but the actual number was probably higher. Many deaths among typhoid-prone adolescents and young adults who died in the summer and fall when typhoid is most common were attributed to “diarrhea” or “fever.” Many people recognized the connection between typhoid and contaminated food and drink, but little action was taken until health boards were established. Even then, educating the public to take simple precautions was difficult.

When the housefly was implicated as a typhoid carrier in the late 19th century, Dr. Theodore B. Beatty, state health commissioner, began a crusade against the pest. He distributed literature, gave talks and demonstrations at schools, and helped make “Swat the Fly” a standard greeting. A contest offered prizes to whoever killed the most flies. The winner brought in 707 quarts of dead flies, an estimated 9.5 million, and received the $1,000 prize donated by a Salt Lake City businessman; in one year, Utahns captured

[157] Johns Hopkins University and Medicine. “Coronavirus Resource Center.” https://coronavirus.jhu.edu/region/us/utah

3,715 quarts of flies. The fly menace was lessened, but real progress was made when attention gradually turned to eradicating their breeding grounds.

Following the example of some eastern cities, Salt Lake City instituted a water chlorination program in 1915. It gradually expanded it until 1927, when daily testing of chlorinated water was done at all city water intake points. Reactions to chlorination varied. Mothers worried when they could not taste the chlorine, fearing that the water they gave their children was unsafe. Others said chlorine made the water unpalatable and killed their goldfish. During the prohibition era, some complained that it ruined the taste of their home brew and bathtub gin.

Gradually, with increasing use of sanitary methods—improved sewer systems, purer water, and laws regulating the handling and dispensing of foods—plus the use of a vaccine discovered by Almoth Wright of London in 1906–1907, typhoid was controlled.[158]

The **1918 influenza outbreak**, known as the Spanish Flu, significantly impacted communities worldwide, including Salt Lake City. The pandemic, which emerged in the final stages of World War I, reached Salt Lake City in the autumn of 1918 when the region was still recovering from the war.

The first cases were reported in late September, and by October, the virus had spread rapidly, particularly affecting healthy young adults. Influenza often led to pneumonia, resulting in high mortality rates due to the limited medical resources of the time.

Local health officials launched a public health campaign promoting mask-wearing, social distancing, and gathering restrictions. Schools and theaters closed, and strict quarantine measures were implemented. Despite these efforts, the city faced thousands of cases and over 500 deaths, overwhelming the healthcare system.

The pandemic also caused economic disruption as businesses and schools closed and communities united to support one another. As the outbreak waned in early 1919, Salt Lake City reflected on the importance of public health preparedness and effective communication.

The legacy of the 1918 influenza outbreak remains a poignant reminder of community resilience in the face of public health challenges.[159]

In 1985, Salt Lake County faced an outbreak of **acute rheumatic fever** (ARF), a serious condition stemming from untreated streptococcal throat infections that notably affected children and adolescents. The 99 verified cases were in 20 of Utah's 29 counties; the most significant outbreaks occurred in Salt Lake and Utah's more heavily populated counties. ARF can lead to severe complications, including rheumatic heart disease, emphasizing the need for early diagnosis and treatment of strep throat.

[158] Murphy, Miriam B. "Salt Lake City Had Its Typhoid Mary." History to Go, History Blazer. April 1996. https://historytogo.utah.gov/typhoid-mary/
[159] University of Michigan Center for the History of Medicine and Michigan Publishing, University of Michigan Library. "Influenza Encyclopedia: Salt Lake City, UT." https://www.influenzaarchive.org/cities/city-saltlakecity.html

Local health officials, schools, and healthcare providers collaborated to identify cases and educate the community about the symptoms of strep throat and the importance of antibiotic treatment to prevent ARF. This outbreak highlighted the necessity of monitoring communicable diseases and ensuring proper healthcare access to prevent serious complications associated with bacterial infections. As a result, measures were reinforced to guarantee that children received appropriate medical attention for throat infections.[160]

Beginning in late 2016, communities across the United States reported a significant increase in **hepatitis A** infections, with over 22,000 cases documented nationwide by July 2019. While some areas continue to face this outbreak, Utah officially declared its outbreak over in February 2019 after nearly 300 cases had been recorded. This success was primarily attributed to innovative strategies implemented by the Salt Lake County Health Department (SLCoHD). Of the cases in Utah, about 200 were reported in Salt Lake County, primarily among individuals experiencing homelessness or using illicit drugs, which complicated efforts to provide treatment.[161]

The first case of COVID-19 in Utah was documented in early March 2020. By November 2023, Salt Lake County had experienced 419,514 confirmed cases, 18,930 hospitalizations, and 1,909 deaths during the pandemic.[162] COVID-19 demonstrated how disease outbreaks can evolve rapidly and have wide-ranging public health impacts, disrupt supply chains, and contribute to economic losses.

Several interrelated factors shape the probability of future occurrences of epidemics and pandemics. Globalization and increased travel enable the rapid spread of disease across borders, while urbanization creates densely populated environments where infections can thrive. Climate change also plays a role, as shifting climates may expand the habitats of vectors like mosquitoes, potentially increasing diseases such as malaria and dengue fever. Additionally, zoonotic diseases—those that jump from animals to humans—become more likely as humans encroach on wildlife habitats. Antimicrobial resistance further complicates matters, making infections more challenging to treat and control. The strength of public health infrastructure is crucial, as more robust systems can effectively contain outbreaks. With these various elements at play, the risk of future epidemics and pandemics remains significant, highlighting the need for proactive global health measures and improved surveillance to mitigate potential threats.

Figure 140 displays a list of priority pathogens that could cause the next pandemic. The list was compiled by more than 200 scientists from 50 countries. Although these pathogens may not currently be active in the United States, they could emerge or reemerge due to various modes of travel and transportation.

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[160] Centers for Disease Control and Prevention. 1987. "Acute Rheumatic Fever – Utah." *MMWR*. 36(8);108-10,115. https://www.cdc.gov/Mmwr/preview/mmwrhtml/00000880.htm

[161] Shapiro, Michelle. "Field Notes: Salt Lake County Stops Hepatitis A Outbreak." National Association of County & City Health Officials. September 30, 2019. https://www.naccho.org/blog/articles/field-notes-salt-lake-county-stops-hepatitis-a-outbreak

[162] Utah Coronavirus Dashboard. https://coronavirus-dashboard.utah.gov/overview.html

## Priority pathogens that could cause the next pandemic

| Family | Priority pathogen | Disease | Vector or reservoir | Transmission | Distribution |
|---|---|---|---|---|---|
| Bacteria | Vibrio cholera (serotype O139) | Cholera ^ | Humans, environment | Fecal-oral from contaminated water | South Asia, developing countries |
| | Klebsiella pneumonia (multi-resistant) | Pneumonia | Humans, environment | In hospitals, person to person | Global |
| | Yersinia pestis | Plague ^ | Rodents, fleas | Respiratory for pneumonic plague | Asia, Africa, Americas |
| | Shigella dysenteriae (serotype 1) | Dysentery ^ | Humans, environment | Faecal-oral from contaminated food / water | Developing countries |
| | Salmonella entérica (invasive non-typhoidal) | Invasive non-typhoidal salmonellosis | Humans, animals, environment | Contaminated food, person to person | Global |
| Arenavirus | Mammarenavirus lassaense | Lassa fever | Rodent Mastomys | Infected rodents, person to person | Western Africa |
| Coronavirus | Merbecovirus (including MERS) | Respiratory syndrome | Bats | Zoonotic and person to person | Middle East |
| | Sarbecovirus (including SARS and SARS-CoV-2) | Acute respiratory syndrome, e.g. COVID-19 | Bats, humans and other mammals | Zoonotic and person to person | Global, already caused a PHEIC |
| Flavivirus | Orthoebolavirus zairense, sudanens | Ebola Zaire * ^ Ebola Sudan | Bats and other mammals | Contact with body fluids | Central Africa, West and East Africa |
| | Orthomarburgvirus marburgense | Marburg | Bats and other mammals | Contact with body fluids | Central and East Africa |
| | Orthoflavivirus flavi | Yellow Fever * | Mosquitoes, non-human primates | Mosquito bite | Central Africa, South America |
| | Orthoflavivirus denguei | Dengue * | Aedes mosquitoes | Mosquito bite | Tropical and subtropical zones |
| | Orthoflavivirus zikaense | Zika (and associated congenital disease) | Aedes mosquitoes, sexual transmission | Mosquito bite | Americas, Asia, Africa, Pacific. Already caused a PHEIC |
| Hantavirus | Orthohantavirus hantanense | Haemorrhagic fever with renal syndrome | Field mice | Inhalation of the virus in rodent faeces | Asia |
| | Orthohantavirus sinnombrense | Pulmonary syndrome | Deer mice | Inhalation of the virus in rodent faeces | North America |
| Nairovirus | Orthonairovirus haemorragiae | Crimean-Congo haemorrhagic fever | Ticks, livestock | Contact with infected animals | Asia, Africa, Europe |
| Orthomyxovirus | Alphainfluenzavirus influenzae H1, H2, H3, H5, H6, H7, H10 | Avian influenza ^ | Birds | Zoonotic and person to person via respiratory route | Global |
| Paramyxovirus | Henipavirus nipahense | Nipah disease | Bats | Zoonotic, potentially human to human | Asia |
| Phenuivirus | Bandavirus dabieense | Severe fever syndrome with thrombocytopenia | Ticks, small mammals | Tick bites, person to person | Asia |
| Picornavirus (medium priority) | Enterovirus coxsackiepol | Polio * | Humans | Fecal-oral, contaminated water | Asia (Afghanistan, Pakistan) |
| Poxvirus | Orthopoxvirus variola | Smallpox * | Humans | Respiratory, by direct contact | Eradicated. Confined to some laboratories |
| | Orthopoxvirus Monkeypox | Mpox * | Rodents, humans | Zoonotic and person to person | Endemic in Africa but has gone global. Already caused a PHEIC |
| Retrovirus (medium priority) | Lentivirus humimdef1 | HIV1/AIDS ^ | Humans | Sexual transmission and blood-borne | Global |
| Togavirus | Alphavirus chikungunya | Chikungunya | Aedes mosquitoes | Mosquito bite | Asia, Africa, Americas |
| | Alphavirus venezuelan (serogroup O) | Venezuelan equine encephalitis | Mosquitoes, rodents | Mosquito bite | South and Central America |

Note: All families are considered high priority, except those marked as medium.
For some of the pathogens, vaccines (*) or treatments (^) are already licensed and effective, albeit with problems of availability and/or access. For the remaining majority, vaccine and/or treatment candidates are in preclinical or clinical development. Smallpox, which is no longer vaccinated against because it has been eradicated, could be reintroduced by an act of bioterrorism.

PHEIC: Public health emergency of international concern.

Source: WHO [Updated list from 30/07/2024]

ISGlobal

**Figure 140: Emerging or Reemerging Priority Pathogens[163]**

## Climate Change Considerations

Climate change significantly influences the incidence of pandemics and epidemics through various interconnected ways. As climate shifts alter habitats, humans come into closer contact with wildlife, increasing the risk of zoonotic diseases. Warmer temperatures and changing precipitation patterns expand the ranges of disease-carrying vectors like mosquitos and ticks, introducing new diseases to vulnerable populations. Furthermore, climate-induced migration from rural to urban areas often results in crowded living conditions where infections can spread quickly. Extreme weather events disrupt public health infrastructure, exacerbating disease transmission, while food insecurity linked to climate change can heighten susceptibility to infections. These factors create an environment where infectious diseases can emerge and spread more readily, highlighting the urgent need for integrated public health strategies considering climate impacts.

## Secondary Hazards

Epidemics and pandemics often generate a range of secondary hazards that can exacerbate the initial health crisis. One significant issue is the impact on mental health, as individuals may experience increased anxiety, depression, and stress due to isolation and fear of the disease. Economic disruption is another primary concern; job losses and business closures can lead to heightened poverty and financial instability. Healthcare systems can become overwhelmed, resulting in diminished care quality for infected individuals and those with other medical needs. Supply chain disruptions may cause shortages of essential items, while social unrest can arise from economic hardship and misinformation. Vulnerable populations often face more significant risks during these times, experiencing heightened challenges in access to healthcare and essential resources. Additionally, environmental concerns may arise from inadequate waste management practices, and educational disruptions can hinder children’s development, particularly in low-income families. All these secondary hazards were evident during the recent Covid-19 pandemic. The combination of these secondary hazards underscores the interconnectedness of public health crises and highlights the need for comprehensive strategies to mitigate their far-reaching impacts.

## Vulnerability Assessment

In Salt Lake County, certain areas and populations are particularly vulnerable to public health outbreaks and epidemics. Low-income communities often face limited access to healthcare, preventive services, and health education, making them more susceptible. Housing conditions, especially in crowded areas, can facilitate the spread of infectious diseases due to increased close contact among residents. High population density, particularly in urban centers like downtown Salt Lake City, further contributes to this risk. Additionally, the elderly population, who may have compromised immune systems, and children in schools—frequent sites for outbreaks—are at increased risk. Uninsured or underinsured individuals may delay seeking medical help due to financial constraints, exacerbating their vulnerability. Furthermore, specific ethnic and racial groups may experience disparities in health access, while individuals with pre-existing health conditions face higher susceptibility to severe outcomes during health crises.

## ESTIMATED IMPACTS AND POTENTIAL LOSSES

In the event of an epidemic or pandemic, Salt Lake County could face significant challenges impacting public health, the economy, and social structures. Healthcare facilities might become overwhelmed, leading to shortages of critical resources such as beds and medical equipment, which could increase morbidity and mortality rates. Economically, local businesses—especially in hospitality, retail, and services—could suffer considerable losses due to forced closures and reduced customer traffic, resulting in higher unemployment rates. The education sector might also be affected, with school closures disrupting learning and exacerbating disparities between high- and low-income families. Mental health issues could arise as individuals deal with the stress and anxiety associated with illness and financial strain. Additionally, demand for social services might increase, stretching resources and support systems thin. Public transportation could see reduced ridership, complicating access to essential services, while public safety resources might be tasked with enforcing public health measures. Overall, the multifaceted impacts of an epidemic or pandemic could create lasting challenges for the community.

## VULNERABLE POPULATIONS

In Salt Lake County, certain populations are particularly vulnerable during public health outbreaks. Children are at higher risk due to their developing immune systems and close interactions in schools and childcare settings. The elderly also face significant threats, as age often correlates with increased severity of illness. Individuals with chronic health conditions, such as diabetes, heart disease, or respiratory ailments, are more susceptible to complications from infections. Low-income communities may struggle with limited access to healthcare, nutritious food, and stable housing, further increasing their risk. Additionally, people with compromised immune systems, including those undergoing medical treatments, are at increased danger. Those experiencing homelessness often lack proper hygiene and healthcare access, increasing their vulnerability. Minority communities may also face unique cultural and socioeconomic challenges that impact their health during outbreaks. Lastly, while essential for response efforts, healthcare workers face a heightened risk of exposure due to their front-line roles.

## COMMUNITY LIFELINES

In Salt Lake County, various FEMA community lifelines could be significantly impacted by an epidemic or pandemic. The Safety and Security lifeline may face strain as public health concerns limit the capacity of law enforcement and emergency services, impacting their response to other emergencies. The Health and Medical lifeline is directly affected as healthcare systems become overwhelmed with increased patient loads, shortages of medical supplies, and healthcare worker fatigue. The Food, Hydration, and Shelter lifeline may experience disruptions in supply chains, leading to food shortages and challenges in providing clean water. The Energy lifeline could also suffer from workforce shortages in the energy sector, affecting power supplies. Communications become crucial as the need for accurate public health information increases, putting pressure on communication systems to counter misinformation. The Transportation lifeline may be disrupted by travel restrictions, complicating logistics for healthcare and essential services. Lastly, due to the need for proper disposal of medical waste and personal protective equipment (PPE), the functioning of the Hazardous Waste lifeline becomes a concern.


**Figure 141: FEMA Community Lifelines[164]**

## CHANGES IN DEVELOPMENT

Epidemics and pandemics can significantly shape Salt Lake County development trends through various channels. For instance, public health crises often prompt increased funding for healthcare infrastructure, leading to facility enhancements and better emergency preparedness. This, in turn, influences urban planning and resource allocation. Economically, such events can disrupt local businesses, particularly in sectors like tourism, resulting in shifts in real estate development and job markets. Changes in population dynamics may occur as people relocate for better opportunities or living conditions, further impacting housing and urban growth. Additionally, the rise of remote learning during health crises can drive investments in technology infrastructure within educational institutions. As communities reassess transport needs, there might be a shift toward sustainable mobility solutions. Greater emphasis may be placed on mental health and community support services, affecting funding for related facilities and public spaces.

Epidemics and pandemics can significantly reshape land use development by prioritizing public health and community resilience. For instance, an increased demand for open spaces may prompt cities to improve parks and recreational areas, promoting social distancing and overall well-being. Additionally, the rise in remote work could lead to a decline in traditional office spaces, encouraging developers to repurpose commercial properties for residential or collaborative work environments. There may also be a surge in the construction of healthcare facilities, with zoning regulations adjusted to support this need. Communities might focus on mixed-use developments to create vibrant neighborhoods that minimize commuting and encourage local living. Furthermore, urban planning could incorporate sustainable practices and infrastructure to withstand future health crises better. These changes aim to foster healthier, more adaptable communities that can effectively respond to emerging public health challenges.

Additionally, a pandemic or epidemic can significantly reshape future land development by introducing various challenges and shifts in priorities. Economic slowdowns often accompany such crises, leading to reduced investment in real estate and delayed projects due to financial uncertainty. Public health concerns can also prompt governments to implement new regulations that alter zoning laws. Developers

[164] FEMA. "Community Lifelines." https://www.fema.gov/emergency-managers/practitioners/lifelines

might favor locations that minimize reliance on crowded infrastructure as commuting patterns evolve. Moreover, the construction industry could face supply chain disruptions, increasing project costs and timelines.

Salt Lake County plans several future land development initiatives to accommodate its growing population and enhance community well-being. Key projects include transit-oriented developments encouraging public transportation by creating mixed-use spaces near transit hubs. Additionally, there is a strong focus on affordable housing initiatives to tackle the housing crisis through partnerships with developers. The county is also investing in expanding parks and recreational facilities to improve the quality of life for residents. Urban renewal projects are in place to revitalize targeted neighborhoods, while sustainable development practices are being integrated into new projects. Furthermore, transportation improvements and designated economic development zones aim to enhance infrastructure and attract businesses, fostering job creation in the region. For the latest updates, consulting the Salt Lake County planning department or local government resources is advisable.

## VULNERABILITY SCORE

Given Salt Lake County's moderate social vulnerability, high expected annual loss, and high community resilience to overall hazards, its vulnerability to an epidemic or pandemic may still be significant.[165] While the high community resilience can help in the aftermath of a public health crisis, the high expected annual loss indicates that the potential impact of an infectious disease outbreak is substantial. Additionally, the moderate social vulnerability suggests that there are underlying factors that could exacerbate the impact of a public health crisis.



[165] FEMA. “National Risk Index.” https://hazards.fema.gov/nri/map

# Radon

## Hazard Description

Radon is a radioactive gas released from the nuclear decay process of uranium and radium, which are trace elements of many soils. Small particles of uranium in rocks and soil decay into radium, which in turn, breaks down further into radon. Alpha, beta, and gamma radiation are emitted. Radon is odorless, colorless, and tasteless. As it moves up through the ground, radon can enter a home through cracks and gaps in walls and floors, cavities inside walls, and gaps around service pipes and water supply connections. Though relatively harmless at low levels, radon is classified by the Environmental Protection Agency (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 daily exposure to this naturally occurring radiation.

Nearly 18,000 deaths in the United States each year are caused by radon gas, according to the Huntsman Cancer Institute and other cancer centers. Since 2005, the Office of the Surgeon General has warned the public of the dangers of radon, especially its cancer-causing abilities. 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. Thirty-three percent of Utah homes have dangerously high levels of radon. Radon is the leading cause of lung cancer in nonsmokers. Smokers living in high radon homes have nine times the risk of lung cancer.[166]

Utah also has high levels of uranium, the source of radon, in the ground, leading to high levels of gas throughout the state. Found in most Utah homes, radon can enter a home through cracks and gaps in walls and floors if not properly vented. In fact, 21,000 Americans and an estimated 200–300 Utahns die annually from radon-induced lung cancer.[167]

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. In 1970, research was initiated to address sources of indoor radon, determinants of concentration, health effects, and approaches to mitigation. A widely publicized incident in Salt Lake County escalated the problem of indoor radon in 1984, 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’s) Indoor Radon Program that enables the DRC 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 DRC's primary goal is to assure that radiation exposure to individuals is kept to the lowest practical level. A vital mechanism in reducing radiation exposure and potentially saving lives is the Indoor Radon Program. Radiation risk to the American public from radon

166 UtahRadon.org. “Working to Protect Utahns from the Dangers of Radon.” 2024. https://utahradon.org/
167 Ibid.

gas is undisputed. 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 in the past decade.

## Hazard Profile

| | | | | | |
|---|---|---|---|---|---|
| **Potential Impact** | | Catastrophic | **Probability** | X | Highly Likely |
| | | Critical | | | Likely |
| | X | Limited | | | Occasional |
| | | Negligible | | | 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 | | | | |

## Magnitude/Extent

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 (Figure 142).

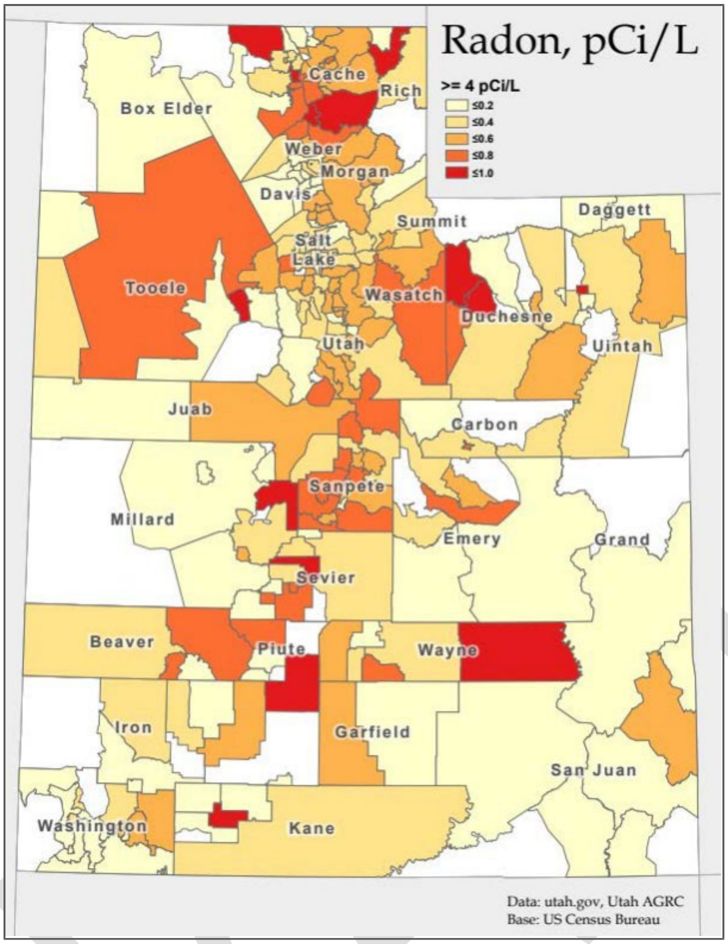



Figure 142: Radon, pCi/L Range of Magnitude by County, Utah

The 2024 Utah State Enhanced Hazard Mitigation Plan maps the counties within the state according to radon geological hazard significance ranking in local hazard mitigation plans. Salt Lake County hazard ranking for radon is moderate (Figure 143).

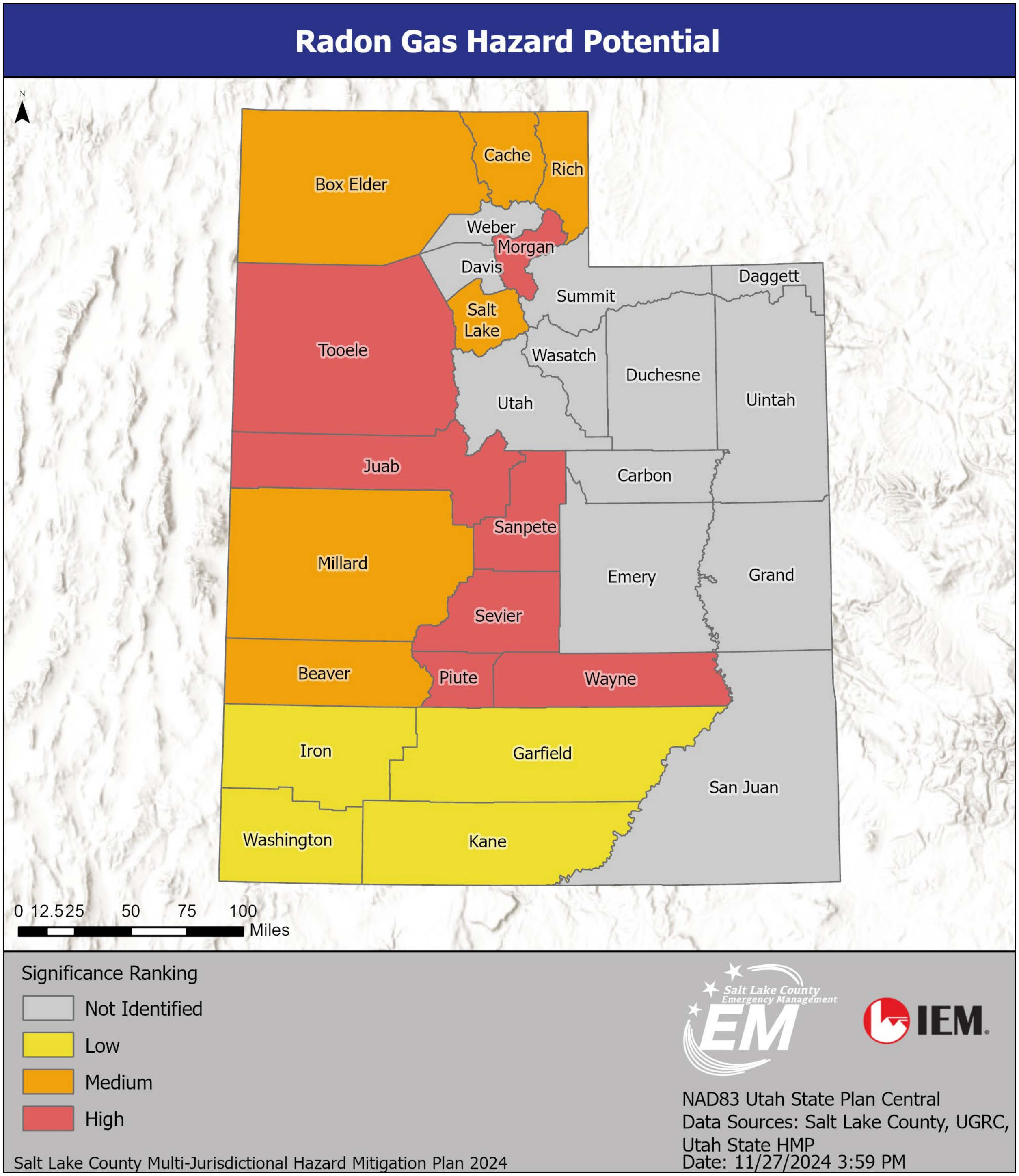



Figure 143: Radon Hazard Ranking in Local Mitigation Plans, Map by County

## Location

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. Utah Department of Environmental Quality provides data on radon test results summarized by zip code. Figure 144 shows the average radon score by zip code within Salt Lake County. Homes confirmed to have 4 pCi/L or higher are considered to have elevated radon levels and are recommended to take action. Figure 145 shows the percentage of homes that tested with elevated radon levels.

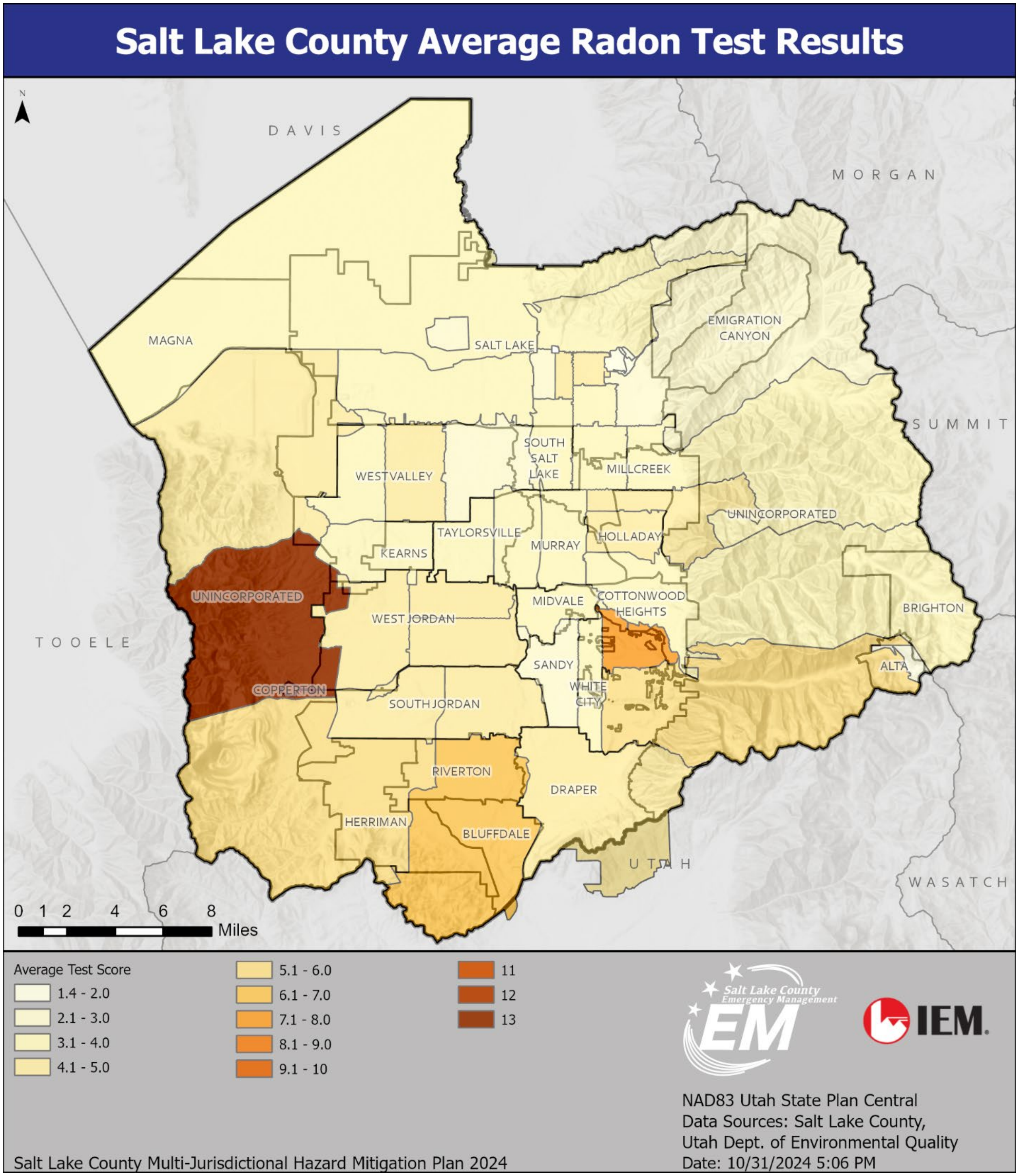



**Figure 144: Salt Lake County Radon Test Results—Average**

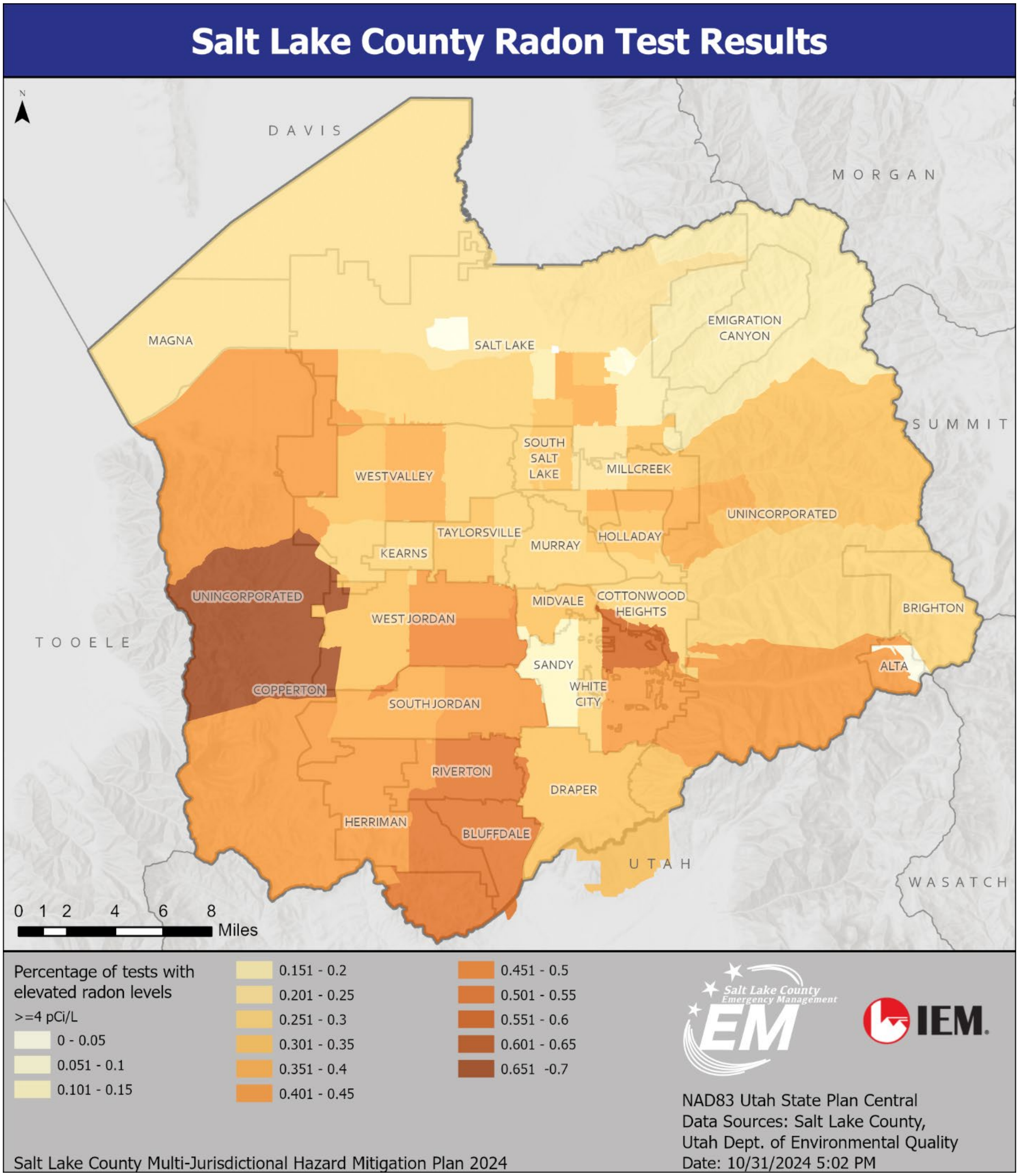



**Figure 145: Salt Lake County Radon Test Results—Maximum**

## Historical Events and Probability of Future Occurrences

According to the EPA, nearly 1 in 3 homes checked in seven states and on three tribal 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 millirem limit, 800 millirem 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. Figure 146 shows the percentage of radon tests performed per year from 2006 to 2021, and the test result by category. The chart categories are blue, indicating results less than 2 pCi/L; yellow, indicating 2 to 3.9 pCi/L, and red, indicating greater or equal to 4 pCi/L. The 2021 radon test results showed 34.7 percent of results were greater or equal to 4 pCi/L, 30.4 percent of results were between 2 to 3.9 pCi/L, and 34.9 percent of results were less than 2 pCi/L.

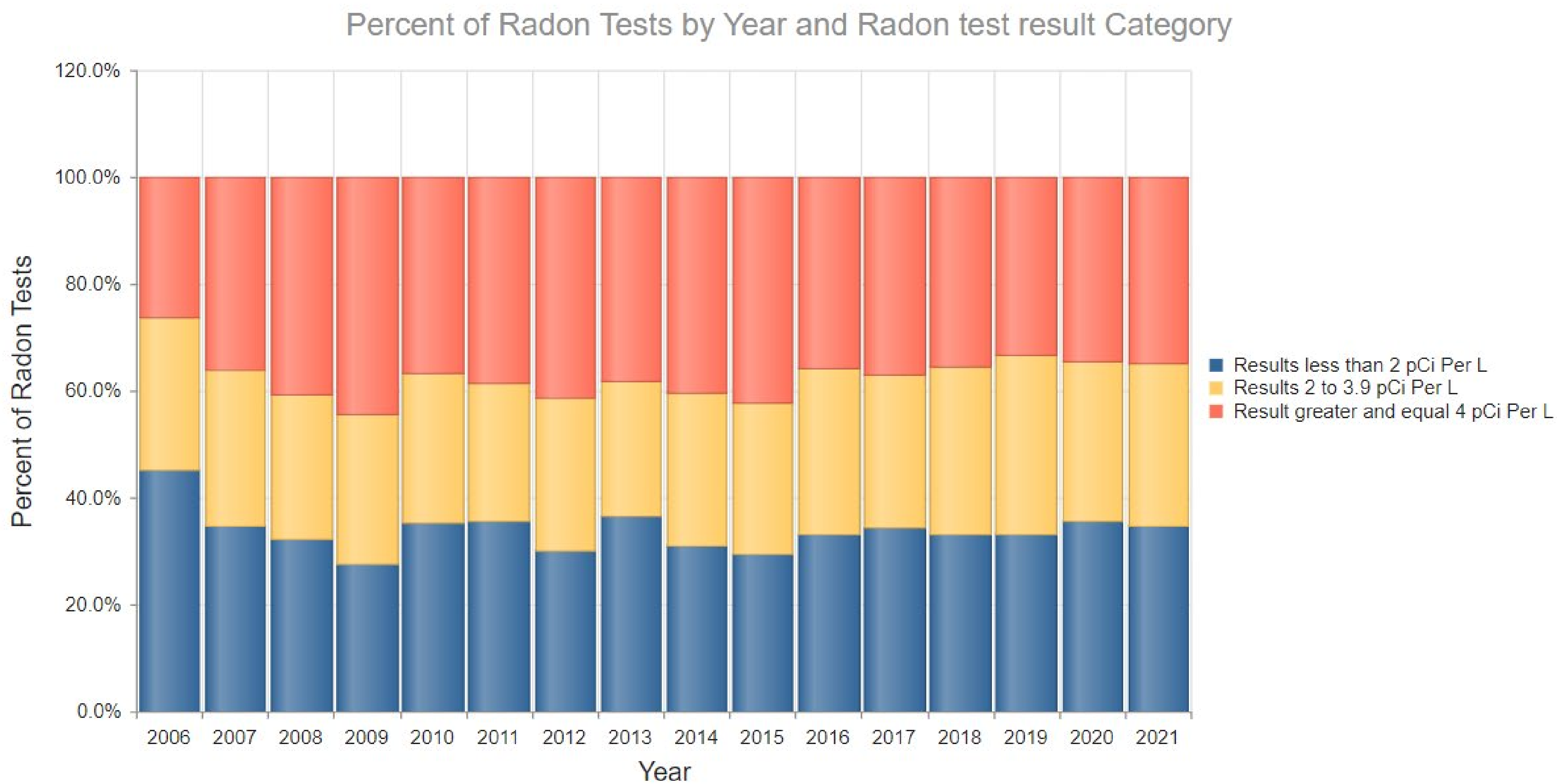



**Figure 146:Salt Lake County Radon Test Results (2006–2021)[168]**

168 Utah Environmental Public Health Tracking. "Salt Lake County Results (2006-2021)." 2024. https://ibis.utah.gov/epht-view/query/result/radon/RadonNumberTest/Percent.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. Because radon is always present in the soil, the probability of future occurrences is highly likely.

## Climate Change Considerations

There has been study in arctic climates that thawing of the permafrost layer that normally acts as a barrier to radon can lead to increased vulnerability. However, the effects of climate change on radon exposure in Utah are not well understood.

## Secondary Hazards

No secondary hazards from radon are known at this time.

## Vulnerability Assessment

Radon does not impact infrastructure, but all humans and households exposed within the county are 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 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 1,000 times the risk of death as any other EPA carcinogen. It is important to note that the action level is not a safe level because 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. While not every individual exposed to radon will develop lung cancer, the likelihood of developing it increases with higher radon concentrations and prolonged exposure. The amount of time between exposure and onset of the disease is usually many years.

### ESTIMATED IMPACT AND POTENTIAL LOSSES

The most pronounced impact of radon is the health impacts to the population. Radon exposure contributes to chronic disease and death. According to the Utah State Hazard Mitigation Plan, radon gas is estimated to have caused 5,630 deaths between 1973 and 2015 and is considered Utah’s most deadly geologic hazard.

Although radon does not cause direct structural losses to buildings or infrastructure, it does have a societal cost. Treatment of lung cancer or other health care costs for affected individuals are significant.

The Utah Geological Survey reported that the estimated 5,630 fatalities in Utah lung cancer cases caused by radon would have an estimated cost of between $2.7 to 3.6 million.[169]

Residences, government offices and other public buildings, schools, businesses, and other structures throughout the county are vulnerable to radon. The concentration may vary by location, soil characteristics, and construction characteristics. Installation of radon mitigation systems in existing buildings or including them in new construction will incur costs to building owners, but these costs may offset potential later health costs.

## VULNERABLE POPULATIONS

All populations within Salt Lake County can be exposed to radon gas and are considered vulnerable. However, some may be exposed to higher concentrations, exposed for longer durations, or have other characteristics that put them at greater risk to radon-related illness. People who live in rented housing may be less aware of their exposure and may have restrictions on installing mitigation systems. Lower income families may not have access to financial resources to address radon concentrations in their homes. Language barriers may limit some individuals' awareness of the effects of radon. Other social vulnerability characteristics may also affect individual's decisions about seeking medical care for radon-related illness, such as limited income or lack of access to health insurance.

Children may be more vulnerable, because their lungs are smaller, still developing, and they tend to breathe more rapidly. Elderly individuals may have underlying health conditions or weakened immune systems that may contribute to vulnerability to radon. They also may have physical limitations, particularly if they have a disability or limited mobility, and may have more prolonged exposure to radon. They may have challenges adequately ventilating their homes, which may contribute to radon build-up.

Individuals who have a history of smoking face compounded risks from radon exposure and are more likely to develop cancer than either smoking or radon alone.

## COMMUNITY LIFELINES

FEMA Community Lifelines are a critical component of emergency management in the United States. Community Lifelines are the most fundamental services in the community that, when stabilized, enable all other aspects of society to function. Community Lifelines are essential for the well-being of any community. They provide support and assistance to individuals who require help, especially during times of crisis. These lifelines are designed to address the essential needs of a community during and after a disaster. There are eight lifelines, each with its own focus and purpose (Figure 147). Radon is not likely to disrupt the day-to-day operations of Community Lifelines.

[169] Utah Geological Survey, Geologic Hazards. "Costs of Geologic Hazards." https://geology.utah.gov/hazards/info/costs/#tab-id-4


**Figure 147: Community Lifelines[170]**

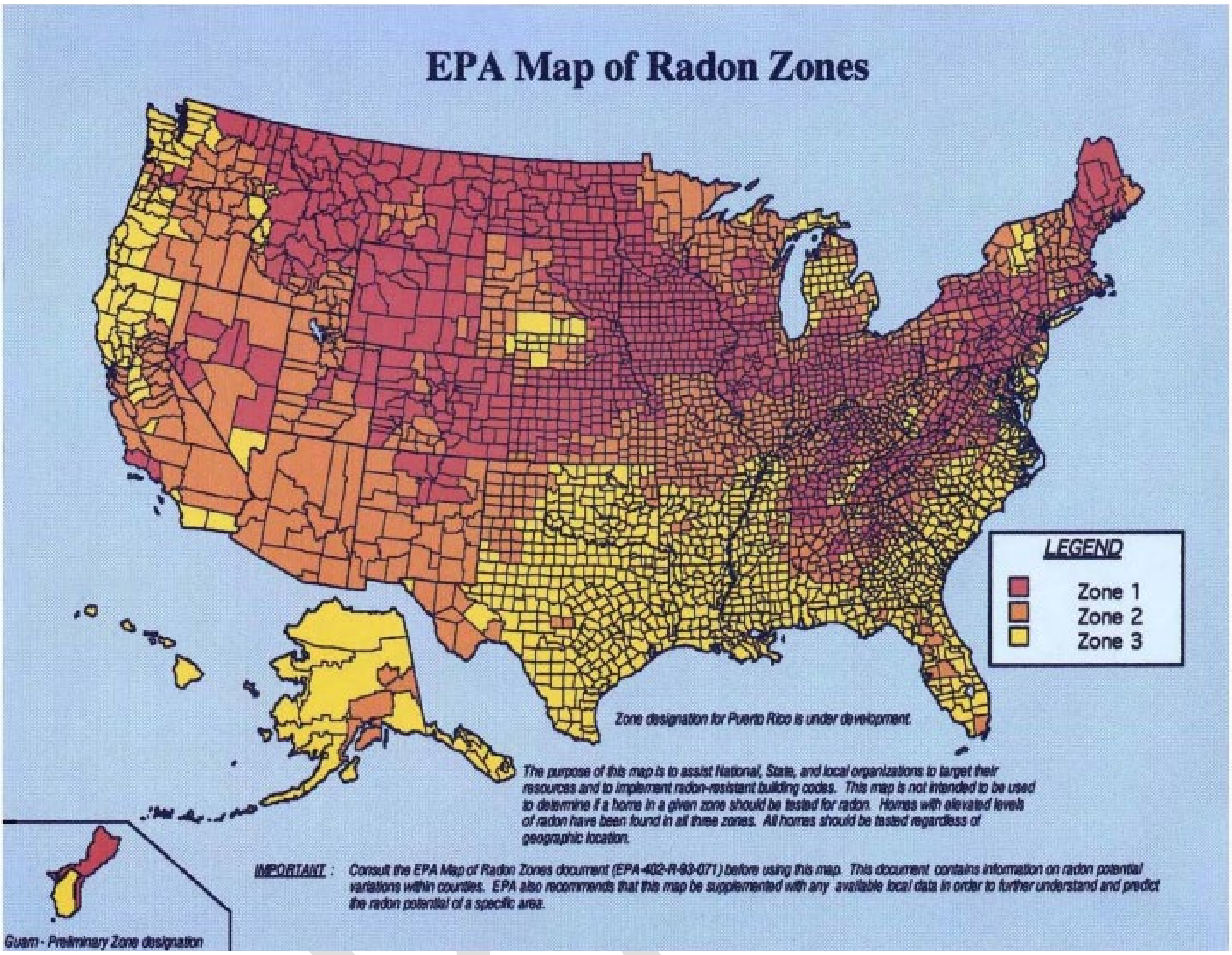
## CHANGES IN DEVELOPMENT

Potential impacts from increased vulnerability to radon exposure is loss of life and decreased air quality and soil erosion. Changes in population patterns may result in populations seeing an increase in health issues for radon exposure. People may move to an area with lower or no levels of radon. Changes in land use and development can result in building inspection requirements that may change to prevent radon exposure. Overall vulnerability to radon exposure has stayed the same since the last plan update.

## VULNERABILITY SCORE

The National Risk Index (NRI) does not include any data on the relative risk of radon. The EPA created a map (Figure 148) to identify radon potential across the country.[171] Salt Lake County is within Zone 2, which has moderate potential for elevated radon levels, with averages between 2 and 4 pCi/L.

[170] FEMA. “Community Lifelines.” https://www.fema.gov/emergency-managers/practitioners/lifelines
[171] U.S. Environmental Protection Agency. “Radon Zones Map.” May 2024. https://www.epa.gov/system/files/documents/2024-05/radon-zones-map_text_link.pdf




| | | |
|---|---|---|
| | **Zone 1 (red zones)** | Highest potential; average indoor radon levels may be greater than 4 pCi/L (picocuries per liter) |
| | **Zone 2 (orange zones)** | Moderate potential; average indoor radon levels may be between 2 and 4 pCi/L |
| | **Zone 3 (yellow zones)** | Low potential; average indoor radon levels may be less than 2 pCi/L |

Figure 148: EPA Map of Radon Zones

# Severe Winter Weather

## Hazard Description

Severe winter weather in Salt Lake County includes heavy snow, lake-effect snow, snow squalls, and blizzards. Significant snowstorms are characterized by the rapid accumulation of snow, often accompanied by high winds, cold temperatures, and low visibility.

Heavy snow generally means snowfall accumulating 4" or more in depth in 12 hours or less, or snowfall accumulating 6" in depth in 24 hours or less.[172] Salt Lake County also experiences lake-effect snow. As cold air moves over the warmer water of the Great Salt Lake, warmth and moisture are transferred into the lowest portion of the atmosphere. The air rises and clouds form and grow into narrow bands that produce heavy snow downwind of the lake.

A snow squall is often associated with a strong cold front. Snow squalls move in and out quickly and typically last less than an hour. Although they typically do not lead to large accumulations of snow, the combination of gusty winds, white-out conditions, and cold temperatures can create icy roads in just a few minutes. Reduced visibility and slick roads create extremely dangerous conditions for motorists.

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 3 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. Blowing snow can reduce visibility to less than one-quarter mile, and the resulting disorientation makes even travel by foot dangerous if not deadly.

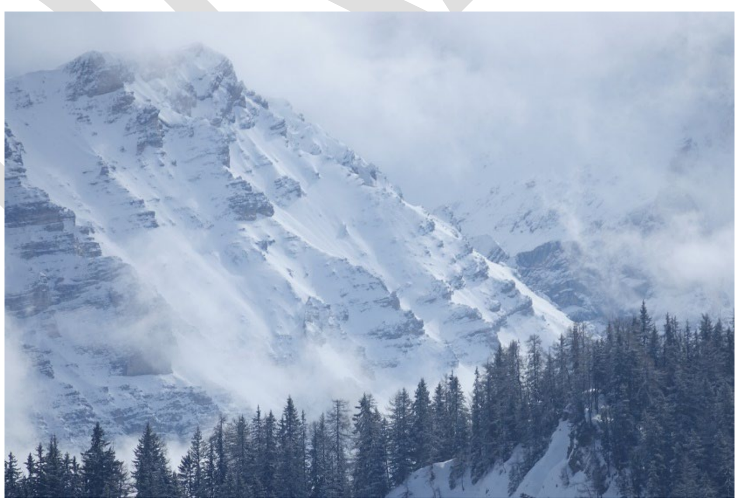


**Figure 149: Snow in Wasatch Mountains[173]**

[172] National Weather Service Forecast Glossary. https://forecast.weather.gov/glossary.php?word=HEAVY%20SNOW
[173] Pixabay. https://pixabay.com/photos/snow-mountain-winter-nature-3304547/

## Hazard Profile

| | | | | | |
|---|---|---|---|---|---|
| **Potential Impact** | | Catastrophic | **Probability** | X | Highly Likely |
| | X | Critical | | | Likely |
| | | Limited | | | Occasional |
| | | Negligible | | | 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 the potential for avalanches, flooding, transportation failure, and infrastructure damage and failure, including power outages | | | | |
| **Analysis Used** | National Centers for Environmental Information, National Weather Service, Utah Avalanche Center, UDEM, local input, and review of historical events and scientific records | | | | |

## Magnitude/Extent

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 potential magnitude of 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 4 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.

The NWS Winter Storm Severity Index is a tool to assist forecasters in describing the possible significance of weather-related impacts of winter storms. It aims to convey the complexities and hazards associated with winter storms and the potential societal effects on the public. The classification tool and description of potential impacts are shown in Figure 150.

| Potential Winter Storm Impacts |
|---|
| **Winter Weather Area**<br>**Expect Winter Weather.**<br>• Winter driving conditions. **Drive carefully.** |
| **Minor Impacts**<br>**Expect a few inconveniences to daily life.**<br>• Winter driving conditions. **Use caution while driving.** |
| **Moderate Impacts**<br>**Expect disruptions to daily life.**<br>• Hazardous driving conditions. **Use extra caution while driving.**<br>• Closures and disruptions to infrastructure may occur. |
| **Major Impacts**<br>**Expect considerable disruptions to daily life.**<br>• Dangerous or impossible driving conditions. **Avoid travel if possible.**<br>• Widespread closures and disruptions to infrastructure may occur. |
| **Extreme Impacts**<br>**Expect substantial disruptions to daily life.**<br>• Extremely dangerous or impossible driving conditions. **Travel is not advised.**<br>• Extensive and widespread closures and disruptions to infrastructure may occur.<br>• Life-saving actions may be needed. |

**Figure 150: Winter Storm Severity Index**

## Location

Salt Lake County can be affected by severe winter weather events. A storm could affect the entire county or only a portion of it. Snow accumulation totals and other conditions vary with elevation, aspect, landforms, and other local variations.

## Historical Events and Probability of Future Occurrences

Based on the FEMA Disaster Declarations Database, Salt Lake County has received no severe winter weather disaster declarations since the last plan update.

According to NOAA data from 1996 to 2024, there have been 477 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 occurred in one event on January 11, 1997. If this outlier is removed from the data, there is an average of approximately 0.43 deaths, 9.43 injuries, and $308,522 in property damages per year, although these averages are likely still skewed upwards by a small number of high-impact events. Based on the frequency of past events, future occurrences are highly likely.

On January 9, 2024, snow squalls developed and moved southward through Northern Utah during the evening hours on both January 9 and January 10, impacting the evening commutes. Utah Highway Patrol reportedly responded to 101 vehicle accidents on January 9, and 143 vehicle accidents on January 10. A portion of these were included in estimates of $75,000 in property damage. Surprisingly, no injuries were reported with these accidents.

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 the 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" at Alta, 26" at Snowbird, 25" at Solitude, 15" at Trial Lake, and 12" at Sundance. Snowfall in the valleys and benches included 8" in Holladay and Olympus Cove, 7" in Sandy and Laketown, 6" in Centerville and Brigham City, and 5" at the Salt Lake City International Airport.

In the Blizzard of 1997, up to 4 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 SNOW/LAKE-EFFECT SNOW

According to NOAA data from 1996 to 2024, there have been 243 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 period. This averages to approximately 1 death every 4 years, as well as 7 injuries and $142,302 in property damage per year. However, most events cause no death, injury, or significant property damage and these averages are influenced by a small number of high-impact events.

On March 24, 2023, the snowpack in Salt Lake City was measured at 26", tying a decades-long record and making the winter of 2022–23 one of the wettest in Utah's recorded history, according to Natural Resources Conservation Service data. The National Weather Service reported the snowstorm delivered 4" in the valleys, with nearly 2 feet at the top of Little Cottonwood Canyon, and lake-effect snow bands along the northern Wasatch Front and in parts of Salt Lake County.[174]

On February 18, 2018, the Salt Lake and Tooele Valleys saw widespread heavy snowfall. Total snowfall reports included 25" in Sandy, 23" in Cottonwood Heights, 17.5" in Tooele, 15" in Olympus Cove, and 14" in Taylorsville. On February 19, Tooele recorded 13" of snow, which broke the calendar day record of 8", 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 to 11", while the mountains received from 1 to 2 feet of snow. The highest total for the mountains was at the Park City ski resort in neighboring Summit County, where 23" accumulated. The wet snow helped trigger 6 avalanches during and shortly after the storm. A 37-year-old man snowmobiling near Bountiful Peak in neighboring Davis County 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.

[174] Dunphey, Kyle. "The snowiest winter in decades continues, with more storms on the way." Deseret News. March 24, 2023. https://www.deseret.com/utah/2023/3/24/23655000/utah-friday-storm-snowpack-record/

## Climate Change Considerations

Utah State University Researcher and Assistant State Climatologist Jon Meyer stated that the jet stream—the fast and narrow current of air flowing from west to east that directs storms across the Western United States—has returned. After several years of the jet stream pushing many storms to the north or east of Utah, the jet stream has shifted and has had a major impact on winter weather conditions. The stronger winter storms are consistent with research undertaken by the Utah Climate Center that identified atmospheric dynamics that exist in the Western Pacific and define 6-year dry and wet phases for Northern Utah's weather. The winter storms begin as a Pacific low-pressure system, with moisture concentrated into narrow bands, which scientists refer to as atmospheric rivers—narrow corridors of much higher atmospheric humidity than in typical storms.[175]

## Secondary Hazards

The most significant secondary hazards associated with severe winter weather include 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. Snow accumulation is often accompanied by a heightened risk of avalanche in the days following the storm.

## Vulnerability Assessment

All residents, structures, and infrastructure systems in the planning area are vulnerable to severe winter weather. Winter storms occur frequently in Salt Lake County but with varying levels of severity and impacts.

Disruptions to transportation networks from snowy, slick conditions or poor visibility are common during winter months. These can cause traffic delays throughout the valley. Vehicle collisions and slide offs are possible, and may result in injury. Emergency response can be delayed by traffic and poor driving conditions. Canyons and foothill areas tend to have higher snow accumulations due to higher elevation and roads may become impassable.

Severe storms may also contribute to power outages if distribution systems are damaged by wind or heavy snow and ice accumulation. Outages can be life-threatening to individuals who are dependent on electricity for life support. They can also disrupt operations for other utility services, communications networks, and affect emergency response. In addition, power outages can cause life-threatening situations if residents use alternative means to heat their homes without the use of proper ventilation.

Transportation delays from severe winter storms can have economic impacts by slowing the delivery of goods and services, delaying employees to report to work, and other reductions in business operations.

[175] Jensen, Marcus. "State Climate Officer Explains the Winter Snow Surge and What It Means for Utah's Water Future." Utah State University, Utah State Today. January 17, 2023. https://www.usu.edu/today/story/?story=state-climate-officer-explains-the-winter-snow-surge-and-what-it-means-for-utahs-water-future

Furthermore, power outages may contribute to losses if businesses are unable to open until power service is restored.

The 2023 State Enhanced Hazard Mitigation Plan states that winter storms are considered deceptive killers because most deaths are indirectly related to the storm. Fatalities occur to individuals involved in traffic accidents caused by slick roads and are also the result of heart attacks brought on by the exertion of shoveling snow and hypothermia due to prolonged exposure to the cold. The NOAA reports that of all fatalities related to ice and snow, about 70% occur in automobiles and 25% are a result of people caught out in the elements. Most winter storm fatalities occur in males over age 40. Fifty percent of all exposure-related deaths are people over age 60 and more than 75% of victims are male. Some winter fatalities occur inside the home, primarily when people leave space heaters on, which then catch fire. Others die of carbon monoxide poisoning from furnaces or other heating devices that aren't properly ventilated.[176]

## ESTIMATED IMPACT AND POTENTIAL LOSSES

The NRI includes data on the expected annual losses to individual natural hazards, historical loss, and overall risk at a county and census tract level. Salt Lake County's NRI expected annual loss (EAL) value for winter weather is $1.1 million with a risk score classified as very high (97.9), compared with the rest of the United States (Figure 151). This value is primarily due to population loss (injuries or fatalities), monetized into a population equivalence value.

[176] Utah State Enhanced Hazard Mitigation Plan. 2024.

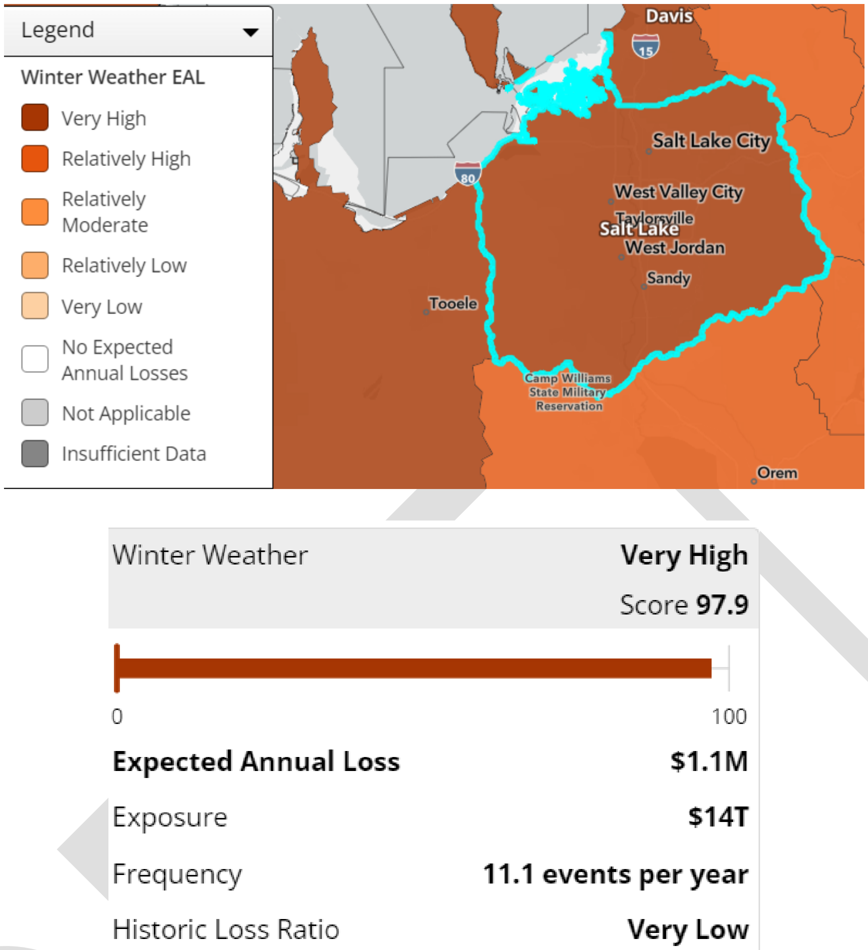



**Figure 151: FEMA National Risk Index Salt Lake County Expected Annual Loss from Winter Weather[177]**

## VULNERABLE POPULATIONS

Unhoused individuals and others without adequate shelter may be especially vulnerable to hypothermia or frostbite if exposed to the cold and wet conditions of winter storms. Motorists may become stranded in poor driving conditions and can also experience hypothermia if isolated for long periods, particularly if they leave their vehicles.

Some residents in canyon communities or on the benches may become isolated due to limited transportation routes, which may become impassable during or immediately following a storm. The elderly and persons with disabilities or life-threatening illnesses are particularly vulnerable if they are dependent on caregivers who are unable to travel through winter storms. Power outages can be life-threatening to those dependent on electricity for life support.

Low-income households, linguistically isolated populations, and other disadvantaged groups tend to suffer greater losses during hazard events. They may be more severely impacted by interruption of

[177] FEMA, National Risk Index. "Salt Lake County expected annual loss winter weather risk score, map and legend." https://hazards.fema.gov/nri/map

services, economic losses, or lack of access to needed resources. Table 64 provides a breakdown of vulnerable populations for which data was available.

**Table 64: Salt Lake County Vulnerable Populations[178]**

| Population Under 5 | Population Over 65 | Foreign Born | Language Other than English | Population with Disability | No Health Insurance | Population in Poverty |
|---|---|---|---|---|---|---|
| 79,892 | 133,703 | 12.9% | 21.6% | 11.4% | 9% | 9.4% |

## COMMUNITY LIFELINES

Lifelines are the most fundamental services in the community that, when stabilized, enable all other aspects of society to function. Community lifelines are essential for the well-being of any community. They provide support and assistance to individuals who require help, especially during times of crisis. FEMA Community Lifelines are a critical component of emergency management in the United States. These lifelines are designed to address the essential needs of a community during and after a disaster. There are eight lifelines, each with its own focus and purpose (Figure 152). Severe winter weather particularly disrupts transportation lifelines, and can also disrupt energy, communication, food, hydration and shelter, and safety and security lifelines.


**Figure 152: Community Lifelines[179]**

The importance of these lifelines cannot be overstated. In a disaster, communities can be left without access to necessities such as food, water, and shelter. The lifelines help ensure that these needs are met and that people have the resources they need to survive. By providing access to medical care, public health services, and transportation, the lifelines help ensure that people can receive the care they need and safely evacuate if necessary. In addition, the Hazardous Materials lifeline helps to ensure that dangerous materials are managed safely, reducing the risk of further harm. Any or all of these lifelines

[178] United States Census Bureau. "American Community Survey Data, Health." 2023. https://data.census.gov/profile/Salt_Lake_County,_Utah?g=050XX00US49035#health
[179] FEMA. "Community Lifelines." https://www.fema.gov/emergency-managers/practitioners/lifelines

could be disrupted following a severe winter storm. The severity of the storm may determine how long it will take to restore the various services.

Community lifelines help create a sense of safety and security in a community. They provide a safety net for individuals who may be struggling and offer comfort and reassurance that help is available when needed. Without these lifelines, communities would be much more vulnerable to crises and emergencies.

### CHANGES IN DEVELOPMENT

There have been no changes in development related to winter weather vulnerability since the prior HMP update. However, an overall population increase in the county represents an increase in potential exposure to this hazard.

### VULNERABILITY SCORE

The NRI was used as a primary tool during the 2024 Hazard Identification and Risk Assessment (HIRA) update to analyze the county's vulnerability to severe winter weather. The NRI defines risk as the potential for negative impacts as a result of a natural hazard and determines a community's risk relative to other communities by examining the expected annual loss and social vulnerability in a given community in relation to that community's resilience. Salt Lake County's NRI winter weather risk rating is shown in Figure 53. Salt Lake County is rated as having a very high winter weather risk, with a score of 97.4.

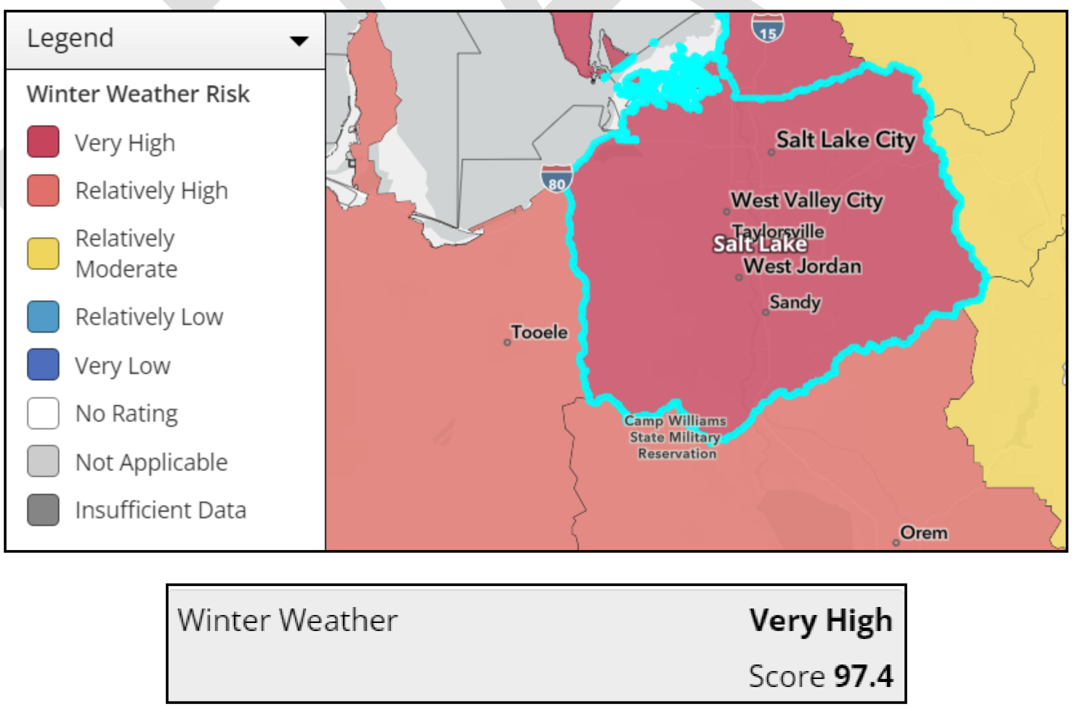



**Figure 153: National Risk Index Winter Weather Risk Map, Rating, and Score for Salt Lake County**[180]

[180] FEMA, National Risk Index. "Salt Lake County Winter Weather Score, Map, and Legend." https://hazards.fema.gov/nri/map

# Tornado

## Hazard Description

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 elements in 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 (e.g., 20 miles per hour [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 form 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 mph, stretch more than 2 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 actions are dissimilar.



## Hazard Profile

| | | | | | |
|---|---|---|---|---|---|
| **Potential Impact** | | Catastrophic | **Probability** | | Highly Likely |
| | | Critical | | X | Likely |
| | X | Limited | | | Occasional |
| | | Negligible | | | 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 Centers for Environmental Information, local input, and review of historic events and scientific records. |

## Magnitude/Extent

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 human-made structure. The F-Scale categorizes each tornado by intensity and area. The scale is divided into six categories, F0 (Gale) to F5 (Incredible). Table 65 outlines each of the F-Scale categories.

**Table 65: Fujita Tornado Damage Scale**[181]

| 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 |

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. 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.

[181] National Oceanic and Atmospheric Administration (NOAA) Storm Prediction Center. "Fujita Tornado Damage Scale." https://www.spc.noaa.gov/faq/tornado/f-scale.html

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. 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 66 lists the 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 66. These estimates vary with height and exposure. Standard measurements are taken by weather stations in open exposures. Table 66 also describes the EF-scale ratings.

**Table 66: Enhanced Fujita Scale for Tornado Damage**[182]

| 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 |

## 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

[182] NOAA. Enhanced Fujita Scale for Tornado Damage. https://www.spc.noaa.gov/efscale/ef-scale.html

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 three tornadoes per year occur 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 of less than 110 mph (F2 or smaller), are no wider than 60 feet, and are on the ground for no longer than a few minutes.

Tornado distribution for the region suggests many tornadoes are funnel clouds aloft encountering the increasing elevation of the region's foothills and mountains, as can be seen in Figure 154 below. Several of the tornadoes impacting Salt Lake County have specifically struck Magna City. A tornado event is possible anywhere within or immediately around the entire planning region, however.

## Historical Events and Probability of Future Occurrences

Based on the FEMA Disaster Declarations Database, Salt Lake County has received no designation for tornado disaster declarations since the last plan update.

According to National Oceanic Atmospheric Administration (NOAA) data from 1965 to 2024 (60 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 3 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 3 years. Based on this recurrence interval, the probability of a future tornado is likely.

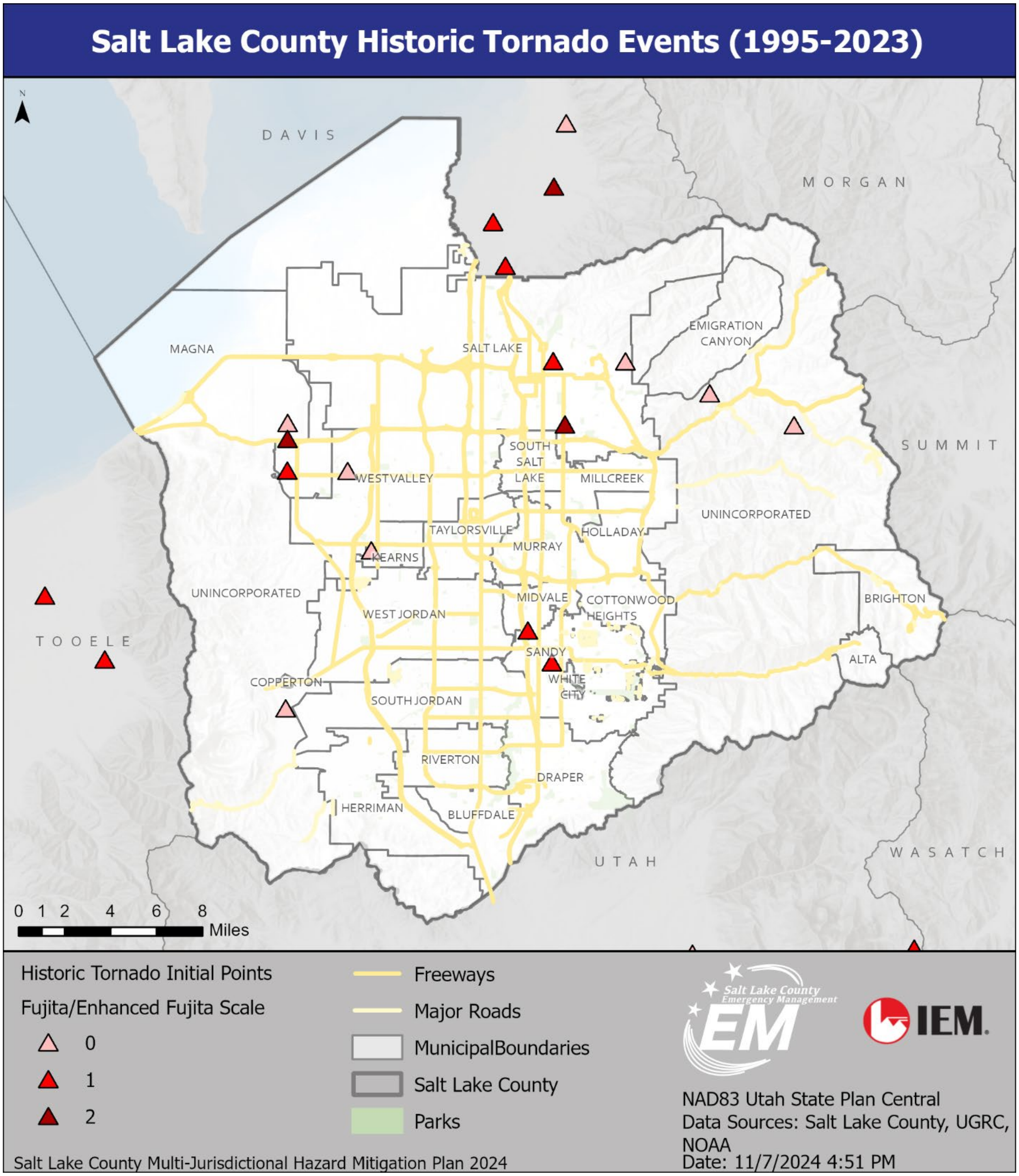



**Figure 154: Salt Lake County Historical Tornadoes**

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.[183] 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 retailer's convention tent, where the lone fatality occurred along with many of the injuries. After blowing out many windows in the Wyndham Hotel, the tornado continued its northeast track, knocking down scaffolding and shearing off a crane at the Church of the Latter-Day Saints (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 makes 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.

**Figure 155: Salt Lake City Tornado, August 11, 1999 (Fireball Is a Power Substation Exploding)**

## Climate Change Considerations

The 2024 State Enhanced Hazard Mitigation Plan concludes an ongoing trend in worsening tornado activity especially in this century is clearer, but little information exists to describe likely consequences for Utah.

[183] American Meteorological Society (AMS). "Tornadogenesis and Operational Considerations of the 11 August 1999 Salt Lake City Tornado as Seen from Two Different Doppler Radars." August 1, 2001. https://journals.ametsoc.org/view/journals/wefo/16/4/1520-0434_2001_016_0377_taocot_2_0_co_2.xml

## 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 heavy rain, which can also cause significant property damage.

## Vulnerability Assessment

All populations, structures, critical facilities, and infrastructure are vulnerable to the dangers posed by tornadoes. Tornadoes pose a significant threat to the safety of county residents. Individuals exposed to the storm can be struck by flying debris, falling limbs, or downed trees, causing serious injury or death.

Tornadoes can cause substantial structural damage. Even lower intensity or magnitude tornadoes can damage roofs, siding, gutters, windows. Stronger tornadoes can completely destroy residences and other structures. Manufactured homes are more vulnerable than site-built structures and are likely to suffer extensive damage. Structures can also be damaged or crushed by falling trees, resulting in physical harm to the occupants. Tornadoes can destroy or make residential structures uninhabitable, and displaced residents may require public shelter or relocation. Large or intense tornadoes may result in a dramatic population fluctuation because people cannot return to their homes or jobs and must seek shelter and/or work outside of the affected area.

Significant debris and downed trees can block roads and make it impossible for emergency response vehicles to access areas of the community. Downed power lines may make roadways unsafe, preventing first responders from answering calls for assistance or rescue.

Tornadoes often result in widespread power outages, increasing the risk to more vulnerable portions of the population who rely on power for health and/or life safety. Extended power outages can increase structure fires and/or carbon monoxide poisoning as individuals attempt to cook or heat their home with alternate, unsafe cooking or heating devices, such as grills.

First responders must enter the damaged area shortly after the tornado passes to begin rescue operations and to organize cleanup and assessment efforts; therefore, they are exposed to downed power lines, unstable debris, hazardous materials, and generally unsafe conditions, elevating the risk of injury to first responders and potentially diminishing emergency response capabilities. Damaged facilities, loss of communications, and damaged emergency vehicles and equipment may significantly impact emergency operations and services. When the community is affected by significant property damage, funding will be required for infrastructure repair and restoration, temporary services and facilities, overtime pay for responders, and normal day-to-day operating expenses. City or county departments may be damaged or destroyed, delaying response and recovery efforts for the entire community.

Tornadoes can lead to significant economic losses related to both structural damage and disruption to services. Businesses that are uninsured or underinsured may have difficulty reopening, resulting in a net loss of jobs for the community and a potential increase in the unemployment rate. Extended restoration of roads and utilities may further slow economic recovery. Displaced residents may not be able to immediately return to work, further slowing economic recovery. Lost wages contribute to hardship for the population and affect lower-income households more severely.

Private sector entities that the city and its residents rely on, such as utility providers, financial institutions, and medical care providers, may not be fully operational and require assistance from neighboring communities until full services can be restored. Economic disruption negatively impacts the programs and services the community provides due to short- and long-term losses in revenue. Damage to infrastructure may slow economic recovery since repairs may be extensive and lengthy. Residential structures destroyed by a tornado may not be rebuilt for years, reducing the community's tax base.

Recreation activities may be unavailable, and tourism can be unappealing for years following a large tornado that has devastated directly related local businesses.

The economic and financial impacts of a tornado event on the community will depend on the scale of the event, what is damaged, costs of repair or replacement, lost business days in impacted areas, and how quickly repairs to critical components of the economy can be implemented. The level of preparedness and pre-event planning done by government, businesses, and citizens will contribute to the overall economic and financial conditions in the aftermath of a tornado event.

Critical facilities are the buildings, land, equipment, and activities provided on the public’s behalf by government and/or private organizations. These facilities are important components to a municipality's quality of life. Critical Facilities are necessities for the health, safety, well-being, and stability of communities. Critical infrastructure systems are essential for life safety and economic viability, including transportation, power, communication, and water and wastewater systems (Figure 156). Any of these facilities and their associated functions can be damaged or disrupted by a tornado.

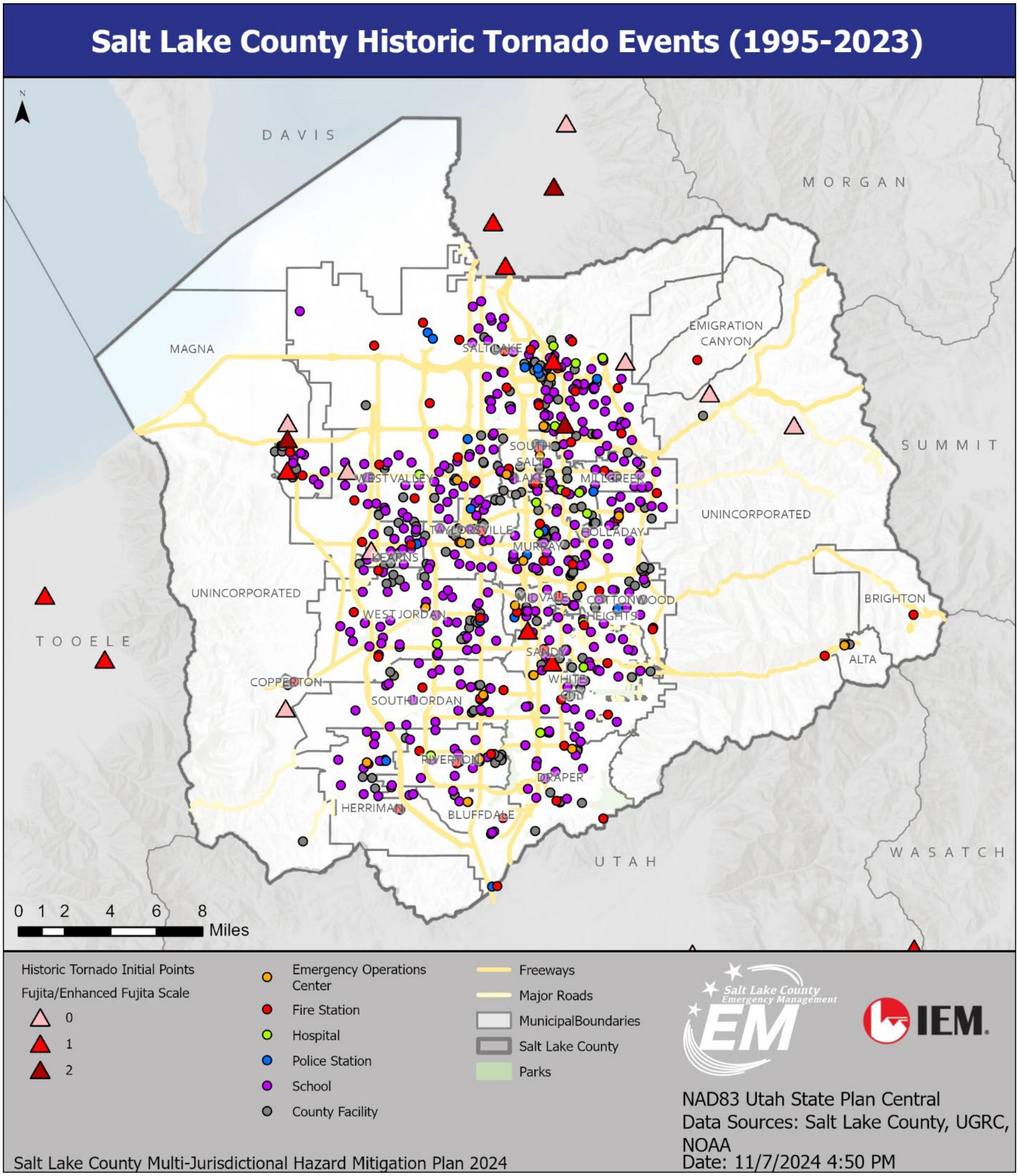



**Figure 156: Historic Tornadoes and Critical Facilities**

## ESTIMATED IMPACT AND POTENTIAL LOSSES

The National Risk Index (NRI) includes data on the expected annual losses to individual natural hazards, historical loss, and overall risk at a county and census tract level. Salt Lake County's NRI expected annual loss (EAL) value for Tornado is $3.4 million with a risk score of 81.4 and a rating of "relatively moderate" compared with the rest of the United States (Figure 157).

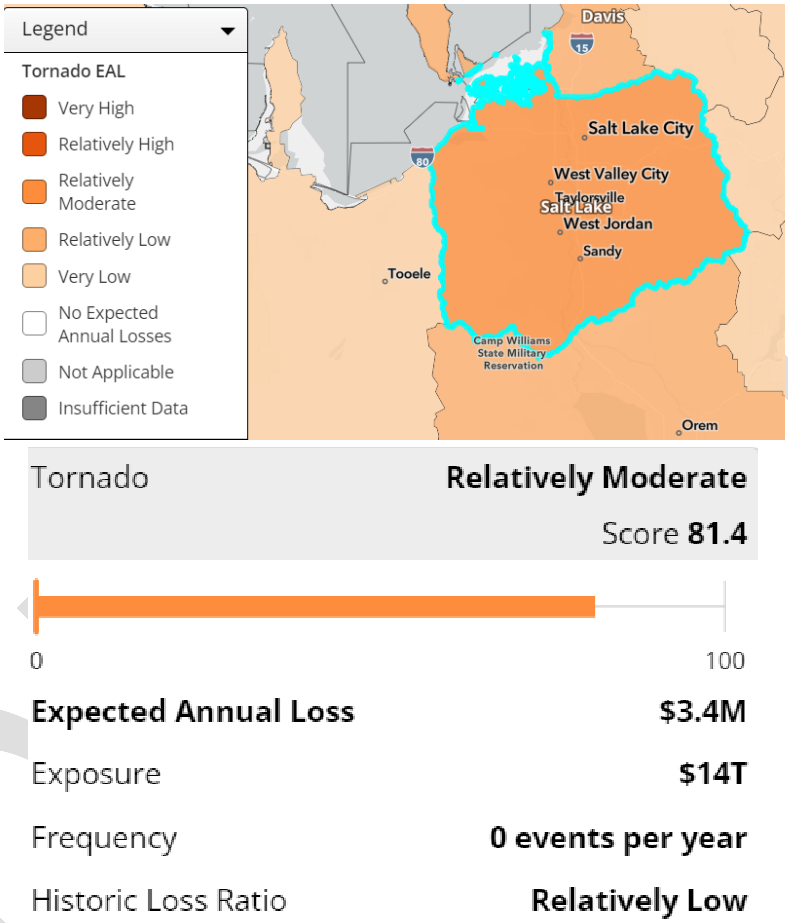



**Figure 157: FEMA National Risk Index Salt Lake County Expected Annual Loss from Tornado[184]**

## VULNERABLE POPULATIONS

FEMA defines vulnerability as susceptibility to physical injury, harm, damage, or economic loss. Tornadoes have the potential to pose a significant risk to the population and can create dangerous situations. Providing and preserving public health and safety is often difficult. Impacts to vulnerable populations can include greater susceptibility to tornado impact, injuries and even death due to limited mobility and decreased ability to respond rapidly to tornado warnings or evacuate. Other barriers include the lack of a safe place to go during tornadoes.

[184] FEMA, National Risk Index. "Salt Lake County Expected Annual Loss Tornado Risk Score, Map and Legend." https://hazards.fema.gov/nri/map

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 injury from heavy winds and tornado activity. Table 67 provides a breakdown of vulnerable populations.

**Table 67: Salt Lake County Vulnerable Populations[185]**

| Population Under 5 | Population Over 65 | Foreign Born | Language Other Than English | Population with Disability | No Health Insurance | Population in Poverty | Population in Mobile Homes |
|---|---|---|---|---|---|---|---|
| 79,892 | 133,703 | 12.9% | 21.6% | 11.4% | 9% | 9.4% | 7,199 |

The population in a car at the time of a tornado would also be vulnerable. According to the 2023 American Community Survey, 23.1 percent of the population in Salt Lake County transported to work by car, truck, or van.

## COMMUNITY LIFELINES

Community lifelines are the most fundamental services in the community that, when stabilized, enable all other aspects of society to function. Community lifelines are essential for the well-being of any community. They provide support and assistance to individuals who require help, especially during times of crisis. FEMA Community Lifelines are a critical component of emergency management in the United States. These lifelines are designed to address the essential needs of a community during and after a disaster. There are eight lifelines, each with its own focus and purpose (Figure 158).

185 U.S. Census Bureau. "American Community Survey Data." 2023. https://data.census.gov/profile/Salt_Lake_County,_Utah?g=050XX00US49035#health


**Figure 158: Community Lifelines[186]**

The importance of these lifelines cannot be overstated. In a disaster, communities can be left without access to necessities such as food, water, and shelter. The lifelines help ensure that these needs are met, and that people have the resources they need to survive. By providing access to medical care, public health services, and transportation, the lifelines help ensure that people can receive the care they need and safely evacuate if necessary. In addition, the Hazardous Materials lifeline helps to ensure that dangerous materials are managed safely, reducing the risk of further harm. Any or all these lifelines could be disrupted following a tornado. The severity of the tornado may determine how long it takes to restore the various services.

Community lifelines help create a sense of safety and security in a community. They provide a safety net for individuals who may be struggling and offer comfort and reassurance that help is available when needed. Without these lifelines, communities would be much more vulnerable to crises and emergencies.

## CHANGES IN DEVELOPMENT

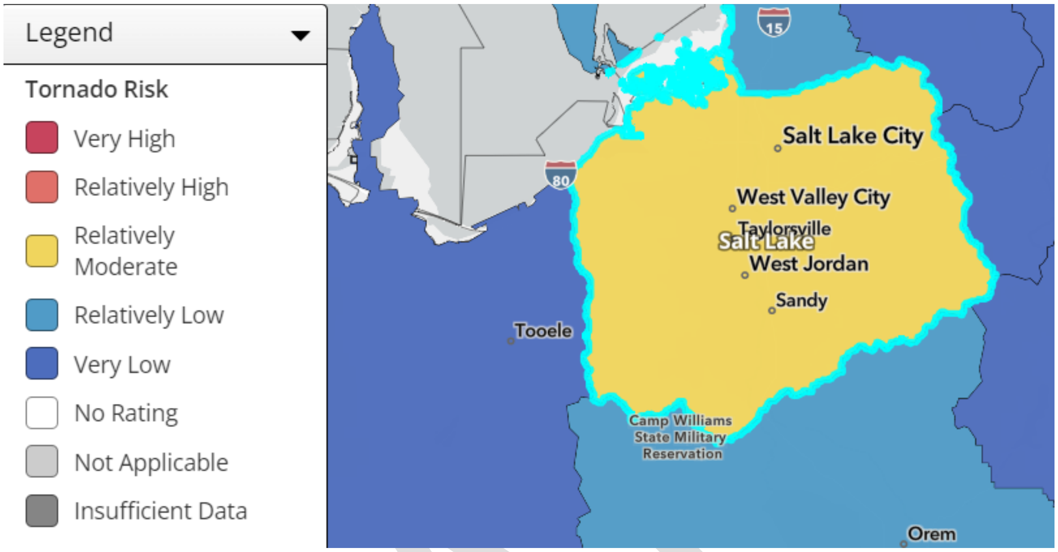
The changes in development that would increase vulnerability of Salt Lake County to tornadoes would be increase in population since the last plan update. The 2024 State Enhanced Hazard Mitigation Plan states Salt Lake County is one of the fastest growing counties in the state in terms of percent increase, and because of this, more and more people and assets are being exposed to severe weather hazards, thus potentially increasing vulnerability to certain hazards.[187] Although the likelihood of a tornado is unchanged, an increase in population represents an increase in vulnerability to tornadoes since the last plan update.

## VULNERABILITY SCORE

In order to analyze the county's vulnerability to tornadoes, the NRI was used as a primary tool during the 2024 Hazard Identification & Risk Assessment (HIRA) update. The NRI defines risk as the potential for negative impacts because of a natural hazard and determines a community's risk relative to other

[186] FEMA. "Community Lifelines." https://www.fema.gov/emergency-managers/practitioners/lifelines
[187] Utah 2024 State Enhanced Hazard Mitigation Plan

communities by examining the expected annual loss and social vulnerability in each community in relation to that community's resilience. Salt Lake County's NRI Tornado risk rating is shown in Figure 159. Salt Lake County has relatively moderate Tornado risk and a risk score of 78.5.




| Tornado | Relatively Moderate |
|---|---|
| | Score **78.5** |

**Figure 159: National Risk Index Tornado Risk Map, Legend and Score for Salt Lake County Utah**[188]



[188] FEMA, National Risk Index. "Salt Lake County Tornado Score, Map and Legend." https://hazards.fema.gov/nri/map

# Wildfire

## Hazard Description

Fire is a natural process in wildland areas. However, wildfires are particularly concerning in the wildland-urban interface (WUI). The WUI is the line, location, 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, and other buildings. Significant human development has occurred in the WUI in Salt Lake County, leading to many residents occupying fire-prone areas. Approximately 65 percent of Utah's wildfires are started by lightning, although 35 percent are initiated by human activity.

Wildfire removes vegetation that protects soil from excessive rainfall and the resulting runoff. It also damages soil by making it hydrophobic or water-repellent. These conditions contribute to the depletion of wildlife resources, soil erosion, water runoff, and, in some cases, severe slope failures and debris flows. Past wildfires in Salt Lake County have also significantly impacted watersheds. State and local agencies have worked together to enhance ordinances and other measures to protect watersheds in the county.

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. The energy output from a wildfire can make protecting homes nearly impossible and pose tremendous danger to firefighters and homeowners.

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 due to the proximity of fuel to flames. Aspect also influences fuel moisture content. Fuels tend to be drier on south- and west-facing slopes. Higher elevations are associated with cooler temperatures, higher relative humidity, and changes in vegetative fuel types.
- **Vegetation:** The type of surrounding vegetation significantly influences how quickly a fire will spread. For example, light grasses burn rapidly, whereas heavy, dense fuels like Douglas Fir burn slowly but more intensely. Different fuels vary in their rates of spread, intensity, and resistance to control.

  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 more easily, allowing fire to spread rapidly. Continuity describes how a fuel is arranged horizontally. Fuel broken up in patches burns unevenly and more slowly than uniform fuels. Compactness refers to how fuel is placed vertically. Compact fuels burn more slowly than tall, deep fuels, which have greater access to oxygen.
- **Weather:** Weather (temperature, humidity, precipitation, and wind) affects how easily a fuel ignites, how intensely it burns, and how easy it is to control. High temperatures heat fuels and reduces water content, which increases flammability. A decrease in relative humidity causes a proportionate reduction in fuel moisture, promoting easier ignition and more intense burning. The wind carries the

heat from a fire into unburned fuels, drying them out and causing them to ignite more easily. The wind can also blow embers into unburned areas ahead of the primary fire, potentially starting spot fires.

Figure 160 illustrates the key factors contributing to an area's wildfire vulnerability: vegetation and fuel sources, topography, and weather conditions.[189] Possible ignition sources should also be considered. Many wildfires in Utah are caused by lightning, but more are due to human influences. Most human-caused wildfires are accidental ignition from faulty electrical systems or damaged power lines, sparks from vehicles or machinery, improperly extinguished campfires, or weed burning. Wildfire can also be caused by intentional acts of arson.

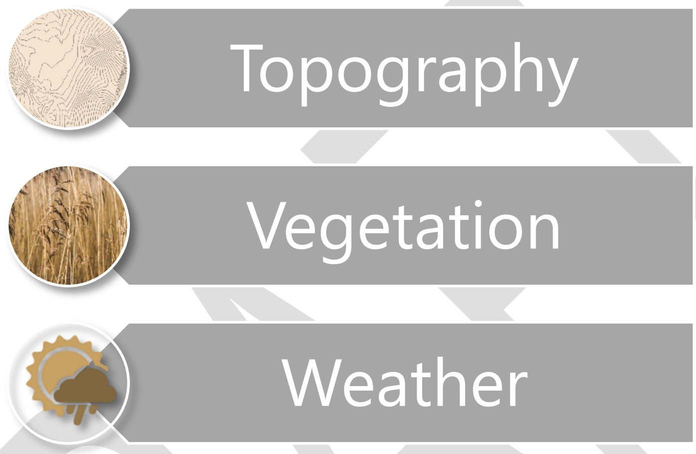



Figure 160: Key Factors Contributing to an Area's Wildfire Vulnerability

## Hazard Profile

<table>
<tr><td rowspan="4">Potential Impact</td><td></td><td>Catastrophic</td><td rowspan="4">Probability</td><td>X</td><td>Highly Likely</td></tr>
<tr><td>X</td><td>Critical</td><td></td><td>Likely</td></tr>
<tr><td></td><td>Limited</td><td></td><td>Occasional</td></tr>
<tr><td></td><td>Negligible</td><td></td><td>Unlikely</td></tr>
<tr><td>Location</td><td colspan="5">Wildland–urban interface (WUI) zones near the foothills and in forested areas; canyons along the Jordan River; undeveloped islands within urban areas (Dimple Dell)</td></tr>
<tr><td>Seasonal Pattern</td><td colspan="5">June–October</td></tr>
<tr><td>Conditions</td><td colspan="5">Areas affected by drought, heavily overgrown and dry brush and debris, lightning, and human triggers</td></tr>
<tr><td>Duration</td><td colspan="5">Days to months, depending on the climate, fuel load, and available resources (financial, manpower) to extinguish the fire</td></tr>
<tr><td>Secondary Hazards</td><td colspan="5">Debris flows, erosion, traffic accidents, air pollution, destruction of natural resources</td></tr>
<tr><td>Analysis Used</td><td colspan="5">Review of plans and data provided by the US Forest Service, Utah FFSL, FEMA, UGRC, County Hazard Analysis Plans, WWA, and UDEM</td></tr>
</table>



[189] First Street. "Does Salt Lake County have Wildfire Risk?" https://firststreet.org/county/salt-lake-county-ut/49035_fsid/fire

## Magnitude/Extent

Utah utilizes the following fire danger rating scale:[190]

- **Low:** Grasses and brush are not easily ignited by small firebrands. Dead and down timber fires spread slowly along the ground with little danger of spotting.
- **Moderate:** Fire in open grasslands can burn briskly and spread rapidly on windy days. Timber fires spread at a slow to moderate pace.
- **High:** Fires can ignite easily from various causes. Unattended brush and campfires are prone to escape, and fire spreads rapidly, with short distance spotting common.
- **Very High:** Fires ignite easily from any cause, spreading rapidly immediately after ignition and intensifying quickly. Spot fires that start new fires are a constant danger.
- **Extreme:** All fires are potentially serious because they ignite, spread, and burn intensely. It is often too dangerous for firefighters to use direct attack suppression tactics.

## Location

The areas of Salt Lake County most likely to experience significant destruction from a wildland fire include the foothills and bench areas on or near the Wasatch Range, Traverse Mountain, and the Oquirrh's. These WUI areas are most susceptible due to the amount of forested lands and the increasing population growth spreading into the foothills. Another area concern is vegetation type, such as sagebrush, mountain scrub oak, cheatgrass, pinyon and juniper trees, and riparian vegetation. Sagebrush and mountain shrubs throughout the county burn hot and fast and spread quickly. During prime burning conditions (hot, dry, and windy), the pinyon-juniper class is also prone to burning.

As population growth continues, the pressure to develop in WUI areas will likely increase the threats associated with wildfire. To reduce these threats, mitigation measures must be identified and enforced. The Risk to Potential Structures map (Figure 161) represents the likelihood of a wildfire and fire intensity, with generalized consequences for a home on each pixel. For every location on the landscape, it poses the hypothetical question, "What would be the relative risk to a house if one existed here?" This allows for comparing wildfire risk between areas with existing homes and areas where new construction may be proposed.[191]

[190] Utah Fire Info. "Fire Danger." https://utah-fire-info-utahdnr.hub.arcgis.com/pages/fire-danger
[191] Utah Wildfire Risk Assessment, Salt Lake County Summary Report. https://wildfirerisk.utah.gov/

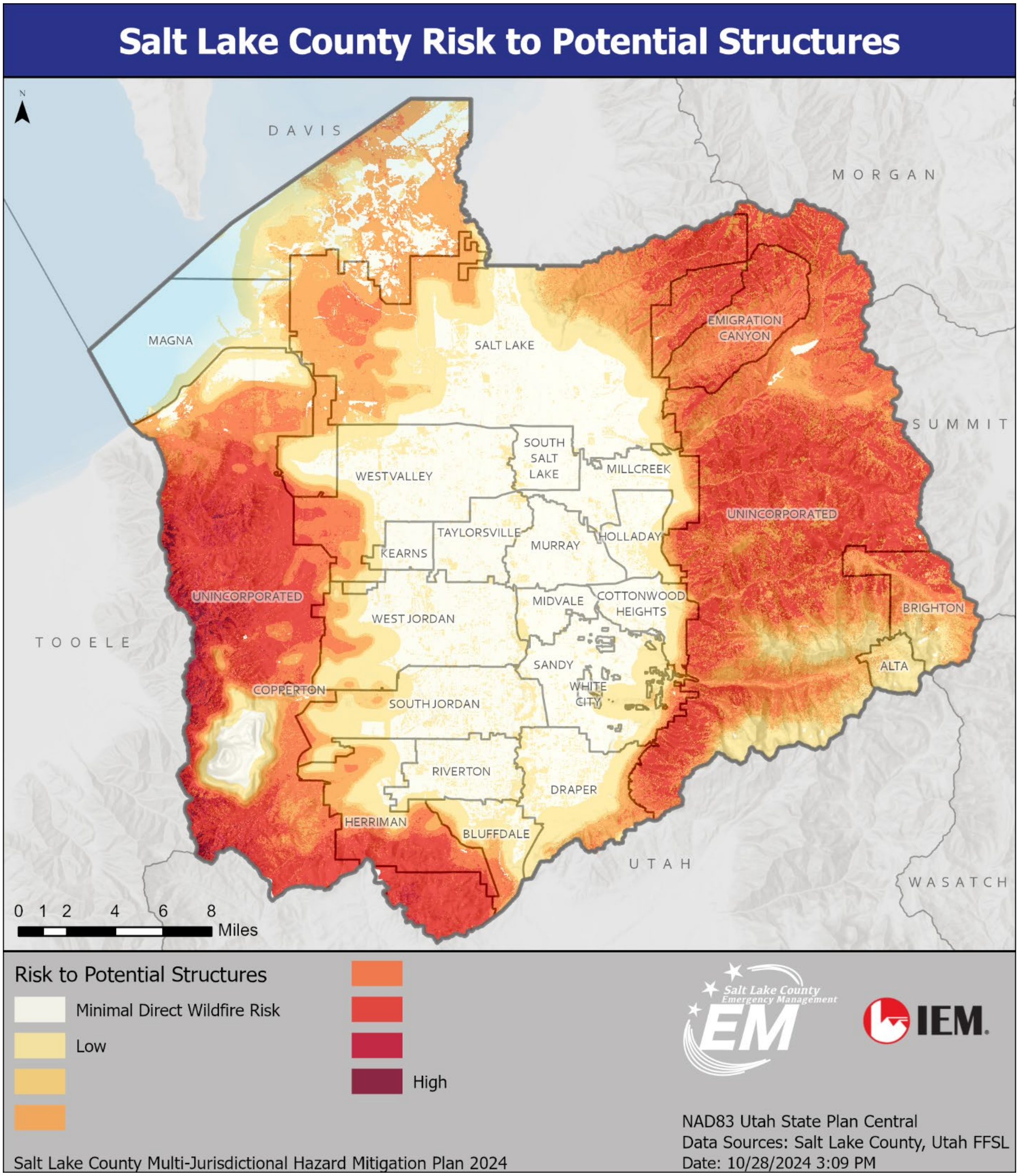



**Figure 161: Wildfire Risk to Potential Structures**

Figure 162 shows the wildfire hazard potential for Salt Lake County based on the Utah Wildfire Risk Explorer. This index quantifies the relative potential for wildfires that may be difficult to control and can be used to prioritize areas where fuel treatments are needed.

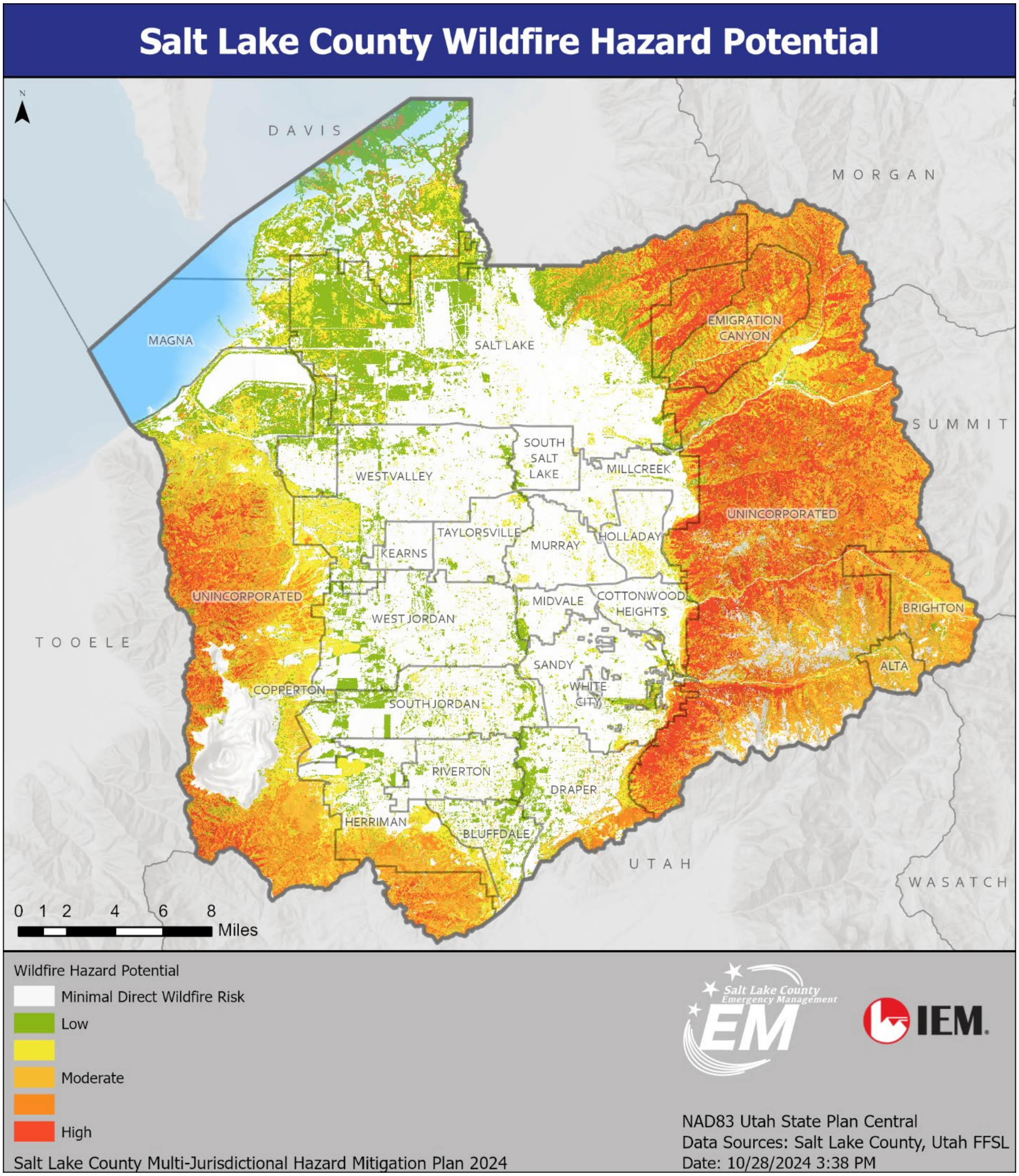



**Figure 162: Wildfire Hazard Potential**[192]

[192] Ibid.

Table 68: Wildfire Hazard Potential Area by Category

| | Wildfire Hazard Potential Category | Acres | Percent |
|---|---|---|---|
| | Minimal Direct Wildfire Impacts | 223,886 | 43.3 % |
| | Very Low | 0 | 0.0 % |
| | Low | 6,231 | 1.2 % |
| | Moderate | 51,345 | 9.9 % |
| | High | 122,449 | 23.7 % |
| | Very High | 112,591 | 21.8 % |
| | Total | 516,502 | 100.0 % |

## Historical Events and Probability of Future Occurrences

Based on the Federal Emergency Management Agency (FEMA) Disaster Declarations database, Salt Lake County has not received any wildfire Disaster Declarations since the last plan update. According to the National Oceanic and Atmospheric Administration( NOAA) data, there have been 18 wildfire events in 14 days in Salt Lake County from 2010 to 2024 (Salt Lake and Tooele Valleys, Great Salt Lake Desert and Mountains, Wasatch Mountains I-80 North, Wasatch Mountains South of I-80, Great Salt Lake Desert and Mountains, Salt Lake Valley, Wasatch Mountains I-80 North, Wasatch Mountains South of I-80). Figure 165 shows additional data from Utah Forestry Fire and State Lands, including fire perimeters and fire origin points from 1999 to 2020.

Figure 163 presents data on human-caused wildfires and the number of fires from October to May by year. Figure 164 also shows the frequency of fires by month and whether a local, state, or federal agency reported them.

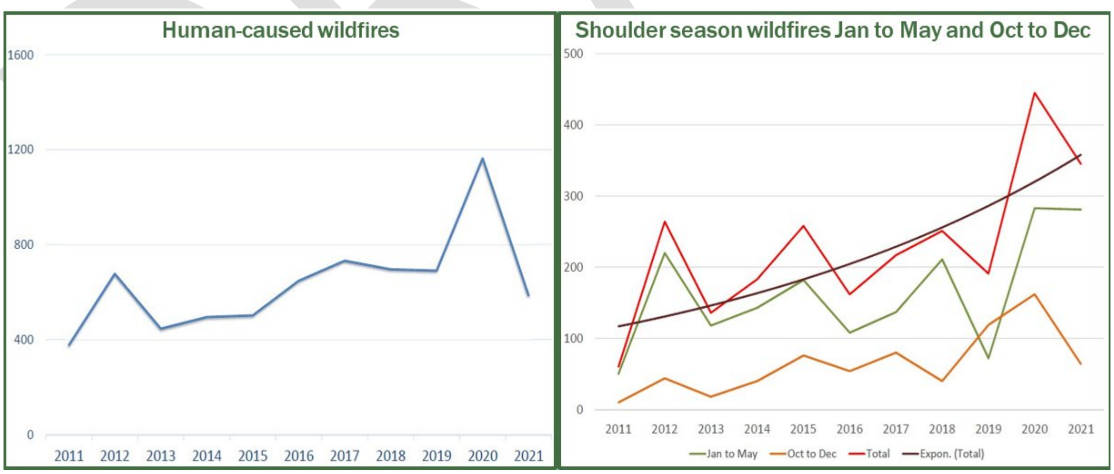



Figure 163: Wildfire Data for Utah, 2011–2021[193]

[193] Utah Division of Forestry, Fire, and State Lands. "Fire Program Overview and Strategic Plan." 2022. https://ffsl.utah.gov/fire/catastrophic-wildfire-risk-reduction/

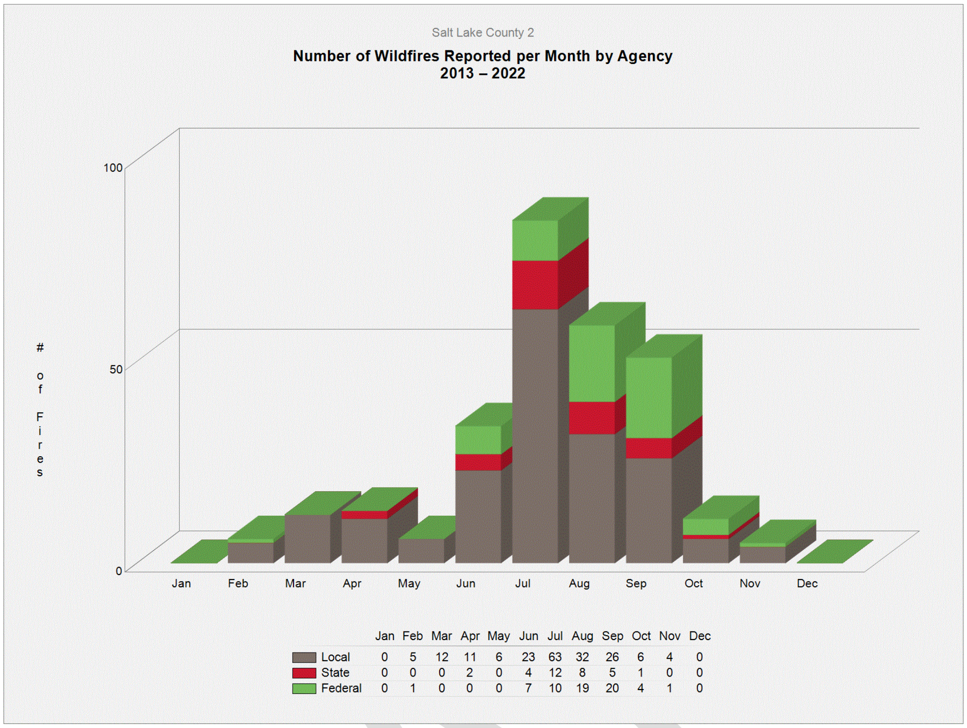



**Figure 164: Number of Wildfires Reported per Month by Agency[194]**

Several notable wildfires have occurred in Salt Lake County recently. On July 20, 2024, the Sandhurst Fire began near Ensign Peak above the Utah Capitol building in northern Salt Lake City. Several roads were closed to allow emergency response crews access. Twenty-two homes were evacuated, and several radio towers and the City Creek watershed protection were a concern. The fire burned 203 acres before it was contained.

On August 14, 2021, sparks from a vehicle started a fire in Parley's Canyon. Thousands of homes were evacuated near Lambs Canyon, Mill Creek Canyon, and Summit Park in neighboring Summit County. Interstate I-80 was temporarily closed to traffic. The fire was initially estimated at over 2,000 acres, but more accurate mapping indicated the fire burned 538 acres. No structures were destroyed.

In April 2015, a brush fire occurred in the Avenues area of Salt Lake City. Another fire occurred in Herriman City in 2016, destroying two homes and causing evacuations. In neighboring Tooele County, the Dollar Ridge Fire destroyed 90 homes. These fires prompted significant fire responses, required many citizens to evacuate, and created the threat of debris flows in the following years. The Dollar Ridge Fire received a Fire Management Assistance Declaration.



194 Utah Wildfire Risk Explorer. "Area of interest summary report for Salt Lake County." https://wrap.wildfirerisk.utah.gov/

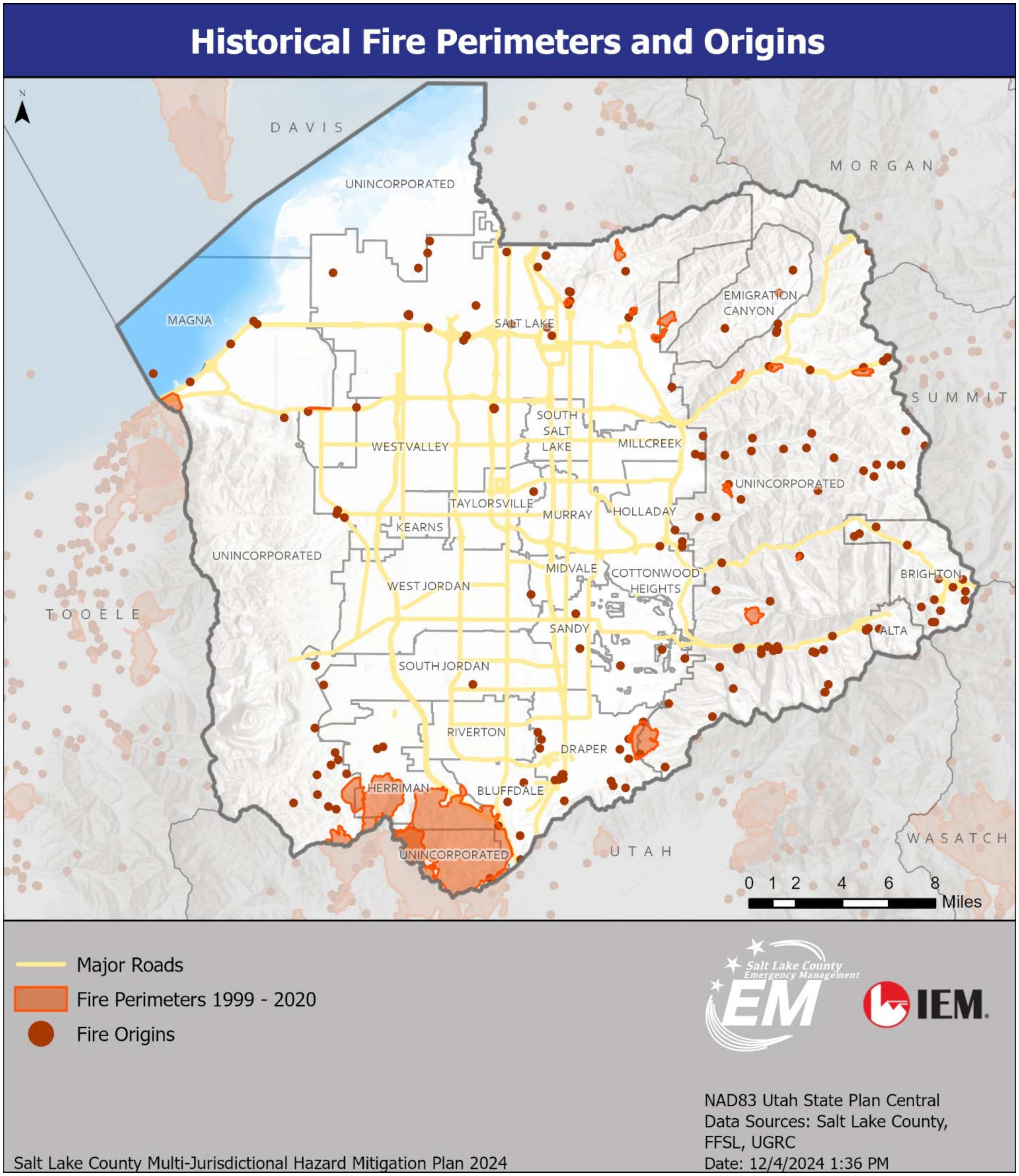



**Figure 165: Historical Fire Perimeters and Origin Points**

According to historical averages, there is a near 100 percent chance of a wildfire occurrence in the next year. As previously stated, NOAA data indicates that there have been 14 recorded days with a wildfire event in Salt Lake County from 2010 to 2024. This averages out to approximately one wildfire event every year. The USDA Forest Service ranks the wildfire potential of the majority of Salt Lake County as “Very High” or “High” (see Figure 166).

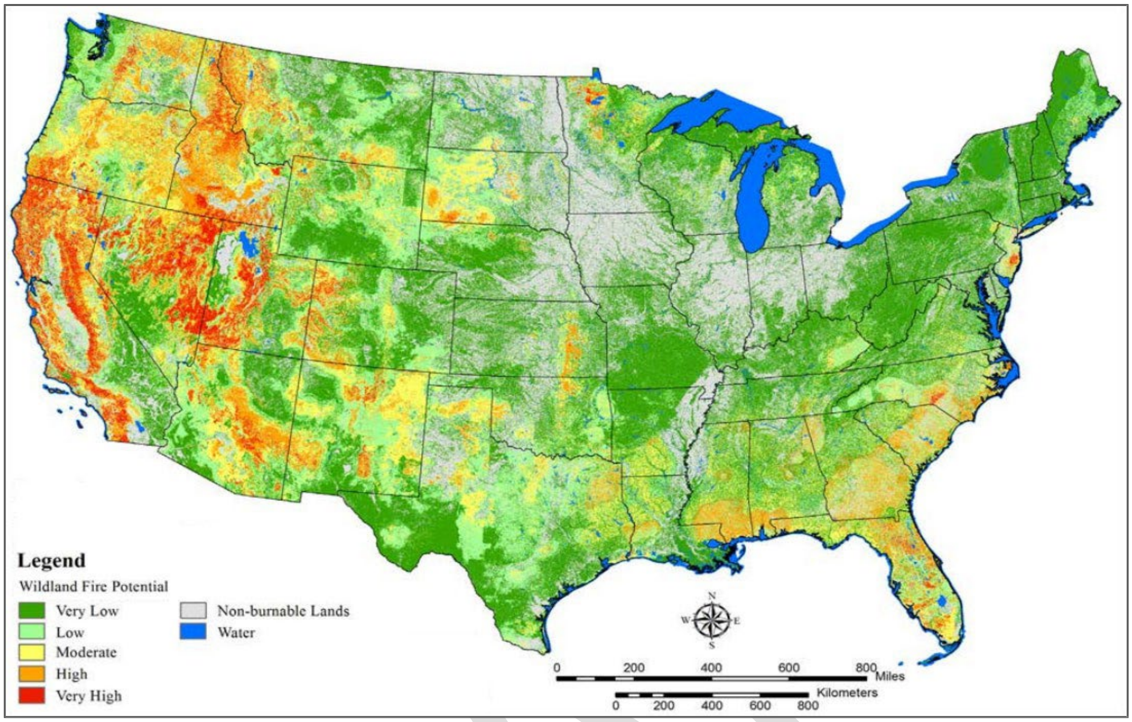



**Figure 166: Wildland Fire Potential**[195]

Figure 167 shows another measure of fire probability based on the Utah Wildfire Risk Assessment. Burn probability is the annual probability of a wildfire burning in a specific location. It is based on fire behavior models that simulate thousands of possible fire seasons. These simulations are based on past observations and include factors such as the probability of a fire occurring, weather, topography, and ignition. It does not predict or forecast fire danger conditions nor represent information about the potential intensity of a fire if one occurs.[196]



[195] From Dillon, Greg, et al. "Fire Potential: A Tool for Assessing Wildfire Risk and Fuel Management Needs." Proceedings of the Large Wildland Fires Conference. US Forest Service. 2015. https://www.fs.usda.gov/rm/pubs/rmrs_p073/rmrs_p073_060_076.pdf

[196] Utah Wildfire Risk Explorer. "Area of interest summary report for Salt Lake County." https://wrap.wildfirerisk.utah.gov/Map/Pro#map-themes

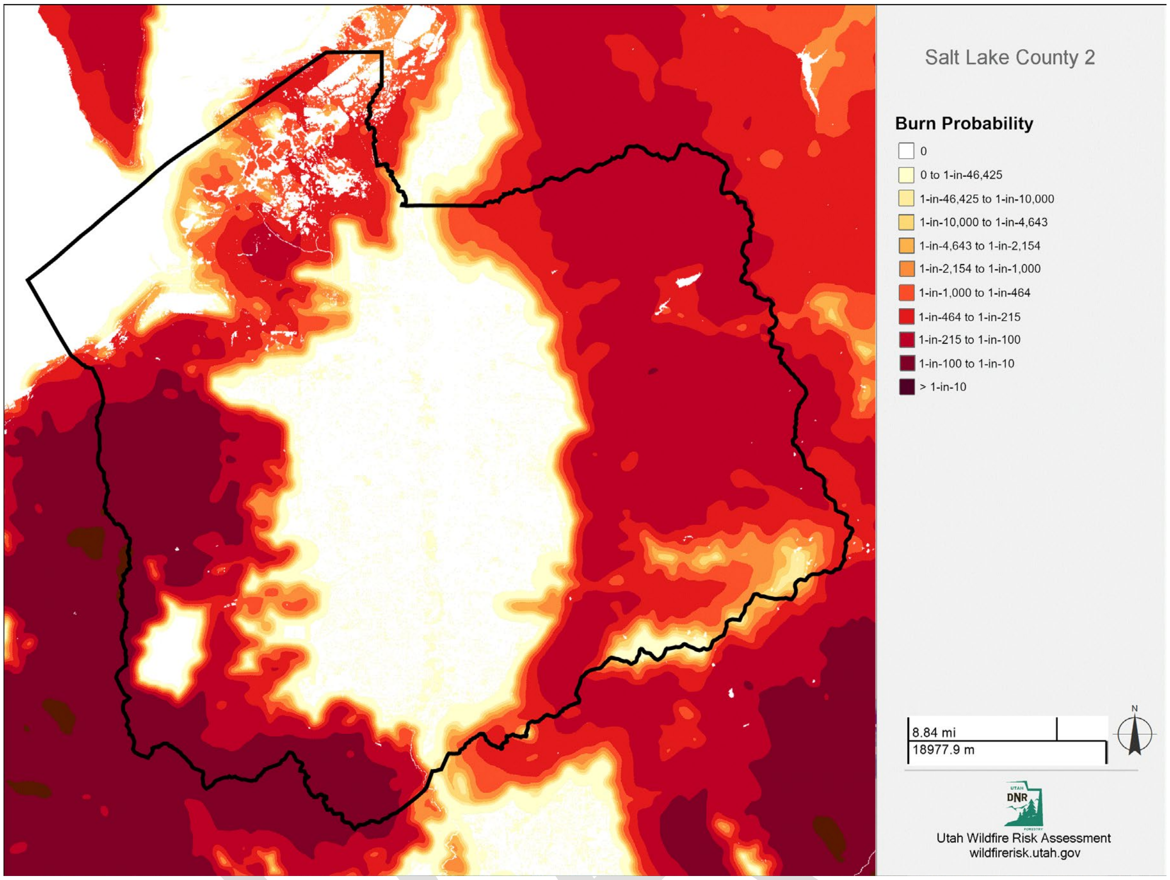



Figure 167: Burn Probability Map

Table 69: Burn Probability Categories and Acreage[197]

| | Burn Probability Category | Acres | Percent |
|---|---|---|---|
| | Minimal Direct Wildfire Impacts | 147,845 | 28.6 % |
| | 0 to 1-in-46,425 | 45,128 | 8.7 % |
| | 1-in-46,425 to 1-in-10,000 | 6,906 | 1.3 % |
| | 1-in-10,000 to 1-in-4,643 | 9,294 | 1.8 % |
| | 1-in-4,643 to 1-in-2,154 | 13,335 | 2.6 % |
| | 1-in-2,154 to 1-in-1,000 | 21,691 | 4.2 % |
| | 1-in-1,000 to 1-in-464 | 33,454 | 6.5 % |
| | 1-in-464 to 1-in-215 | 62,428 | 12.1 % |
| | 1-in-215 to 1-in-100 | 128,477 | 24.9 % |
| | 1-in-100 to 1-in-10 | 47,728 | 9.2 % |
| | > 1-in-10 | 215 | 0.0 % |
| | Total | 516,501 | 100.0 % |

[197] Ibid.

The probability of extreme fire behavior (Figure 168) represents the likelihood of flame lengths exceeding 11 feet, considered the threshold for extreme fire behavior during fire operations.[198]

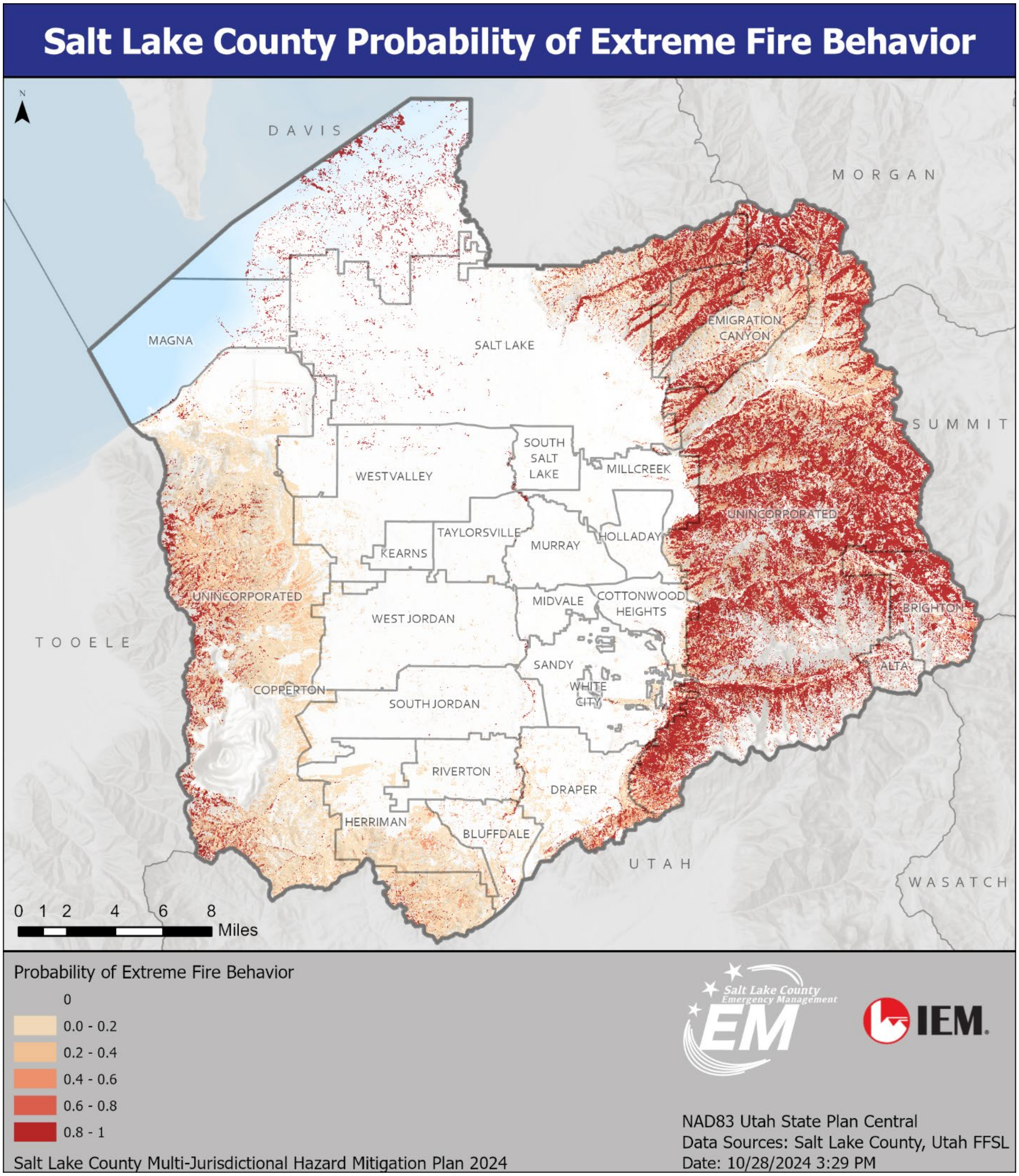



**Figure 168: Potential for Extreme Fire Behavior**

198 Utah Wildfire Risk Explorer. https://wrap.wildfirerisk.utah.gov/Map/

## Climate Change Considerations

As climate conditions have warmed, wildfires have become more intense and destructive, especially in the western United States. Fire can play an important role in ecosystems, and forest management policies have shifted to allow more natural fire cycles. However, rising temperatures and periods of drought, which contribute to changes in fuels and create dangerous fire conditions, have complicated this natural cycle. Warmer temperatures also allow invasive species like the bark beetle to thrive. These beetles have killed thousands of square miles of trees, making them more susceptible to wildfire and increasing the likelihood of faster-spreading fires.[199]

Since the early 20th century, Utah's temperature has increased by more than 2.5°F. The 2024 Utah Enhanced State Hazard Mitigation Plan projects that warming temperatures and increasing drought incidents in the western United States will increase the number of acres burned by wildfires. In addition, early spring onsets, snowmelts, and reduced seasonal snowpacks are projected to heighten fire risk.[200]

## Secondary Hazards

The most direct impacts of a wildfire are damage or complete loss of property, injury, or even death. Secondary impacts can include poor air quality due to smoke in nearby areas. This can be particularly harmful for elderly individuals or others with chronic heart or lung conditions. Damage to the environment, wildlife, and natural resources are also significant. Much of the mountainous area in western Salt Lake County is a watershed, and fire can impact the quality of the water supply. As the area is a major outdoor recreation and tourism hub, a major fire can also have significant economic impacts. The risk of debris flows after a fire in mountainous areas is high for several years after a fire until vegetation is reestablished.

## Vulnerability Assessment

The risk of wildfire to the people and property of Salt Lake County is a significant concern. The county has large areas of forested land, with high fuel loads near developed areas. Of the 516,502 acres in Salt Lake County, 235,040 (46%) are in High or Very High Wildfire Hazard Potential areas. These factors—combined with compounding weather conditions such as high heat, drought, and high wind—create the potential for both natural and human-caused fires that can lead to property damage and loss of life.

In the risk assessment framework, wildfire hazard is measured by two primary factors (see Figure 169): 1) burn probability (or likelihood of burning), and 2) fire intensity (measured as flame length, fire line intensity, or other similar measures). Figure 161–Figure 168 and Table 69 above provide various examples of probability and intensity. This section aims to identify assets potentially exposed to wildfire hazards to assess vulnerability.

[199] USGS. "Wildfire and Climate Change." https://www.usgs.gov/science-explorer/climate/wildfire
[200] Utah Hazard Mitigation. "Climate Change Considerations." 2024 Utah State Hazard Mitigation Plan. https://hazards.utah.gov/state-of-utah-hazard-mitigation-plan/

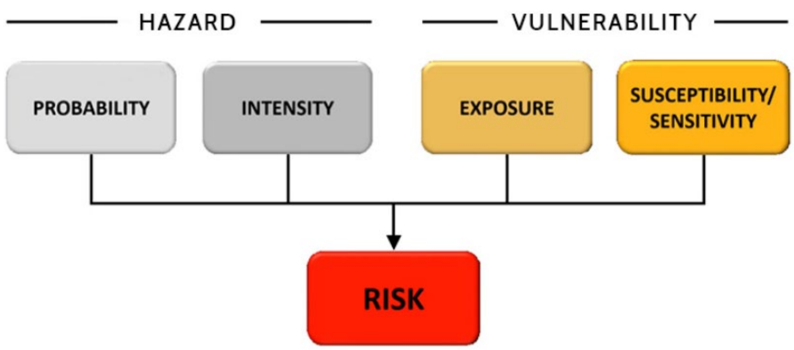



Figure 169: Fire Risk Assessment Framework[201]

An analysis based on the Utah Wildfire Risk Assessment Portal was conducted to identify each county's wildfire threat risk. The results show the threat based on the percentage of land falling under various threat categories, ranging from VVL (Very, Very Low) to VVH (Very, Very High). Seven Utah counties have 25 percent or more of their land classified as a high wildfire threat, with Salt Lake County having the highest percentage, at 59.8 percent.

Table 70: Salt Lake County Wildfire Threat 2024[202]

| 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% |

Growing counties are recommended to follow FEMA's Firewise construction recommendations for all new development areas to minimize wildfire risk. The Firewise program encourages and supports neighborhoods in mitigating wildfire hazards. There are currently 28 Firewise communities in Utah.

Table 71: Firewise Communities in Salt Lake County[203]

| Title | Number of Residents | First Year |
|---|---|---|
| Emigration Canyon | 850 | 2002 |
| Hi-Country Estates Phase 1 | 88 | 2016 |
| Mt. Air | 100 | 2017 |
| Town of Brighton | 299 | 2021 |

In 2005, Utah identified almost 600 communities and their surrounding natural resources as "at risk" from wildland fire. The annually updated list comprises communities throughout Utah that wildland fire officials have determined to be at risk from wildland fire. The "Overall Score" represents the sum of multiple risk factors analyzed for each community. Risk factors include fire history, local vegetation, and firefighting

[201] Utah Department of Natural Resources, Forestry, Fire, and State Lands. "Utah Wildfire Risk Assessment." https://ffsl.utah.gov/fire/utah-wildfire-risk-assessment/
[202] 2024 Utah State Hazard Mitigation Plan.
[203] Firewise USA. 2024, Interactive Map. nfpa.maps.arcgis.com/apps/Viewer/index.html?appid=c4a788340df748f18d98d8363145bb67

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 communication with communities on the list.

**Table 72: Communities at Risk - Forestry, Fire, State Lands (2019)[204]**

| Communities at Risk | Fire Occurrence | Structure Hazard | Fuel Hazards | Values Protected | Fire Protection Capability | Overall Score |
|---|---|---|---|---|---|---|
| **Alta** | 1 | 2 | 1 | 2 | 2 | 6 |
| **Big Cottonwood** | 1 | 2 | 2 | 3 | 0 | 8 |
| **Bluffdale** | 2 | 1 | 1 | 2 | 0 | 6 |
| **Brighton** | 2 | 2 | 2 | 3 | 1 | 10 |
| **Copperton** | 1 | 0 | 1 | 2 | 0 | 4 |
| **Cottonwood Heights** | 1 | 0 | 1 | 2 | 0 | 4 |
| **Dimple Dell** | 1 | 0 | 2 | 3 | 0 | 6 |
| **Draper (see Suncrest)** | NA | NA | NA | NA | NA | NA |
| **Emigration Canyon** | 2 | 1 | 3 | 3 | 0 | 9 |
| **Herriman** | 2 | 0 | 1 | 2 | 0 | 5 |
| **High Country Estates I** | 2 | 0 | 1 | 2 | 0 | 5 |
| **Holladay** | 1 | 0 | 1 | 2 | 0 | 4 |
| **Lambs Canyon** | 2 | 2 | 2 | 2 | 0 | 8 |
| **Little Cottonwood** | 1 | 2 | 2 | 2 | 0 | 7 |
| **Mount Aire** | 2 | 1 | 2 | 2 | 0 | 7 |
| **Olympus Cove** | 1 | 0 | 1 | 2 | 0 | 4 |
| **Salt Lake City** | 2 | 0 | 1 | 2 | 0 | 5 |
| **Sandy** | 1 | 0 | 1 | 2 | 0 | 4 |
| **Suncrest (Draper)** | 1 | 0 | 2 | 3 | 0 | 6 |

[204] Utah Department of Natural Resources, Forestry, Fire, and State Lands. "2019 Communities at Risk." https://ffsl.utah.gov/fire/wildfire-community-preparedness/communities-at-risk/, https://drive.google.com/file/d/1VQeWa63cO1eydm9uvuPDqdGnyzLIQLue/view

## ESTIMATED IMPACT AND POTENTIAL LOSSES

The National Risk Index (NRI) includes data on the expected annual losses from individual natural hazards, historical loss, and overall risk at a county and census tract level. Salt Lake County's NRI expected annual loss (EAL) value for wildfire is $24 million, with a risk score of 99.4 and a rating of Relatively High percentile compared with the rest of the United States (Figure 170).


**Figure 170: FEMA National Risk Index Salt Lake County Expected Annual Loss from Wildfires[205]**

Fire can damage or destroy structures, including homes, businesses, critical facilities, and other community assets. In strong winds, embers can travel several miles from the main fire and may ignite secondary fires when they encounter flammable dry vegetation, rooftops, or debris.

Residents closest to the fire may be evacuated; longer-term displacements are likely if residences are damaged. Some households may need to seek public shelter. Homes in the foothills may be on dead-end spur roads that may be more difficult to navigate in an evacuation due to narrow lanes and higher traffic volumes. These areas may also be more problematic for fire trucks to reach. Individuals closest to the wildfire are at risk of burns, other injuries, or death. Poor air quality and smoke inhalation can affect individuals across a large area and are particularly harmful to those with underlying health conditions.

Fires can damage utility systems such as power lines and substations, communication towers, water treatment facilities, and other infrastructure systems. Roads and other transportation networks may require closure, which can cause widespread disruption as people seek alternative routes. Some canyon communities only have one major access road, which may leave residents isolated from services and, in the event of an evacuation, may cause traffic delays. Emergency response may be delayed by power or communication disruptions if roadways are inaccessible or responding agencies are overwhelmed.

Wildfires can also have significant economic consequences. Businesses can experience direct damage to facilities, inventory, or equipment. Fire can also disrupt power, communication, other utility services, and transportation networks, which can further interrupt business operations. Businesses closed by evacuations or other interruptions will experience a loss in revenue. Businesses that remain open may be short-staffed due to employees' inability to report to work. The canyons and forests are vital to Salt Lake

[205] FEMA, National Risk Index. "Salt Lake County Expected Annual Loss Wildfire Risk Score, Map and Legend." https://hazards.fema.gov/nri/map

County's recreation and tourism industries. Fires restrict access to these areas during the event and may lead to long-term reductions in visits to the affected areas. The cost of fire suppression, repairs to damaged facilities, and economic losses can all make recovery difficult for a community. A large-scale fire can strain the community's financial resources and further slow economic recovery.

As one might expect, the effect of wildfires on the environment is typically devastating. Significant vegetation and wildlife habitats can be destroyed, requiring a long time to regenerate. Ash and debris can diminish water quality and affect the water supply. Furthermore, when land is stripped of vegetation, erosion increases, along with the risk of slope failure or debris flows, which could further threaten structures or impact water supplies and quality.

## VULNERABLE POPULATIONS

Social vulnerability is an indicator of an individual's ability to cope with and recover from trauma. For any given exposure, populations with high social vulnerability tend to experience impacts more severely. Social and economic factors can make it more difficult for some people to prepare for, respond to, and recover from wildfires. Vulnerable populations may lack access to resources, experience cultural and institutional barriers, have limited mobility, or have medical conditions exacerbated by stress or smoke conditions.

People over the age of 65 and individuals with disabilities are more susceptible to air pollution and particulates associated with wildfire smoke. These individuals may also experience challenges if evacuations are required. Language barriers can make it difficult to follow directions during an evacuation or to access support after a disaster. Race and ethnicity are strongly correlated with disparities in health and access to aid and resources. Wildfires disproportionately impact people with low incomes due to factors such as inadequate housing and a diminished ability to evacuate or afford relocation expenses.

Diminished air quality is an environmental impact that can result from a wildfire and pose potential health risks. Smoke plumes from wildfires can contain potentially inhalable carcinogenic matter. Particles of soot and ash that are too small for the respiratory system to filter can cause immediate and possibly long-term health effects. Older adults or those with compromised respiratory systems may be more vulnerable to diminished air quality after a wildfire event.

In addition, fire protection in WUI areas is difficult because the tactics used for wildfire suppression cannot be used for structure protection and suppression. The energy emitted from a wildfire is hazardous to firefighters and homeowners, making protecting homes almost impossible. One-third of all firefighter deaths occur while fighting wildfires. Many believe that WUI areas significantly increase firefighter risks. Legally, federal wildland protection agencies are seldom responsible for protecting structures. State forestry agencies' legal responsibility for protecting structures in non-federal wildlands varies widely.

Table 73 provides statistics on vulnerable populations living in Salt Lake County. Figure 171 illustrates the areas in Salt Lake County with vulnerable populations, based on the indicators under 5 years old, limited English proficiency, and over 65 years old.

Table 73: Salt Lake County Vulnerable Populations at Risk of Wildfire[206]

| Indicator | Number | | Percent | |
|---|---|---|---|---|
| Families in poverty | 14,238 | ±1,027 | 5.1% | ±0.4% |
| People with disabilities | 116,735 | ±2,910 | 9.9% | ±0.3% |
| People over 65 years | 133,703 | ±2,776 | 11.3% | ±0.3% |
| People under 5 years | 79,892 | ±2,713 | 6.8% | ±0.2% |
| People of color | 364,456 | ±15,081 | 30.9% | ±1.3% |
| Black | 21,531 | ±2,346 | 1.8% | ±0.2% |
| Native American | 10,243 | ±1,394 | 0.9% | ±0.1% |
| Hispanic | 225,177 | ±7,575 | 19.1% | ±0.7% |
| Difficulty with English | 38,373 | ±2,383 | 3.5% | ±0.2% |
| Households with no car | 21,291 | ±1,297 | 5.2% | ±0.3% |
| Mobile homes | 7,151 | ±719 | 1.8% | ±0.2% |

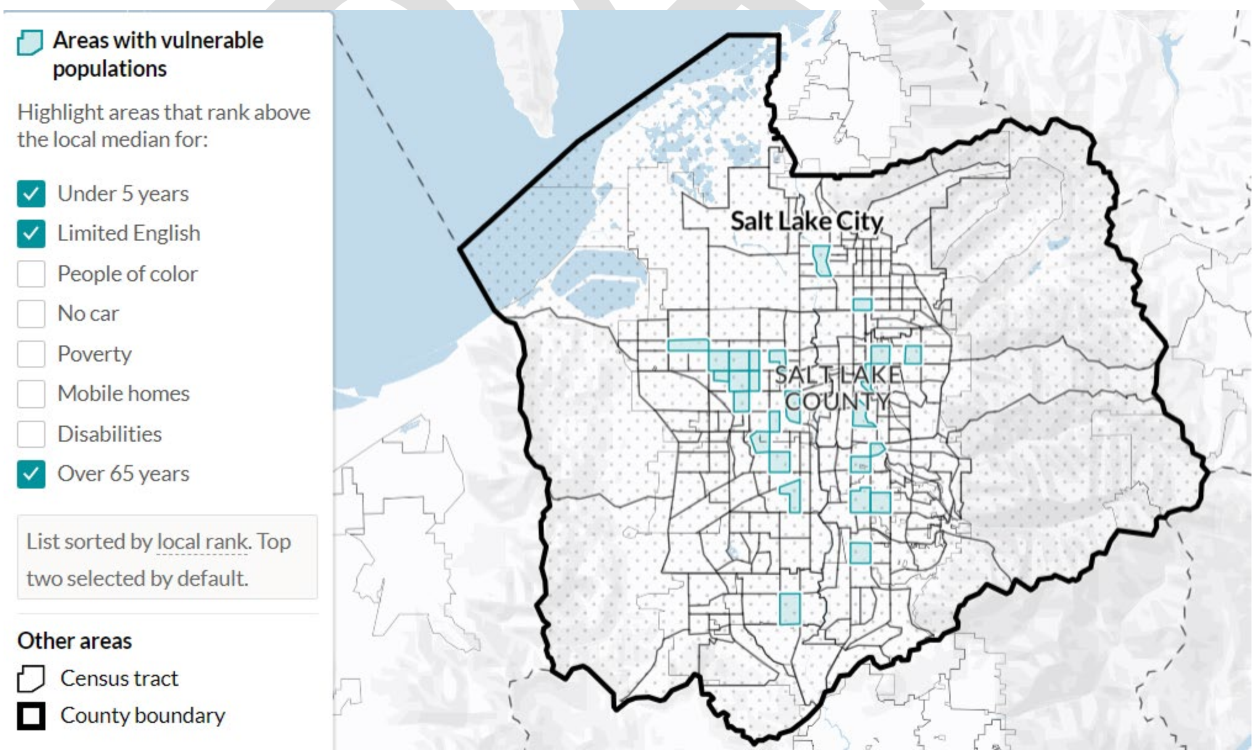



Figure 171: Wildfire Risk Vulnerable Populations Map, Salt Lake County by Three Indicators[207]

## COMMUNITY LIFELINES

Lifelines are essential community services that, when maintained, allow all other aspects of society to function effectively. Community lifelines are essential for the well-being of any community, providing support and assistance to individuals who need help, especially during times of crisis. FEMA Community Lifelines are a critical component of emergency management in the United States. These lifelines are designed to address the essential needs of a community during and after a disaster. Community Lifelines help create a sense of safety and security within a community. They provide a safety net for individuals who may be struggling and offer comfort and reassurance that help is available when needed. Without these lifelines, communities would be significantly more vulnerable to crises and emergencies. There are eight lifelines, each with a specific focus.


**Figure 172: FEMA Community Lifelines[208]**

Wildfires can strain food, hydration, and shelter lifelines for those evacuated. Safety and security lifelines may also be strained when responding to the fire and enacting evacuation procedures. Damage caused by the fire may also disrupt energy, transportation, communication, and water systems.

## CHANGES IN DEVELOPMENT

Salt Lake County continues to experience growth and development in the WUI. According to the U.S. Census, it was the most populous county in the state, with a population of 1,185,813 in 2023, reflecting steady growth over the past 13 years. However, the estimated 2024 population is slightly lower at 1,185,057, with a growth rate of -0.06 percent in the past year, according to the latest census data. Since 2010, when the population was 1,032,997, Salt Lake County has grown 14.72 percent.[209]

Growth increases vulnerability to wildfire, as the county's high projected population growth coincides with significant wildfire threats. This growth is also increasing residents' exposure to wildfires and may leave many newcomers to Salt Lake County unaware of the risk. In addition to direct risk, this growth could lead

[206] Wildfire Risk. "Salt Lake County Vulnerable Populations at risk from Wildland Fire." 2024. https://wildfirerisk.org/explore/vulnerable-populations/49/49057/
[207] Wildfire Risk. "Wildfire Risk Vulnerable Populations Map, Salt Lake County by Three Indicators." 2024. https://wildfirerisk.org/explore/vulnerable-populations/49/49057/
[208] FEMA. "Community Lifelines." https://www.fema.gov/emergency-managers/practitioners/lifelines
[209] World Population Review.com. 2024. https://worldpopulationreview.com/us-counties/utah/salt-lake-county

to more disruptions associated with evacuations, air quality, and public health concerns. Overall, vulnerability to wildfire has increased since the last plan update.

## VULNERABILITY SCORE

The NRI was used as a primary tool during the 2024 update to analyze the county's vulnerability to wildfire. The NRI defines risk as the potential for negative impacts resulting from a natural hazard. It determines a community’s risk relative to other communities by examining the expected annual loss and social vulnerability in a given community in relation to its resilience. Salt Lake County’s NRI wildfire risk rating is shown in Figure 173. Salt Lake County has a relatively high wildfire risk, with a risk score of 99.2.

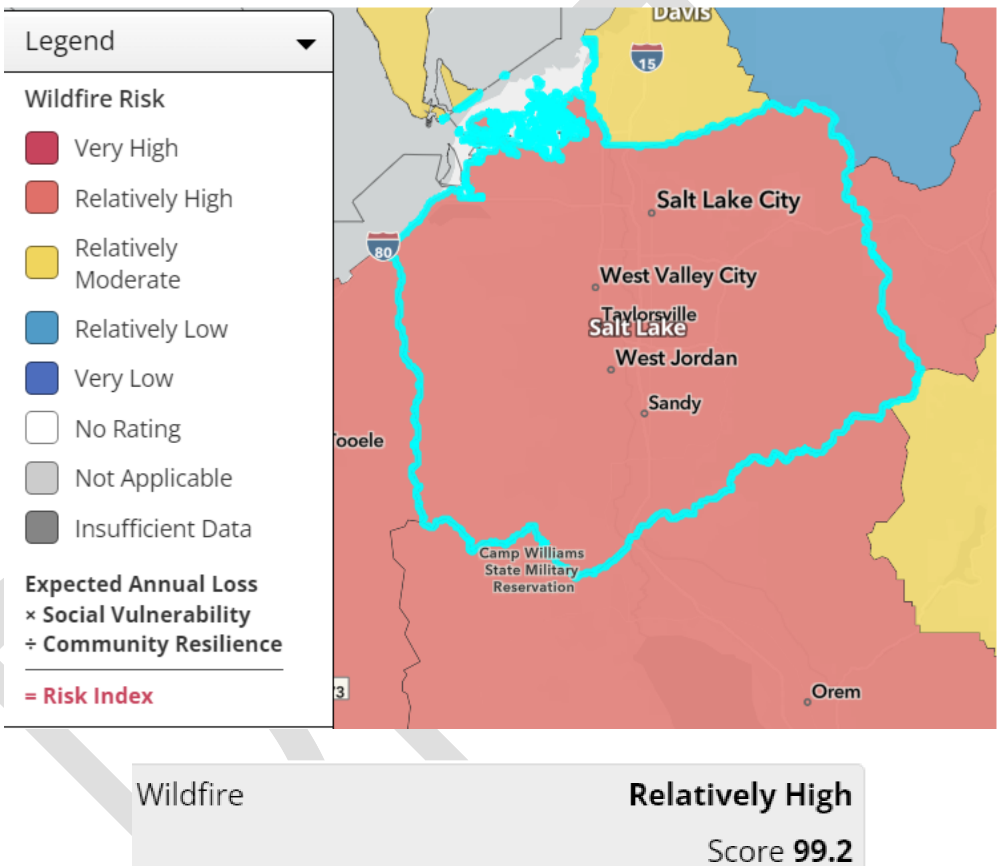



**Figure 173: National Risk Index Wildfire Risk Map, Legend, and Score for Salt Lake County, Utah[210]**

[210] FEMA, National Risk Index. “Salt Lake County Wildfire Score, Map and Legend.” https://hazards.fema.gov/nri/map

# Civil Disturbance

## Hazard Description

Civil disturbance or disorder is a wide-ranging phenomenon encompassing any incident involving large groups 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 or protests.

Civil disorder can be the spontaneous impact of a triggering event, such as the looting seen following disasters (e.g., 2005 Hurricane Katrina in New Orleans), or it can be a specific hazard unrelated to any other hazard (e.g., 1999 World Trade Organization riots in Seattle). It can arise from peaceful events, gatherings, or demonstrations or be preplanned and intentional. 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. Individuals participating in civil disorder will exploit actual or perceived infringements on this right to gain public sympathy for their cause. Therefore, the most effective way to reduce 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 civil disorder erupts, responders have access to a range of nonlethal tools designed to manage riots effectively. These include equipment such as helmets, body armor, and gas masks, which are essential for protecting against physical harm and tear gas. Crowd control tools such as batons, shields, and pepper spray can be utilized to manage and disperse crowds if necessary. Communication devices like two-way radios and earpieces are crucial for maintaining contact and coordination among first responders. Nonlethal weapons such as rubber bullets, bean bag rounds, and stun grenades can be used for crowd control and dispersal, while armored vehicles can be used to transport and protect first responders in volatile situations. Finally, to ensure the safety of the public, first responders, and other protesters, lethal force may be considered as a last resort.

### CIVIL DISTURBANCE DURING DISASTERS

Civil disorder, primarily in the form of looting, often occurs during or immediately after a disaster. Other types of civil disorder, such as rioting, are exceedingly rare after a disaster.

Civil disorder during disasters arises from a range of motivating factors. One factor contributing to civil disorder during disasters is the disruption of environmental and social norms, which creates an atmosphere of chaos. This can lead to the rationalization of acts that would normally be considered unacceptable. This behavior change, combined with a displaced or overburdened police force, can escalate civil disorder after disasters. Another factor contributing to disaster-related civil disorder is resource scarcity, when individuals either lack basic supplies or fear losing access to them. Disasters often disrupt a community’s ability to provide citizens with food, clothing, and potable water. Fearing for their survival, people may loot to obtain these necessities. Lastly, it has been argued that civil disorder during disasters stems from social inequalities. There is a strong correlation between lower socioeconomic status and crime, with evidence suggesting that these conditions are worsened during and immediately following disasters, leading to an increase in crime rates and incidents of looting.

Differing opinions exist regarding the frequency of looting during disasters. Some argue that the scale of looting is often exaggerated, with perceptions of widespread looting influenced by misinterpreted behavior, misunderstandings over property ownership, exaggerated claims, and sensational media coverage. In addition, it is widely observed that in the aftermath of disasters, prosocial behaviors, such as citizens volunteering to help and feed one another, far outweigh antisocial behavior like looting. Nonetheless, looting does exist in many disasters to some degree. Looting can be traced back to various social issues but is likely influenced by a combination of factors. While looting is often seen as opportunistic theft during chaotic events, its historical and cultural contexts play a significant role in understanding its roots.

Due to the stress caused by the impacts of a disaster, the affected populace is already under considerable duress. Therefore, responders and emergency managers must exercise caution when responding to these events. Shifting search and rescue operations to trained strike teams could help free up police resources, allowing law enforcement to focus on preventing looting. Establishing disaster recovery operations quickly and efficiently is crucial for meeting the basic needs of residents. Additionally, public information campaigns are vital for informing citizens and alleviating fears.

## POLITICALLY MOTIVATED CIVIL DISORDER

Politically motivated civil disorder occurs when a large group of individuals disturb public order to bring about political or social change. This can be preplanned in response to a significant social event or happen spontaneously at large gatherings. This type of civil disorder can result in rioting, looting, or unauthorized gatherings that disrupt public order.

Politically motivated civil disorder can arise for various reasons, such as attempts to address socioeconomic inequalities, advocate for changes in laws, exploit chaotic situations, or pursue anarchist objectives. It can occur in the following scenarios, among others: peaceful marches and parades, planned summits and major political events, and large gatherings at concerts and sports arenas.

In politically motivated civil disorder, the initial targets often serve as symbolic acts of defiance against institutions seen as upholding the societal norms participants wish to change. This includes destructive behavior toward police forces and their equipment, firefighters and their equipment, and other symbols of law and order. This destructive behavior often morphs into crimes of opportunity, such as looting and theft, and finally, aggression toward the public and peacekeepers.

In recent years, politically motivated civil disorder and those who participate in it have become increasingly organized. These individuals often attach their cause to otherwise innocuous or peaceful demonstrations, seeking to exploit a police force already stretched thin with other responsibilities. Anarchist groups like the Black Bloc incorporate guerilla tactics into their operations, such as concealing their identities and using misdirection to evade police, to maximize the opportunity to cause damage. Another tactic used by these groups is inciting violence in the larger crowd. Exploiting existing tensions surrounding various issues—such as hunger, unemployment, lack of 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 quickly incite a crowd to violence.

## Magnitude/Extent

The magnitude or extent of civil disturbances in Utah can vary depending on the situation. Like any other area, Salt Lake County can experience a range of civil disturbances, from peaceful protests and demonstrations to more severe incidents such as riots or civil unrest. Factors such as population size, current social and political issues, and law enforcement response can all play a role in the extent of civil disturbances in Salt Lake County.

## Location

Though civil unrest can occur anywhere, it is more likely in locations with high levels of inequality, lack of access to education and economic opportunities, political instability, ethnic or religious tensions, and a history of unresolved conflicts. Additionally, issues such as police brutality, government corruption, and lack of trust in institutions can also make a community more vulnerable to civil disturbances.

## Historical Events and Probability of Future Occurrences

Although civil disturbances and riots of significant magnitude are not highly likely in any given year, they remain a possibility in Salt Lake County. For instance, in February 2016, a civil disturbance arose following an altercation between police and a teenage male, which resulted in the teen being shot. A crowd soon gathered and began to throw rocks and yell obscenities at the police. This led to the arrest of four people who failed to obey commands to evacuate. In another example, at a rowdy celebration during the 2002 Winter Olympics in Salt Lake City, a crowd attempted to force its way into a beer tent and evade security. The situation escalated, requiring 75 to 100 police in full riot gear to regain control of the area. At least 30 people were arrested.

On June 1, 2020, Salt Lake City experienced significant protests in response to police brutality and the death of George Floyd. The protests began peacefully during the day but escalated as night fell. Demonstrators marched through the streets, chanting slogans and holding signs calling for justice and an end to racial inequality. However, as the evening progressed, tensions rose, and clashes between the police and protesters resulted in vandalism and destruction of property. A 7-11 store, the State Capitol building, City Creek Mall, a police station, and other locations were vandalized. The National Guard was deployed to help restore order.[211]

[211] McGurk, Nick. "Salt Lake DA: 40-50 Arrested, Police and Protester Actions Being Examined." ABC 4. June 1, 2020. https://www.abc4.com/news/salt-lake-city-protests/salt-lake-district-attorney-40-50-arrested-police-and-protestor-actions-being-examined/

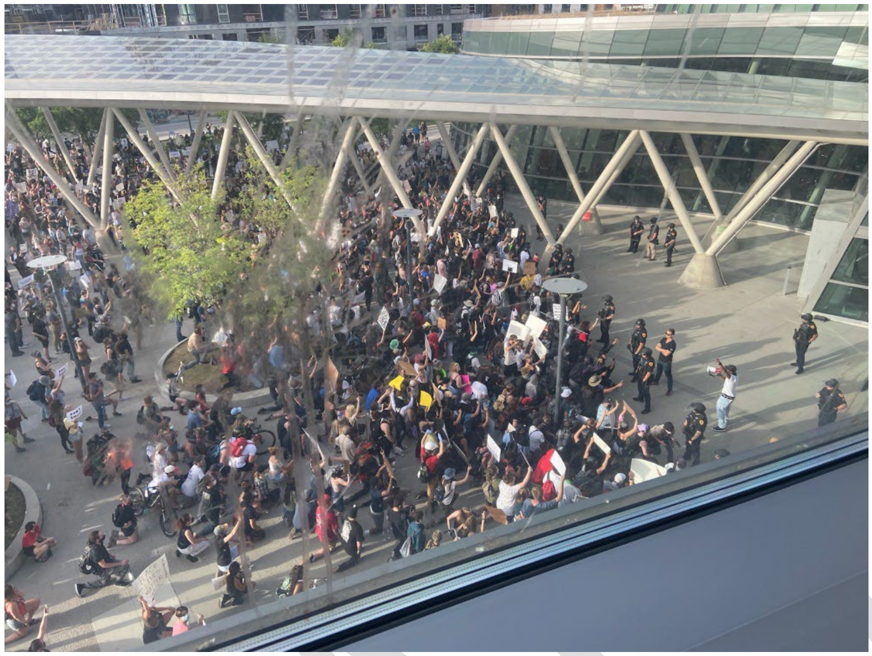


**Figure 174: Protest Outside Salt Lake City Public Safety Building, June 2020**[212]

On April 29, 2024, an Israel–Hamas protest took place at the University of Utah. Over 200 protestors gathered and set up tents. Officers from the University of Utah, Salt Lake City, West Valley City, Utah Highway Patrol, and the Unified Police Department dispersed the crowd and cleaned up the tents, pallets of water, toilet paper, buckets of human waste, and other debris left by the protestors. More than 21 people were arrested for trespassing, disorderly conduct, failure to disperse, and resisting arrest. The protestors violated the Utah State Law Administrative Code and the University of Utah Speech Policy by setting up structures overnight on campus.[213]

According to the Southern Poverty Law Center, as of 2023, 20 hate and antigovernment groups were being tracked in Utah, including five with a significant presence in Salt Lake City: The Active Club, Eagle Forum, Mom Army Salt Lake City, Utah Constitutional Militia, and Utah Patriots.[214] Additionally, seven groups are statewide. Although civil disturbances could arise from any contentious situation or gathering of predisposed people, Salt Lake County needs to remain aware of groups with the potential to spark these events.

## Climate Change Considerations

Civil disturbances and violent protests or riots can have localized short-term environmental impacts, such as damage to buildings and infrastructure, leading to increased waste and emissions from fires. However, in the larger context of climate change, the direct impact of civil disturbances and violent riots is relatively

[212] Photo courtesy of Salt Lake County Emergency Management
[213] University of Utah Communications. "University of Utah Campus Protest Recap." The University of Utah. May 1, 2024. https://attheu.utah.edu/facultystaff/university-of-utah-campus-protest-recap/
[214] Southern Poverty Law Center. "In 2023, 20 Hate and Antigovernment Groups were Tracked in Utah." https://www.splcenter.org/states/utah

minor. While civil disturbances and violent riots can have immediate environmental consequences, their effects on climate change are minimal compared to other human activities.

## Secondary Hazards

Civil disturbances can have far-reaching impacts on the climate through secondary or cascading events. These disturbances can disrupt crucial infrastructure such as power plants, transportation networks, and industrial facilities, leading to increased emissions of greenhouse gases and other pollutants. Additionally, civil disturbances can contribute to deforestation through land clearing and illegal logging, reducing the capacity of forests to absorb carbon dioxide and thereby increasing levels of greenhouse gases in the atmosphere. The displacement of populations due to civil disturbances can also lead to increased demand for resources and energy in host communities, putting pressure on natural resources and contributing to environmental degradation and climate change. Furthermore, the economic impacts of civil disturbances, such as damage to businesses and infrastructure, loss of livelihoods, and increased poverty, can further exacerbate pressure on natural resources and contribute to environmental degradation and climate change. These examples highlight the interconnectedness of civil disturbances and their potential impact on the climate.

## Vulnerability Assessment

Although civil disorder is inherently a threat to the public, its numerous hazardous impacts also threaten public safety. Salt Lake County, like any other area, has the potential for civil disturbances. Social tensions, public demonstrations, and other forms of civil unrest can contribute to the county's vulnerability by creating social tensions, disrupting public order, and potentially leading to unrest and conflict. Public demonstrations and other forms of civil unrest can strain resources and infrastructure, impacting the community's safety and security. Additionally, civil disturbances can affect the functioning of essential services and disrupt daily life, making it necessary for residents to stay informed and prepared to follow guidance from local authorities.

### ESTIMATED IMPACTS AND POTENTIAL LOSSES

#### IMPACT ON SALT LAKE COUNTY RESIDENTS

During a civil disturbance, residents can be impacted in several ways. They may experience disruptions to essential services such as transportation, healthcare, and utilities. There is also potential for property damage, personal injury, and emotional distress. Additionally, civil disturbances can lead to economic repercussions, including loss of income and damage to businesses. Injuries and fatalities are also possible.

#### IMPACT ON ESSENTIAL FACILITIES AND OTHER PROPERTY

Essential facilities may be impacted if they are near or the target of civil disorder or riots. Businesses are often the focus of civil disruption, as individuals will target these establishments for looting and vandalism.

In addition, in scenarios where supplies are limited, these businesses are often looted for their goods. Any building/edifice where the riot or disorder occurs may be vulnerable to damage.

### IMPACT ON CRITICAL INFRASTRUCTURE

Civil disturbances can lead to various impacts and losses to a community's critical infrastructure. This can include damage to transportation systems, such as roadways, bridges, and public transit facilities, as well as disruption to communication networks, including phone lines and internet services. Additionally, civil disturbances can damage power plants, electrical grids, and water supply systems, leading to power outages and water supply disruptions. These disruptions can significantly impact the daily lives of community members and hinder the delivery of essential services.

### IMPACT ON OPERATIONS

First responders are particularly at risk during civil disruptions. They are often the first individuals on the scene, which puts them in direct danger of injury. Additionally, responders are seen as part of the authority being protested, making them potential targets. Civil disturbances can also overwhelm local emergency response services, impacting their ability to manage the situation effectively. This can lead to increased call volumes, communication challenges, physical damage to facilities, and the need for heightened security measures. Emergency operation centers may need to coordinate with law enforcement and other agencies to effectively manage civil disturbances.

### IMPACT ON ENVIRONMENT

Civil disturbances can have several impacts on the environment. These include increased pollution from burning vehicles, buildings, and other materials, as well as the use of chemical agents to disperse crowds. Habitat destruction is also a concern, as unrest can destroy natural habitats, such as forests and wetlands. Additionally, large gatherings during civil disturbances can result in increased waste generation, including litter and potentially hazardous materials. Furthermore, civil disturbances can disrupt ecosystems and wildlife, leading to the displacement of animals and the destruction of natural resources.

## VULNERABLE POPULATIONS

The populations most vulnerable to social disturbances generally include marginalized communities, such as low-income individuals, ethnic minorities, refugees, and people with disabilities. These groups often face systemic barriers and discrimination, making them more susceptible to the negative impacts of social disturbances. Additionally, individuals who lack access to education, healthcare, and social support systems are also at heightened risk during times of social unrest. However, all individuals and infrastructures near a civil disorder are vulnerable to injury or damage.

## COMMUNITY LIFELINES

Civil disturbances can impact several FEMA Community Lifelines, including safety and security, food, hydration, shelter, health and medical services, energy, communications, and transportation. These disturbances can disrupt law enforcement and emergency services, compromising public safety. Additionally, they can result in shortages of essential resources such as food, water, and shelter due to damaged infrastructure or restricted access. Health and medical services may be overwhelmed, while energy distribution and communication networks can be disrupted, leading to power outages and compromised access to information. Furthermore, transportation systems may be delayed, hindering the movement of goods, services, and people, as well as emergency response and evacuation efforts.


**Figure 175: FEMA Community Lifelines**[215]

## CHANGES IN DEVELOPMENT

Civil disturbances can significantly impact future land use and development in a community. These disturbances can lead to damage to infrastructure, businesses, and residential properties, which may result in a decline in property values. As a result, developers and investors may be hesitant to invest in the affected areas, leading to a slowdown in development and revitalization efforts. Civil disturbances can also create a sense of insecurity and instability, which may discourage businesses and residents from moving into the area. This can alter land use patterns, with certain regions being abandoned or repurposed for other uses. Overall, civil disturbances can hinder the long-term growth and development of a community, requiring significant time and effort to rebuild and restore trust with investors and developers.

## VULNERABILITY SCORE

The county's diverse population, including various political and social viewpoints, can lead to tensions and potential conflicts. Additionally, large public gatherings and events may present opportunities for civil disturbances. Recent social and political movements have created conditions that can lead to civil unrest.

Based on Salt Lake County's moderate social vulnerability, high expected annual loss, and high community resilience to overall hazards, the community's vulnerability to civil disturbance is moderate to high. While its moderate social vulnerability may help mitigate some impacts, the high expected annual loss and high community resilience to overall hazards suggest that the community may still be significantly vulnerable to civil disturbances.

[215] FEMA. "Community Lifelines." https://www.fema.gov/emergency-managers/practitioners/lifelines

# Hazardous Materials

## Hazard Description

Hazardous materials, also known as HAZMAT, threaten human health, safety, and the environment and are classified as physical or health hazards. Physical hazardous materials can explode, catch fire easily, or react dangerously with water or other substances. They include explosives, flammable gases and liquids, organic peroxides, oxidizers, pyrophoric materials, and unstable/reactive materials. Health hazard materials are those that can cause harm to human health if ingested, inhaled, or absorbed through the skin. They include toxic, highly toxic, and corrosive substances. These materials come in various forms, including gases, liquids, and solids. HAZMAT can be found in many settings, such as workplaces, homes, and transportation systems. Hazardous materials are classified based on the National Fire Protection Association (NFPA) codes and standards.

- HAZMAT Incident—**Fixed Site** is defined as an uncontrolled release of hazardous material originating from a building, structure, or fixed equipment that can pose a risk to life, health, safety, property, or the environment.
- HAZMAT Incident—**Transportation** is defined as the uncontrolled release of a hazardous material during transport that can pose a risk to life, health, safety, property, or the environment.

## Magnitude/Extent

Hazardous materials can have a devastating and enduring impact on communities. Exposure to these substances may lead to various health issues, ranging from minor irritations to serious illnesses or even fatalities. Additionally, HAZMAT spills can severely damage the environment by contaminating the air, soil, and water. Cleanup can take weeks, months, or even years to complete, depending on the extent of the spill.

Beyond their physical impact, HAZMAT incidents can lead to considerable psychological and economic harm within a community. Evacuations, property loss, and interruptions to everyday life can significantly affect individuals and families. Additionally, these incidents can have a ripple effect on the local economy, reducing productivity and revenue for businesses and industries. Information on various HAZMAT incident levels can be found in Table 74.

**Table 74: HAZMAT Incident Levels[216]**

| Incident Level | Type | Description |
|---|---|---|
| Incident Level 1 | Minor Hazard | The hazardous material poses a low risk and can usually be handled by the local fire department or HAZMAT team without extra assistance. |
| Incident Level 2 | Moderate Hazard | The hazardous material poses a moderate threat to human health and the environment. Additional resources and specialized equipment may be required to manage the situation. |
| Incident Level 3 | Serious Hazard | A hazardous material significantly threatens human health and the environment. These situations often require a large-scale response with multiple agencies and specialized equipment. |
| Incident Level 4 | Severe Hazard | A significant threat to humans and the environment requires a massive response from multiple agencies, specialized equipment, and significant resources. |
| Incident Level 5 | Catastrophic Hazard | The hazardous material poses an extreme threat to human health and the environment. |

The seriousness of a hazardous material incident is assessed based on several factors, including the type and number of hazardous materials involved, the location and scale of the release or spill, and the potential effects on human health, the environment, and property. Other influencing factors include weather conditions, population density, and how quickly emergency services can respond. Generally, these incidents can vary in severity from minor spills that can be rapidly contained and cleaned to significant events that may have enduring and devastating impacts on the surrounding area.

## Location

Hazardous materials incidents occur more frequently than commonly thought and can occur anywhere worldwide. Certain regions are particularly susceptible due to factors such as industrial facilities dealing with hazardous substances, natural disasters, and individuals' mistakes. Such incidents can lead to serious damage to property and infrastructure, disturb everyday life, and, tragically, even loss of life.

For example, regions with a high density of industrial facilities that manage hazardous materials are more vulnerable to incidents, including spills, leaks, or explosions. Such events can result in environmental harm, injuries, fatalities, and disruptions to the local economy and community. Salt Lake County contains several chemical plants, as detailed in Table 75, which put the area at risk for incidents involving hazardous materials and potential contamination. Additionally, the county has numerous pipelines transporting natural gas, natural gas liquids, condensate, crude oil, petroleum, and petrochemical products.

[216] Lone Star HAZMAT. "What is Meant by the Different HAZMAT Incident Levels?" https://lonestarhazmat.com/what-is-meant-by-the-different-hazmat-incident-levels/

**Table 75: Petrochemical Companies in Salt Lake County[217]**

| Corporation | |
|---|---|
| Ecolab | Tata Chemicals |
| Linde | Solenis |
| Air Liquide | Kao Corporation |
| Johnson Matthey | Alpha Plastics |
| PPG | Rentech |
| Huntsman Corp | Hempel |
| Wurth | Headwaters |
| Solvay | Brody Chemical |
| Daikin | Tronox |
| Innophos | ChemTreat |
| IFF | Chemtrade |
| PPG Industries | Incitec Pivot |
| Bridgestone Global | Asphalt Materials |
| INVISTA | Western Explosive Systems |



217 Glassdoor. "Top Chemical Manufacturing Companies in Salt Lake City, UT." https://www.glassdoor.com/Explore/browse-companies.htm?overall_rating_low=3.5&page=1&locId=755&locType=M&locName=Salt%20Lake%20City,%20UT&industry=200068&filterType=RATING_OVERALL

The map in Figure 176 shows the gas transmission and hazardous liquid pipelines in Salt Lake County.

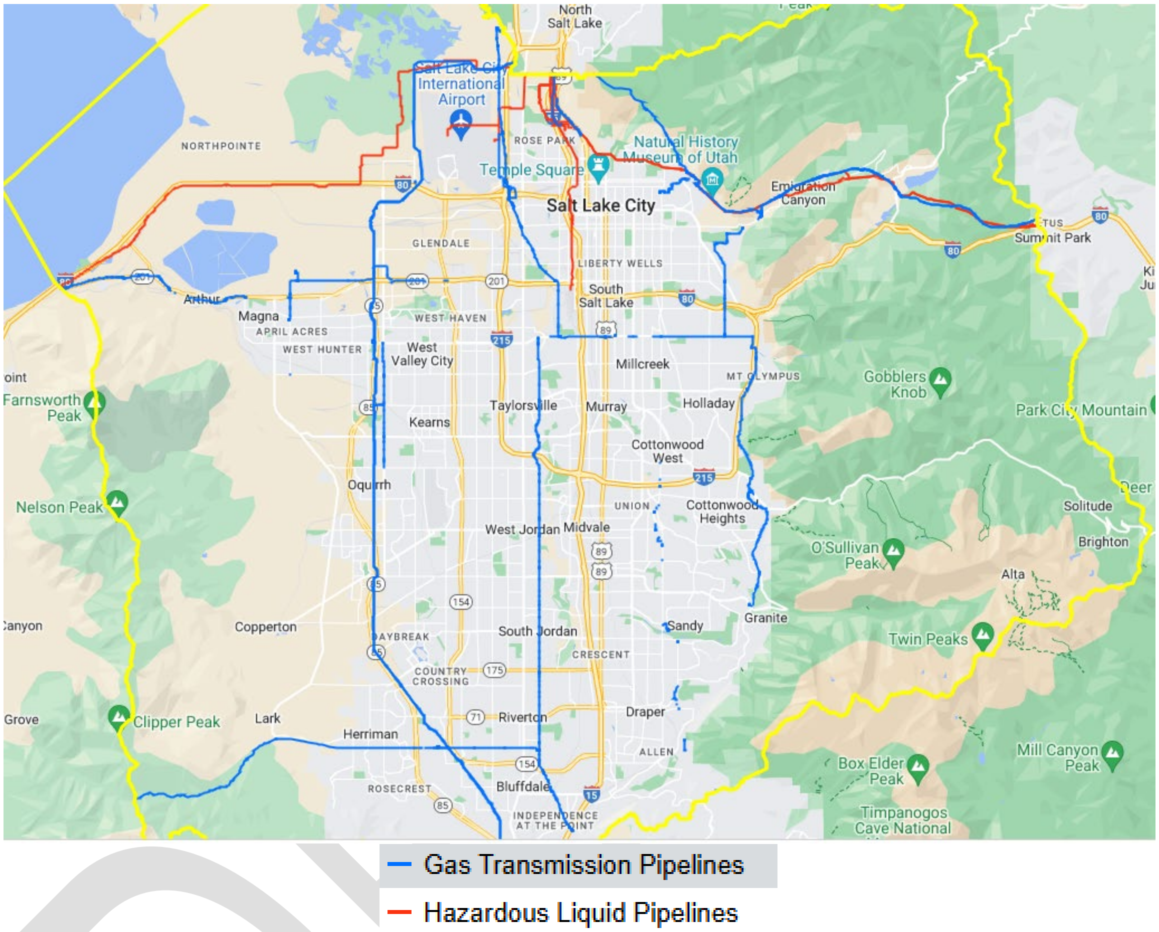



**Figure 176: Salt Lake County Hazardous Pipelines**[218]

## Historical Events and Probability of Future Occurrences

From January 1, 2018, to October 28, 2024, at the time of writing, Salt Lake County experienced 2,368 HAZMAT incidents. Fortunately, there were no injuries, fatalities, or evacuations. However, eleven incidents were considered serious, as detailed in Table 76.[219]

[218] National Pipeline Mapping System. "Public Viewer." https://pvnpms.phmsa.dot.gov/PublicViewer/
[219] Pipeline and Hazardous Materials Safety Administration. "Incident Report Database." https://portal.phmsa.dot.gov/analytics/saw.dll?Portalpages&PortalPath=%2Fshared%2FPublic%20Website%20Pages%2F_portal%2FHazmat%20Incident%20Report%20Search

**Table 76: HAZMAT Transportation Incidents, Salt Lake County**

| Report Number | Carrier | Incident City | Date | Commodity | Hazardous Class | Shipper |
|---|---|---|---|---|---|---|
| 2018030143 | Jackson Energy | Midvale | 01/18/2018 | Diesel fuel, Gasoline, Casinghead | 3 | Chevron Products |
| 2018100372 | Saia Motor Freight Line, LLC | Salt Lake City | 10/05/2018 | Hydrochloric acid | 8 | Univar USA INC. |
| 2019060242 | Quality Carriers | Salt Lake City | 03/02/2019 | Flammable liquids N.O.S. | 3 | Akzo Nobel |
| 2021070759 | Tesoro Corporation | Salt Lake City | 07/12/2020 | Petroleum crude oil | 3 | Tesoro Corporation |
| 021010605 | FedEx Freight, INC | Salt Lake City | 12/30/2020 | Corrosive liquid, acidic, inorganic, N.O.S. | 8 | Steen Research LLC |
| 2021120260 | Tesoro Refining & Marketing Company | Salt Lake City | 10/13/2021 | Petroleum crude oil | 3 | Tesoro Corporation |
| 2022050252 | YRC INC. | West Valley City | 11/27/2021 | Paint including paint, lacquer, enamel, stain, shellac, varnish, polish, liquid filler, and liquid lacquer base | 3 | Sumter Coatings INC |
| 2022040362 | FedEx Freight, INC. | Salt Lake City | 03/30/2022 | Combustible liquid, N.O.S. | 2 | PAK Technologies |
| 203010095 | FedEx Freight, INC. | Salt Lake City | 12/23/2022 | Corrosive liquid, acidic, Inorganic N.O.S. | 8 | Applied Specialty Inc. |
| 2023010542 | FedEx Freight, INC. | Salt Lake City | 01/03/2023 | Corrosive liquid, base, organic, N.O.S. | 8 | BPC, Seatex (C8) |
| 2024020576 | FedEx Freight, INC. | Salt Lake City | 02/06/2024 | Flammable liquids, N.O.S. | 3 | Baker Petrolite LLC. |

## SUPERFUND SITES

A Superfund site is a location identified by the U.S. Environmental Protection Agency (EPA) as contaminated by hazardous waste. These areas seriously threaten human health and the environment, often containing toxic chemicals, heavy metals, and other harmful substances.

The presence of a Superfund site in a community can have serious repercussions. Residents may be exposed to harmful contaminants, which can result in various health issues such as cancer, birth defects, respiratory problems, and neurological conditions. Moreover, the pollution can negatively affect local ecosystems, endangering wildlife and disrupting the natural environment.

Superfund site cleanup tends to be complicated, lengthy, and costly. It may include activities such as digging up contaminated soil, purifying polluted water, and disposing of hazardous waste. Generally, taxpayers pay the expenses; the entire process can span years or even decades.

**Table 77: Superfund Sites, Salt Lake County**

| Site Name | City | NPL[220] Status | Description |
|---|---|---|---|
| 700 South 1600 East PCE Plume | Salt Lake City | Final | The 700 South 1600 East PCE Plume site is near the George E. Wahlen U.S. Department of Veterans Affairs (VA) Medical Center in Salt Lake City, Utah. In the late 1970s and early 1980s, the VA operated a dry-cleaning service that used tetrachloroethylene (PCE), leading to soil and groundwater contamination through improper disposal.<br>PCE was first detected in the groundwater at 32 µg/L in the 1990s, exceeding the drinking water standard of 5.0 µg/L. This prompted EPA investigations in 1999, finding concentrations between 11 and 320 µg/L.<br>By 2010, dissolved PCE was found in residential springs. On September 18, 2012, officials supported listing the site on the National Priorities List (NPL) due to exposure concerns. It was officially added to the Superfund NPL in May 2013, with the VA responsible for cleanup.[221] |
| Davenport and Flagstaff Smelters | Sandy | Deleted | The Davenport and Flagstaff smelters site is about 15 miles southeast of Salt Lake City, Utah, at the mouth of Little Cottonwood Canyon. Established around 1870, the smelters processed lead and silver ore from nearby Alta, Utah, leading to soil contamination. Both smelters were decommissioned by 1879, and the area transitioned from agricultural use to residential |

220 National Priorities List
221 U.S. Environmental Protection Agency. “700 South 1600 East PCE Plume Salt Lake City, UT.” https://cumulis.epa.gov/supercpad/cursites/csitinfo.cfm?id=0800743

| Site Name | City | NPL[220] Status | Description |
|---|---|---|---|
| | | | and commercial development in the 1970s and 1980s. Cleanup efforts are ongoing at the site.[222] |
| Kennecott North Zone/Tailings | Magna | Proposed | The Kennecott North Zone is an industrial area at the northern edge of the Oquirrh Mountains, near Magna and the Great Salt Lake. Major transport routes, including I-80, pass through the site. Since 1906, the area has processed ores, such as copper, lead, and gold, producing hazardous waste that has contaminated soils, water, and wetlands. Key contaminants include arsenic, cadmium, lead, and selenium. On January 18, 1994, the EPA proposed adding the North Zone to the NPL. A 1995 agreement between Rio Tinto Kennecott Copper (RTKC), the EPA, and Utah Department of Environmental Quality (UDEQ) allowed RTKC to undertake cleanup projects while deferring the NPL listing.<br>The 2002 Record of Decision (ROD) outlined a cleanup strategy targeting surface materials threatening workers and wildlife. It also included long-term efforts to treat groundwater and remediate inaccessible waste. The ROD included detailed summaries of the necessary actions.[223] |
| Kennecott South Zone/Bingham | Copperton | Non-NPL, Superfund Alternative Approach | The Kennecott South Zone, located 25 miles southwest of Salt Lake City in the Oquirrh Mountains, includes the Bingham Mining District, the Bingham Canyon open pit mine, waste rock dumps, and the Copperton Mill. Mining began in the 1860s and continues today, resulting in hazardous waste that contaminates soils, sludge, surface water, and groundwater, impacting nearby wetlands and the Great Salt Lake. Cleanup efforts are ongoing. Although not on the NPL, the site is considered NPL-caliber and is being managed through the Superfund Alternative Approach.[224] |
| Midvale Slag | Midvale | Deleted NPL | The 446-acre Midvale Slag site in Midvale and Murray City, Utah, hosted five lead and copper smelters from 1871 to 1971. After the facilities were demolished in the 1970s, the area was contaminated with heavy metals, and ongoing cleanup and maintenance efforts continue.[225] |

[222] U.S. Environmental Protection Agency. “Davenport and Flagstaff Smelters Sandy, UT.” https://cumulis.epa.gov/supercpad/SiteProfiles/index.cfm?fuseaction=second.Cleanup&id=0801257#bkground
[223] U.S. Environmental Protection Agency. “Kennecott (North Zone) Magna, UT.” https://cumulis.epa.gov/supercpad/SiteProfiles/index.cfm?fuseaction=second.Cleanup&id=0800636#bkground
[224] U.S. Environmental Protection Agency. “Kennecott (South Zone) Copperton, UT.” https://cumulis.epa.gov/supercpad/SiteProfiles/index.cfm?fuseaction=second.Cleanup&id=0800601#bkground
[225] U.S. Environmental Protection Agency. “Midvale Slag, Midvale, UT.” https://cumulis.epa.gov/supercpad/SiteProfiles/index.cfm?fuseaction=second.Cleanup&id=0800641#bkground

| Site Name | City | NPL[220] Status | Description |
|---|---|---|---|
| Murray Smelter | Murray City | Proposed NPL | The 142-acre Murray Smelter site in Murray City, Utah, was once the largest lead smelter in the U.S. Owned by ASARCO, it operated two smelters: the Germania Smelter (1872–1902) and the Murray Smelter (1902–1949). Smelting byproducts include slag, arsenic, and cadmium, leading to contamination of soil, sediment, and groundwater with heavy metals. The cleanup is complete, and ongoing maintenance activities are in place.[226] |
| Petrochem/Ekotek | Salt Lake City | Deleted NPL | The 7-acre Petrochem Recycling Corp./Ekotek site in northern Salt Lake City, Utah, has a history of oil refining, hazardous waste management, and used oil recycling. Improper practices contaminated the groundwater and soil with hazardous substances. After cleanup, the EPA removed the site from NPL in 2003, but groundwater monitoring is ongoing.[227] |
| Portland Cement | Salt Lake City | Final NPL | The 71-acre Portland Cement site in Salt Lake City, Utah, was used from 1963 to 1983 to deposit approximately 500,000 cubic yards of cement kiln dust (CKD), which contains heavy metals such as arsenic, lead, and chromium. The site also saw the disposal of chromium-bearing bricks, leading to soil, air, and groundwater contamination. Cleanup has occurred, and ongoing maintenance activities are in place.[228] |
| Rose Park Sludge Pit | Salt Lake City | Deleted NPL | The Rose Park Sludge Pit is in Rosewood Park, Salt Lake City, Utah. From the 1930s to 1957, the Utah Oil and Refining Company disposed of acidic waste in an unlined pit, covering around 5 acres and reaching depths of 20 feet. This waste contaminated the soil and groundwater. After cleanup, the EPA removed the site from the NPL in 2003, and maintenance continues.[229] |
| Sharon Steel | Midvale | Deleted NPL | The 470-acre Sharon Steel Corp. (Midvale Tailings) site in Midvale, Utah, operated as a smelting and ore milling facility from 1906 to 1971, producing lead, copper, and zinc. In 1982, the Utah Department of Environmental Quality (UDEQ) intervened after discovering residents were using contaminated tailings in gardens and sandboxes. Testing revealed high levels of lead |

[226] U.S. Environmental Protection Agency. "Murray Smelter Murray City, UT." https://cumulis.epa.gov/supercpad/SiteProfiles/index.cfm?fuseaction=second.Cleanup&id=0800697#bkground
[227] U.S. Environmental Protection Agency. "Petrochem Recycling Corp./Ekotek Plant Salt Lake City, UT." https://cumulis.epa.gov/supercpad/cursites/csitinfo.cfm?id=0800649
[228] U.S. Environmental Protection Agency. "Portland Cement (KILN Dust 2 & 3) Salt Lake City, UT." https://cumulis.epa.gov/supercpad/cursites/csitinfo.cfm?id=0800690
[229] U.S. Environmental Protection Agency. "Rose Park Sludge Pit Salt Lake City, UT." https://cumulis.epa.gov/supercpad/SiteProfiles/index.cfm?fuseaction=second.Cleanup&id=0800663#bkground

| Site Name | City | NPL[220] Status | Description |
|---|---|---|---|
| | | | and arsenic in the groundwater. Contamination impacted air, soil, and water. After cleanup efforts, the EPA removed the site from the NPL in 2004.[230] |
| Utah Power & Light | Salt Lake City | Final NPL | The 2.2-acre Utah Power & Light/American Barrel Co. site in Salt Lake City operated from 1870 to 1987 for barrel storage, wood treatment, and coal gasification. These activities produced hazardous byproducts, contaminating soil and groundwater. Cleanup has been completed, and maintenance activities continue.[231] |
| Wasatch Chemical | Salt Lake City | Final NPL | The 18-acre Wasatch Chemical Co. site in Salt Lake City, Utah, was used from 1957 to 1971 for warehousing and producing industrial chemicals. From the 1970s to 1992, it blended and packaged pesticides, herbicides, and fertilizers, discharging wastewater on-site and contaminating the soil and groundwater. The cleanup is complete, but operation and maintenance activities are ongoing.[232] |

## Climate Change Considerations

Climate change may increase the likelihood and intensity of hazardous waste incidents. Extreme weather events, such as tornadoes, floods, and wildfires, can damage infrastructure, disrupt waste management systems, and lead to hazardous materials leaking into the environment. Additionally, rising temperatures can intensify chemical reactions that produce hazardous waste and raise the volatility of certain substances. Furthermore, climate change can modify ecosystems, create new pathways for hazardous waste to enter the food chain, and impact human and animal health. Therefore, it is essential to incorporate climate change considerations into a comprehensive strategy to prevent and address hazardous waste incidents, safeguarding public health and the environment.

## Secondary Hazards

Secondary hazards from hazardous materials incidents can significantly amplify the risks associated with the initial event. One major concern is the potential for fires and explosions, especially if flammable materials are involved, which can extend the danger beyond the original site. Additionally, chemical reactions can produce toxic gases, contaminate the air, and pose serious health risks to first responders and nearby residents. Environmental contamination is another critical issue, as hazardous substances can seep into soil and waterways, leading to long-term ecological damage and affecting drinking water

[230] U.S. Environmental Protection Agency. “Sharon Steel Corp. (Midvale Tailings) Midvale, UT.” https://cumulis.epa.gov/supercpad/SiteProfiles/index.cfm?fuseaction=second.Cleanup&id=0800694#bkground
[231] U.S. Environmental Protection Agency. “Utah Power & Light/American Barrel Co. Salt Lake City, UT.” https://cumulis.epa.gov/supercpad/cursites/csitinfo.cfm?id=0800680
[232] U.S. Environmental Protection Agency. “Wasatch Chemical Co. (Lot 6) Salt Lake City, UT.” https://cumulis.epa.gov/supercpad/SiteProfiles/index.cfm?fuseaction=second.Cleanup&id=0800596#bkground

supplies. The health of emergency personnel can also be compromised during their response efforts. Evacuations may be necessary, causing panic and posing logistical challenges. Increased traffic from fleeing citizens and arriving emergency responders can create further hazards and accidents. Additionally, structural damage from the incident can result in dangerous collapses. Public panic fueled by misinformation can also complicate response efforts.

## Vulnerability Assessment

Salt Lake County is significantly vulnerable to hazardous materials in various locations, including industrial sites, transportation routes, and waste management facilities. The proximity of residential areas to these sites increases the risk of exposure to toxic substances in the event of accidental releases or spills. The effects of hazardous materials incidents include physical harm from inhalation or coming into contact with released substances. If substances ignite or explode, injury or property damage may result. The county's geographical features along the Wasatch Range, coupled with emissions from the US Magnesium refinery, cause air quality concerns, including ground-level ozone particle pollution.[233] According to a 2023 report by the American Lung Association, the Salt Lake City region experienced more unhealthy air pollution in three categories: ozone, short-term particle pollution, and annual particle pollution. This report listed Salt Lake City among the nation's most air-polluted cities, ranking it 10th for ozone and 19th for short-term particle pollution.[234] Salt Lake County's geography, coupled with emissions from refineries, results in an increased potential impact of hazardous materials on public health and the environment.

### ESTIMATED IMPACTS AND POTENTIAL LOSSES

In a significant hazardous materials incident in Salt Lake County, the estimated losses could be substantial, affecting the local economy and community health. The immediate financial impact may include emergency response costs, damage to infrastructure, and the potential for long-term environmental rehabilitation. Additionally, businesses nearby might face temporary closures, leading to job losses and decreased revenue. The public health ramifications could be severe, with possible evacuation orders, health-related emergencies, and long-term effects on air and water quality. This incident could also strain local resources and emergency services, highlighting the need for robust preparedness and response protocols to mitigate such risks.

### VULNERABLE POPULATIONS

Populations vulnerable to hazardous materials incidents often include those living near industrial facilities, transportation routes for hazardous goods, and areas prone to natural disasters. Communities with lower socioeconomic status may face heightened risks due to inadequate emergency preparedness and response resources. Additionally, children, senior citizens, and individuals with preexisting health conditions are particularly susceptible to the adverse effects of hazardous materials exposure, as their

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[233] NOAA Research. "One Facility Makes a Big Contribution to Salt Lake's Winter Brown Cloud." January 25, 2023. https://research.noaa.gov/one-facility-makes-a-big-contribution-to-salt-lakes-winter-brown-cloud/
[234] NOAA Chemical Sciences Laboratory. "Finding Helps Explain Salt Lake City's Persistent Air Quality Problems." January 25, 2023. https://csl.noaa.gov/news/2023/368_0125.html

physical resilience may be compromised. Furthermore, marginalized groups might experience barriers in accessing timely information and medical care during incidents, amplifying their vulnerability and potential health impacts.

## COMMUNITY LIFELINES

Several of FEMA's Community Lifelines (Figure 177) can be significantly impacted in a hazardous materials incident, affecting the overall response and recovery efforts. The Safety and Security lifeline may be strained as authorities work to protect the public from exposure and containment of hazardous materials. Meanwhile, the Health and Medical lifeline could become overwhelmed as hospitals and medical facilities are forced to handle potential casualties requiring immediate care due to exposure or contamination. The Food, Hydration, and Energy lifelines may also be disrupted if the incident involves contamination of local water supplies or facilities producing critical resources. Lastly, the Transportation lifeline may face challenges as roadways are restricted or closed for cleanup and safety measures, hampering emergency responders and the flow of supplies necessary for recovery efforts. The interconnected nature of these lifelines highlights the need for a coordinated response to minimize the impact of such incidents on the community.


**Figure 177: FEMA Community Lifelines**[235]

## CHANGES IN DEVELOPMENT

Future development in Salt Lake County may face significant challenges due to the risks associated with hazardous materials incidents. The presence of industrial facilities and transportation routes for hazardous substances poses a potential threat to both public safety and the environment. Such incidents can lead to long-term consequences, including contamination of land and water resources, which may deter new investments and slow down redevelopment efforts. Zoning regulations may become more stringent because of past incidents, leading to restrictions on where certain businesses can operate. Additionally, community concerns about safety could push policymakers to prioritize environmental assessments and disaster preparedness, ultimately reshaping development plans.

[235] FEMA. "Community Lifelines." https://www.fema.gov/emergency-managers/practitioners/lifelines

Future land development in Salt Lake County could be significantly impacted by incidents involving hazardous materials. Such events can contaminate soil and water resources, limiting land usability for residential, commercial, or recreational purposes. Areas that have experienced spills or accidents may be designated as hazardous zones, leading to increased regulatory scrutiny and potentially costly remediation processes. Developers may face restrictions on building permits, and the perception of risk can deter investment and development in affected regions. Additionally, prioritizing environmental safety measures may lead to more stringent planning and development guidelines, potentially reshaping community layouts and infrastructure design. As awareness of environmental issues grows, future projects may increasingly require comprehensive risk assessments and sustainable practices to mitigate the effects of any hazardous incidents.

## VULNERABILITY SCORE

The vulnerability score is likely moderate to high for a community experiencing frequent minor HAZMAT incidents alongside several petrochemical plants and hazardous pipelines. This assessment considers several key factors. First, the high expected annual losses suggest significant financial impacts that can strain community resources and hinder long-term resilience strategies. While the community exhibits moderate social vulnerability, indicating some degree of cohesion and support, existing disparities can foster tensions. However, the community's high resilience to overall hazards provides a crucial buffer, suggesting that it has robust infrastructure and preparedness measures.[236] Ultimately, while risks remain elevated due to industrial presence and historical incidents, high resilience may mitigate these vulnerabilities, leading to a complex but manageable risk profile.

[236] FEMA. “National Risk Index.” https://hazards.fema.gov/nri/map

# Terrorism

## Hazard Description

According to the Federal Emergency Management Agency (FEMA), terrorism is defined as "the use of force or violence against persons or property in violation of the criminal laws of the United States for purposes of intimidation, coercion, or ransom."[237] This definition encompasses various violent acts, including those committed by individuals, groups, or governments, intended to instill fear and achieve political or ideological goals. Terrorists use threats to create fear, spread propaganda, and gain attention. Terrorism includes international terrorism, domestic terrorism, transnational terrorism, and cyberterrorism. 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.

- **International Terrorism:** Violent, criminal acts committed by individuals and/or groups who are inspired by or associated with designated foreign terrorist organizations or nations (state-sponsored). Activities transcend national boundaries or are sponsored by international groups.
- **Domestic Terrorism:** Committed by homegrown groups who have no ties or connections outside the United States. These groups are generally motivated by political, racial, ethnic, economic, health, and other grievances.
- **Transnational Terrorism:** Actions in which victims, perpetrators, and sites of violence represent different states and nationalities, such as the current war between Israel and Palestine.[238]
- **Cyberterrorism:** Any premeditated, politically motivated attack against information systems, programs, and data that threatens violence or results in violence.[239]
- **Active Shooter:** An emergency scenario in which an individual or individuals are actively engaged in killing or attempting to kill people in a populated area.[240] This type of situation is extremely dangerous and requires immediate action to ensure the safety and security of everyone involved.

## Magnitude/Extent

Terrorist events typically, but not always, aim to impact large numbers of people. The extent of damage or casualties can vary widely, depending on factors such as terrorist intent, the setting, victim response, and law enforcement response time. Even those who are not directly impacted by the event may still be psychologically affected through fear, concern for safety, and reduced activity. Therefore, a terrorist or

[237] FEMA. "Terrorism," in Are You Ready? – A Guide to Citizen Preparedness. Homeland Security Advisory System. Last updated April 25, 2023. https://www.fema.gov/pdf/areyouready/terrorism.pdf
[238] Crenshaw, Martha. "Rethinking Transnational Terrorism." United States Institute of Peace. February 2020. https://www.usip.org/sites/default/files/2020-02/pw_158-rethinking_transnational_terrorism_an_integrated_approach.pdf
[239] Awati, Robert, et al. "Cyberterrorism." TechTarget Network. Last updated February 2024. https://www.techtarget.com/searchsecurity/definition/cyberterrorism#:~:text=Cyberterrorism%20is%20usually%20defined%20as,violence%20or%20results%20in%20violence
[240] Emergency Services and Continuity Planning. "Active Shooter Response." Sonoma State University. https://emergency.sonoma.edu/emergency-procedures/active-shooter-response

active shooter event in Salt Lake County may directly or indirectly have an impact on the community's citizens.

## Location

Terrorists employ various methods to enter a country, including air travel, border crossings, waterways, and illicit means like human trafficking or smuggling. Terrorism can occur anywhere, but certain types of terrorism are more prevalent in specific locations.

International terrorism typically occurs in locations with high-value targets, such as military or civilian government facilities, international airports, major cities, and prominent landmarks. Additionally, terrorists may target large public gatherings, water and food supplies, utilities, and corporate centers. International terrorists can also spread fear by sending explosives or chemical or biological agents through the mail.

Historically, domestic terrorism usually occurs in cities with high levels of poverty and racial tension, which are more prone to civil unrest.

Transnational terrorism is a global threat that can occur in various parts of the world, such as the Middle East, South Asia, Africa, Europe, and North America. Terrorist groups often cross borders and employ various tactics like bombings, kidnappings, assassinations, and cyberattacks to achieve their goals. Their operations pose a significant threat to multiple countries and their citizens, necessitating international cooperation and intelligence sharing to counter these threats effectively.

It is crucial to recognize that any entity or individual using technology is vulnerable to cybersecurity threats. However, certain areas are more susceptible than others. For instance, cybercriminals often target organizations that handle sensitive data, such as financial records, medical information, or personally identifiable information (PII). The finance, healthcare, and government sectors are frequent targets due to the sensitive nature of the data they manage. Cyberattacks can also impact small businesses and individuals, emphasizing the importance of safeguarding devices and information.

Active shooter situations can occur in various locations, such as schools, workplaces, shopping malls, concert venues, and places of worship. These locations are often targeted because they are usually crowded and may have limited security measures in place.

## Historical Events and Probability of Future Occurrences

The most recognized forms of terrorism include:

1. Religious terrorism
2. Political terrorism
3. Ideological terrorism
4. State-sponsored terrorism
5. Criminal terrorism

Acts of terrorism include threats of terrorism, assassinations, kidnappings, hijackings, bomb scares and bombings, cyberattacks, and the use of chemical, biological, nuclear, and radiological weapons.[241]

The following tables provide information on terrorism and active shooter incidents in Salt Lake County.[242]

**Table 78: Salt Lake County Terrorism Incidents**

| Date | City | Perpetrator Group | Fatalities | Injured | Target Type |
|---|---|---|---|---|---|
| **11/03/2016** | Draper | White supremacists/nationalists | 0 | 1 | Private citizens and property |
| **07/01/2010** | Sandy | Animal Liberation Front (ALF) | 0 | 0 | Business |
| **05/05/2010** | Salt Lake City | Animal Liberation Front (ALF) | 0 | 0 | Business |
| **06/14/2004** | West Jordan | Earth Liberation Front (ELF) | 0 | 0 | Business |
| **05/15/1995** | Murray | Animal Liberation Front (ALF) | 0 | 0 | Business |
| **06/10/1995** | Salt Lake City | Animal Liberation Front (ALF) (suspected) | 0 | 0 | Business |
| **02/20/1987** | Salt Lake City | Anti-technology extremists | 0 | 1 | Business |
| **10/08/1981** | Salt Lake City | Anti-technology extremists | 0 | 0 | Educational institution |
| **08/20/1980** | Salt Lake City | White supremacists/nationalists | 2 | 1 | Private citizens and property |
| **09/05/1975** | Salt Lake City | Weather Underground, Weathermen | 0 | 0 | Business |
| **05/13/1970** | Salt Lake City | Left-wing militants | 0 | 0 | Military |

**Table 79: Active Shooter Incidents Salt Lake County**

| Date | Location | Event Description |
|---|---|---|
| **02/12/2007[243]** | Salt Lake City | One notable incident occurred at the Trolley Square Mall in Salt Lake City in 2007, where a gunman opened fire, resulting in five casualties and four injured. No motive was determined. |
| **04/15/1999[244]** | Salt Lake City | The LDS Family History Library shooting took place on April 15, 1999, in Salt Lake City. A man entered the library and randomly shot and killed two people and wounded at least five before being apprehended by police. The incident was a tragic and shocking event for the |

[241] Awati, Robert, et al. "Cyberterrorism." TechTarget Network. Last updated February 2024. https://www.techtarget.com/searchsecurity/definition/cyberterrorism#:~:text=Cyberterrorism%20is%20usually%20defined%20as,violence%20or%20results%20in%20violence
[242] University of Maryland National Consortium for the Study of Terrorism and Responses to Terrorism. "Global Terrorism Database." https://www.start.umd.edu/gtd/search/Results.aspx?search=Salt+Lake+City&sa.x=30&sa.y=17
[243] LaPlante, Matthew D., et al. "Emotionless Killer Gunned Down Victims Randomly." The Salt Lake Tribune. February 13, 2007. https://archive.sltrib.com/article.php?id=5218341&itype=NGPSID
[244] Deseret News staff. "LDS Library Shooting Leaves Three Dead, Including Suspect." Deseret News. April 15, 1999. https://www.deseret.com/1999/4/15/19440335/lds-library-shooting-leaves-three-dead-including-suspect/

| Date | Location | Event Description |
|---|---|---|
| | | community and highlighted the importance of security and safety measures in public spaces. |
| **01/14/1999**[245] | Salt Lake City | The Triad Center shooting took place in Salt Lake City on January 14, 1999. A gunman opened fire at the Triad Center office complex, resulting in multiple casualties. The incident shocked the local community and prompted discussions about improving security measures to prevent such tragic events. |

**Probability:** The increase in political disturbances, both foreign and domestic, is a cause for concern in the United States as it could potentially increase the chances of terrorism and active shooter incidents in the future. Political tensions can often lead to violent acts and extremist ideology, which could result in terrorism.[246] Moreover, the global rise of populist movements has fueled anti-immigrant and anti-minority sentiment, which can increase the risk of domestic terrorism.

Foreign interference in domestic politics can also pose a serious threat. It is not uncommon for foreign powers to fund extremist groups or carry out attacks in other countries to destabilize their governments. Such actions can cause significant harm and increase the likelihood of retaliatory attacks.

While Salt Lake County has several factors that could increase the risk of terrorism—such as being home to major events and venues, such as the Salt Palace Convention Center and the University of Utah, significant chemical plants, extensive waterways, and power plants—the chance of a future terrorist attack is low. However, due to population density, economic activity, and political climate, areas with larger populations or higher levels of economic activity may be considered more attractive targets for terrorist groups and active shooters.

## Climate Change Considerations

While terrorism itself does not cause climate change, with the possible exception of nuclear explosions, its indirect effects can contribute to it. Active shooter events have no impact on climate change. However, there is the potential for climate change to be a driver of future terrorism. Climate change can affect access to basic resources such as water, food, and shelter and lead to economic hardships.[247] Policies, regulations, or other limitations causing reduced access to these resources may contribute to political contention.[248] Control of or access to these resources could potentially lead to violent conflict or acts of terrorism. The indirect effects of terrorism are outlined in the Secondary Hazards section.

[245] Dobner, Jennifer, et al. “KSL Shooter Known to Police; She Has History of Mental Troubles.” Deseret News. January 15, 1999. https://www.deseret.com/1999/1/15/19423490/ksl-shooter-known-to-police-br-she-has-history-of-mental-troubles/
[246] Doxsee, Catrina, et al. “Pushed to Extremes: Domestic Terrorism amid Polarization and Protest.” Center for Strategic & International Studies. May 17, 2022. https://www.csis.org/analysis/pushed-extremes-domestic-terrorism-amid-polarization-and-protest
[247] Spadaro, Paola Andrea. 2020. “Climate Change, Environmental Terrorism, Eco-Terrorism and Emerging Threats.” *Journal of Strategic Security*. 13(4). https://www.jstor.org/stable/26965518?seq=3
[248] Silke, Andrew and John Morrison. 2022. “Gathering Storm: An Introduction to the Special Issue on Climate Change and Terrorism.” *Terrorism and Political Violence*. 34(5), 883–893. https://www.tandfonline.com/doi/full/10.1080/09546553.2022.2069444

## Secondary Hazards

Nuclear events, such as nuclear explosions or nuclear accidents, can significantly impact the climate. The most immediate and direct effect is the release of large amounts of energy, which can cause localized heating and cooling effects. However, the more significant long-term effects are due to the release of radioactive particles into the atmosphere. These particles can travel long distances and significantly impact the Earth's climate, particularly in the area downwind of the event. Radioactive particles can absorb and scatter sunlight, which can lead to a cooling effect on the Earth's surface. The particles can also absorb and emit heat, warming the atmosphere. The exact climate effects of a nuclear event depend on various factors, including the size and location of the event, the type of nuclear material involved, and the weather conditions at the time of the event.

Biological toxins, or biotoxins, are toxic substances produced by living organisms, such as bacteria, fungi, and plants. While these toxins do not directly contribute to climate change, their release into the environment can indirectly impact the climate and the environment. For example, releasing biotoxins into water sources can lead to the growth of harmful algal blooms, which can deplete the oxygen in the water and harm aquatic life. Similarly, the release of biotoxins into soil can have negative impacts on soil quality and crop production. The use of biotoxins as weapons can also have indirect effects on the climate by contributing to political instability and conflict, which can lead to displacement, migration, and changes in land use. These changes can, in turn, impact the Earth's climate and the environment. Additionally, the spread of infectious diseases caused by biotoxins can lead to changes in human behavior and land use, which can indirectly impact the climate. While biotoxins do not directly affect the Earth's climate, their release and use can indirectly impact the environment and climate.

Chemical releases of sarin and ricin are highly toxic chemical compounds that can devastate human health but do not directly affect the Earth's climate. These chemicals are not greenhouse gases and do not deplete the ozone layer. However, their release into the environment can indirectly impact the climate and the environment. For example, if released into water sources, they can contaminate the water and harm aquatic life. Similarly, if released into the soil, they can contaminate crops and other plants. Using these chemicals can also indirectly impact the climate by contributing to political instability and conflict, leading to displacement, migration, and changes in land use. These changes can, in turn, impact the Earth's climate and the environment. However, it is important to note that the primary impact of sarin and ricin is on human health and safety rather than the climate or the environment.

Radiological dispersion, which refers to the release of radioactive material into the environment, can indirectly impact the Earth's climate, causing shifts in atmospheric conditions that lead to changes in weather patterns and temperatures. Additionally, these particles can absorb and scatter sunlight, which can lead to a cooling effect on the Earth's surface. However, it is important to note that radiological dispersion primarily affects human health and safety rather than the climate or environment. The release of radioactive material can have significant short-term and long-term impacts on human health, as well as on the environment and ecosystems.

In the immediate aftermath of 9/11, there were some short-term effects on the climate. The attacks resulted in the collapse of the World Trade Center towers, which released large amounts of dust and debris into the air. This dust and debris contained a variety of pollutants, including asbestos, lead, and other toxic materials, which can negatively impact air quality and public health. Additionally, the burning of jet fuel and other materials at the attack site released large amounts of carbon dioxide and other greenhouse gases into the atmosphere, which can contribute to long-term climate change. However, these climate effects were relatively minor compared to the overall impacts of the attacks on human life, infrastructure, and the economy.

## Vulnerability Assessment

It is crucial to understand that a community’s vulnerability to terrorist attacks depends on several factors, including social and economic inequality, political instability, and religious or ideological tensions. The availability of weapons and resources also affects terrorists’ ability to carry out attacks.

**Table 80: Terrorism Vulnerability[249]**

| Hazard | Application Mode | Hazard Duration | Extent of Effects: Static/Dynamic | Mitigating and Exacerbating Conditions |
|---|---|---|---|---|
| **Conventional Bomb** | Detonation of explosive device on or near the target; delivery is via person, vehicle, or projectile | Instantaneous; additional secondary devices may be employed, extending the duration of the hazard until the attack site is deemed clear | The extent of damage is determined by the type and quantity of explosive material. The effects are typically static, except for cascading consequences, incremental structural failures, etc. | Energy decreases logarithmically as a function of distance from the seat of the blast. Terrain, forestation, structures, etc., can provide protection by absorbing and/or deflecting energy and debris. Exacerbating conditions include ease of access to the target, lack of barriers/shielding, poor construction, and ease of concealment of the device. |
| **Chemical Agent** | Liquid/aerosol contaminants can be dispersed using sprayers or other aerosol generators. Liquids can also vaporize from puddles/containers or munitions. | Chemical agents may pose viable threats for hours or weeks, depending on the agent and conditions. | Contamination can spread from the initial target area through people, vehicles, water, and wind. If not remediated, chemicals may be corrosive or cause long-term damage. | Air temperatures can affect the evaporation of aerosols. Ground temperatures affect the evaporation of liquids. Humidity can enlarge aerosol particles, reducing inhalation hazards. Precipitation can dilute and disperse agents, but dispersed vapors can also enlarge the target area. The micro-meteorological effects of buildings and terrain can alter the 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-of-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 conditions. | Depending on the agent used and the effectiveness of deployment, contamination can be spread via wind and water. Infection can also be transmitted via human or animal vectors. | The altitude at which the release agent is used, along with the effectiveness of deployment, can affect above-ground contamination and dispersion. Sunlight destroys many bacteria and viruses, while light to moderate winds can break up aerosol clouds. The micro-meteorological effects of buildings and terrain can influence aerosolization and how agents travel. Enclosed structures extend the lifespan of biological agents due to the lack of ultraviolet radiation. |

249 Salt Lake County Hazard Mitigation Plan. 2021.

| Hazard | Application Mode | Hazard Duration | Extent of Effects: Static/Dynamic | Mitigating and Exacerbating Conditions |
|---|---|---|---|---|
| **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 the isotope used. | Initial effects will be localized to the site of the attack. Depending on meteorological conditions, subsequent behavior or radioactive contaminants may be dynamic. | Radiation exposure depends on the duration of exposure, distance from the source, the radiation level, and the degree of shielding between the source and the target. |
| **Nuclear Bomb** | Detonation of nuclear device underground, on 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. The 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; the fallout of radioactive contaminants may be dynamic depending on meteorological conditions. | The harmful effects of radiation can be reduced by minimizing the duration of exposure. Light, heat, and blast energy decrease logarithmically as a function of distance from the seat of the blast. Terrain, forestation, structures, etc. can provide shielding by absorbing and/or deflecting radiation and radioactive contaminants. |

## ESTIMATED IMPACTS AND POTENTIAL LOSSES

During a terrorist attack, a community's infrastructure and residents could face various impacts. Infrastructure such as transportation systems, communication networks, and utilities may be damaged, leading to disruptions in daily life. Access to essential and critical emergency services may be impeded. People may experience physical harm, emotional trauma, and loss of life or property. It could also incite widespread fear, anxiety, and a sense of insecurity among community members. The attack could also lead to economic repercussions, affecting businesses and disrupting the overall productivity of the community. Overall, a terrorist attack event can have far-reaching and long-lasting impacts on a community, affecting both the physical and emotional well-being of residents as well as the functionality of the infrastructure.

The impacts of an active shooter event on a community can be profound and long-lasting. The immediate effects may include loss of life, physical injuries, and emotional trauma for those directly involved. Additionally, the community may experience fear, anxiety, and a sense of vulnerability. Individuals and the community can experience long-term psychological effects as well as economic impacts due to decreased property values and potential loss of business activity. Rebuilding a sense of safety and security can take time and require significant resources, including mental health support, community outreach, and efforts to prevent future incidents.

## VULNERABLE POPULATIONS

Specific populations in Salt Lake County are more vulnerable to terrorist attacks, including active shooter situations. These populations include children and students in schools and educational institutions; employees and customers in public places such as shopping malls, restaurants, and entertainment venues; residents in densely populated urban areas; individuals in healthcare facilities such as hospitals and clinics; participants in large public events and gatherings; individuals in religious institutions such as churches, mosques, and synagogues; the homeless population; and individuals in temporary shelters. However, anyone can become a victim of terrorism or an active shooter, regardless of race, religion, ethnicity, or nationality.

## COMMUNITY LIFELINES

During a terrorist event, all lifelines—safety and security, food, hydration and shelter, health and medical, energy (power and fuel), communications, transportation, water systems, and hazardous materials—are all at risk. Explosives, radiological devices, and nuclear bombs can cause substantial damage to structures and infrastructures, blocking evacuation routes and complicating access to essential and critical emergency services, law enforcement, medical aid, and essential items like food and water. Biological and chemical assaults can also destroy crops, poison livestock, and contaminate water supplies and soil, making food production challenging for years. Explosives can cause power outages, disrupting transportation, communication, and fuel supplies. Therefore, protecting citizens and critical assets from these worst-case scenarios in the United States is crucial.


**Figure 178: FEMA Community Lifelines[250]**

## CHANGES IN DEVELOPMENT

Terrorism and active shooters can profoundly impact community development. These acts of violence can create fear, distrust, and instability, hindering economic growth, discouraging investment, and disrupting social cohesion. The aftermath of such events often leads to increased security measures, which can limit public access to essential services and public spaces. Additionally, the psychological trauma experienced by individuals and communities can impede progress and development.

Table 81 provides information regarding population, household, and employment projections from 2025 to 2065 in Salt Lake County, all of which could be affected by terrorism or active shooter incidents.

**Table 81: Salt Lake County Future Development Projections[251]**

| 2025 | 2035 | 2045 | 2055 | 2065 | Absolute Change 2025–2065 | Percent Increase Change 2025–2065 |
|---|---|---|---|---|---|---|
| **Population Projections** | | | | | | |
| 1,249,961 | 1,361,099 | 1,470,574 | 1,594,804 | 1,693,513 | 443,552 | 35% |
| **Household Projections** | | | | | | |
| 454,929 | 521,352 | 579,472 | 635,143 | 689,490 | 234,561 | 52% |
| **Employment Projections** | | | | | | |
| 1,053,362 | 1,182,092 | 1,293,225 | 1,385,240 | 1,454,567 | 401,205 | 38% |

Terrorism and active shooter events can significantly impact population growth, household growth, and employment growth in a community. These events can create an atmosphere of fear and uncertainty, potentially hindering population growth as individuals may be reluctant to move to or remain in the

[250] FEMA. "Community Lifelines." https://www.fema.gov/emergency-managers/practitioners/lifelines
[251] Salt Lake County Hazard Mitigation Plan. 2021.

affected area. Household growth may also be impacted as families choose to relocate to safer areas, leading to a decrease in new households in the community.

Regarding employment growth, terrorism and active shooter incidents can lead to declining business investment and economic activity in the affected area. This can result in job losses and fewer employment opportunities, impacting overall employment growth in the community. Additionally, businesses may be hesitant to establish or expand operations in an area that has experienced such events, further impacting employment growth.

Terrorism can significantly impact future land use and development trends in a community. In the aftermath of a terrorist attack, there may be increased emphasis on security measures and considerations in future land use planning and development. This could lead to stricter building codes, stronger security infrastructure requirements, and limitations on certain types of development in high-risk areas. Additionally, zoning regulations may be changed to enhance security and protect critical infrastructure. As a result, future growth may be influenced by the need to mitigate potential security risks, which could impact the layout and design of communities.

## VULNERABILITY SCORE

Given Salt Lake County's moderate social vulnerability, high expected annual loss, and high community resilience to overall hazards,[252] its vulnerability to a terrorist attack or active shooter event remains significant. While its high community resilience can be beneficial in the aftermath of an attack, its high expected annual loss indicates that the impact of an attack could be substantial. Additionally, its moderate social vulnerability suggests the existence of underlying factors that could exacerbate the impact of a terrorist attack. Therefore, despite the resilience of the county, addressing its underlying vulnerabilities and their potential impact is vital to enhancing overall preparedness and response capabilities.

[252] FEMA. "National Risk Index." https://hazards.fema.gov/nri/map

# Capability Assessment

The capability assessment allows each jurisdiction to evaluate its current programs, funding, staffing, and other resources that can support the accomplishment of the mitigation strategy. A thorough understanding of existing capabilities helps decision-makers identify feasible mitigation actions. This assessment also provides an opportunity to identify gaps in capabilities and consider ways to expand and improve policies and programs.

The assessment evaluates four types of capabilities:

1. **Planning and Regulatory:** The codes, ordinances, policies, laws, plans, and programs that guide growth and development.
2. **Administrative and Technical:** The staff, skills, and tools that implement resources and mitigate actions. This may include the private sector, community-based organizations, and other partner agencies.
3. **Financial:** The funding resources available for mitigation.
4. **Education and Outreach:** Programs and processes used to communicate risks and encourage risk reduction.

All participating jurisdictions conducted an assessment of their capabilities. Some of the findings are presented in Table 88 through Table 92, with additional details available in the jurisdictional annexes.

## Planning and Regulatory

Jurisdictions have the authority to create policies, programs, and regulations that protect and serve their residents. Local policies are typically outlined in community plans, enacted through local ordinances, and enforced by governmental bodies. Many communities have developed plans specifically aimed at enhancing disaster resistance. A primary goal of these plans is to coordinate existing activities so that individual objectives are integrated into a comprehensive course of action.

**Table 82: Salt Lake County Plans**

| Plans | Does the plan address hazards? (Y/N) | How can the plan be used to implement mitigation actions? | When was it last updated? When will it next be updated? |
|---|---|---|---|
| **General Plan** | Y | Incorporate goals identified in this plan into the HMP update. | May 10, 2022, Unknown |
| **Capital Improvement Plan** | Y | Unknown | Salt Lake County (SLCo) Flood Control CIP is updated annually. |

| Plans | Does the plan address hazards? (Y/N) | How can the plan be used to implement mitigation actions? | When was it last updated? When will it next be updated? |
|---|---|---|---|
| **Climate Change Adaptation Plan** | N/A | N/A | N/A |
| **Community Wildfire Protection Plan** | Y | Incorporate goals identified in this plan into the HMP update, specifically with the WUI. It can also shed light on WUI building codes and /or development since there are significantly more people living and /or building in these areas compared to 2019. | December 1, 2019. Update planned for 2025. |
| **Economic Development Plan** | N/A | N/A | N/A |
| **Land Use Plan** | Y | Incorporate land use planning ideas into potential mitigation actions. | June 2020 and July 2017 (Wasatch Canyons Plan and Resource Management Plan).<br>Reviewed annually. |
| **Local Emergency Operations Plan** | Y | Incorporate actions from the county level into mitigation actions in the HMP update. | 2022.<br>Reviewed annually. |
| **Stormwater Management Plan** | Y | Primarily incorporates information on hazardous waste, which can be used to develop mitigation actions for the plan update. Municipal Services District (MSD) is responsible for Unincorporated Salt Lake County stormwater. | May 2020.<br>Reviewed annually. |
| **Transportation Plan** | Y | Can incorporate historical context to aid in new mitigation actions. MSD is responsible for Unincorporated Salt Lake County transportation. | May 2020 and May 2022.<br>Reviewed annually. |
| **Substantial Damage Plan** | Y | It can include EM/activation information to improve coordination between agencies and jurisdictions. | 2022.<br>Reviewed annually. |

| Plans | Does the plan address hazards? (Y/N) | How can the plan be used to implement mitigation actions? | When was it last updated? When will it next be updated? |
|---|---|---|---|
| **Other? (Describe)** | Y, Regional Hydrology and Hydraulics Study | Unknown | March 2020 for the Southwest and Northwest quadrants of SLCo. In progress for Eastside SLCo in 2024. |

Jurisdictions manage land use by adopting and enforcing zoning laws, subdivision regulations, land development ordinances, building codes, building permit requirements, and stormwater management ordinances. When well-prepared and effectively administered, these regulations can help mitigate hazards.

**Table 83: Salt Lake County Regulations and Ordinances**

| Plans | Does this regulation/ordinance effectively reduce hazard impacts? | Is it adequately administered and enforced? | When was it last updated? When will it next be updated? |
|---|---|---|---|
| **Building Code** | N/A | N/A | N/A |
| **Flood Insurance Rate Maps** | Y | No | November 19, 2021 |
| **Floodplain Ordinance** | Y | No | August 3, 2021 |
| **Subdivision Ordinance** | N/A | N/A | N/A |
| **Zoning Ordinance** | N/A | N/A | N/A |
| **Natural Hazard Specific Ordinance (Stormwater, Steep Slope, Wildfire)** | Y | Unknown | August 3, 2021 |
| **Acquisition of Land for Open Space and Public Recreation Use** | N/A | N/A | N/A |
| **Prohibition of Building in At-Risk Areas** | Y | Y | |
| **Other? (Describe)** | None | | |

## Administrative and Technical Capabilities

While legal, regulatory, and fiscal capabilities provide the foundation for effectively developing a mitigation strategy, successful implementation depends on the presence of appropriate personnel. Administrative and technical capabilities emphasize the availability of human resources responsible for executing all aspects of hazard mitigation. These resources include technical experts such as engineers and scientists and personnel with specialized skills in areas like grant writing and project management.

**Table 84: Salt Lake County Administrative Capabilities**

| Administrative Capability | In Place? (Y/N) | Is staffing adequate? | Is staff trained on hazards and mitigation? | Is coordination between agencies and staff effective? |
|---|---|---|---|---|
| **Chief Building Official** | Y | No, there is a shortage of building inspectors statewide. MSD manages this. | Yes, but additional training is needed. | Yes |
| **Civil Engineer** | Y | Yes, SLCo Flood Control operates countywide. | Yes | Yes |
| **Community Planner** | Y | See MSD staffing levels. | Yes, but more training is needed. | Yes |
| **Emergency Manager** | Y | No. The statewide mandate for local jurisdictions to have emergency managers has resulted in many local jurisdictions having an emergency manager who wears multiple hats or only works part-time. | Yes, but more training is needed. | Yes, but improvements could always be made. |
| **Floodplain Administrator** | Y | SLCo flood control operates countywide. | Yes | Yes |
| **Geographic Information System (GIS) Coordinator** | Y | Yes, though additional staff with expertise in emergency management would be beneficial. | Yes, but there are gaps at the county level. Currently, we have one GIS Specialist for county EM, and other GIS staff need to become more familiar with EM management workflows. | Yes, but there is room for improvement. |
| **Planning Commission** | Y | No, there are vacancies on the planning commission boards. See MSD for details. | They may be familiar with local risks, but because these are volunteer | No, it could be improved for better situational awareness. |

| Administrative Capability | In Place? (Y/N) | Is staffing adequate? | Is staff trained on hazards and mitigation? | Is coordination between agencies and staff effective? |
|---|---|---|---|---|
| | | | boards, more formal training would help. | |
| **Fire Safe Council** | Y | Yes | Valley fire chiefs are aware of risks but may focus more on fire-related hazards. More comprehensive training would be beneficial. | Yes, though better communication across agencies and jurisdictions is needed. |
| **CERT (Community Emergency Response Team)** | Y | Varies by jurisdiction in terms of engagement. A revamp is underway to improve coordination and set more precise expectations. | Yes, though more training would be helpful. | Yes, but effectiveness varies by jurisdiction. |
| **Active VOADs (Voluntary Agencies Active in Disasters)** | Y | Staffing shelters can sometimes be challenging. | Yes, though additional training would be helpful. | Yes, but it is always possible to improve relationships. |
| **Other? (Please describe)** | None | | | |

**Table 85: Salt Lake County Technical Capabilities**

| Technical Capability | In Place? (Y/N) | How has the capability been used to assess/mitigate risk in the past? (Answer or N/A) | How can the capability be used to assess/mitigate risk in the future? |
|---|---|---|---|
| **Mitigation Grant Writing** | Y | We have applied for mitigation funds with assistance from the SLCo EM division and the county's grant writer. | We can use the county grant writer and GIS staff to help with future grant applications. GIS staff can provide the demographic and mapping data to support the geographic needs, while the county grant writer can craft the narrative for the grant application. |
| **Hazard Data and Information** | Y | In the past, we have used HAZUS, along with various GIS tools, to identify local hazards for the community and the county EM division. | This data can be used to track mitigation progress over time, ensuring it's an ongoing process rather than just a review every 5 years. |

| Technical Capability | In Place? (Y/N) | How has the capability been used to assess/mitigate risk in the past? (Answer or N/A) | How can the capability be used to assess/mitigate risk in the future? |
|---|---|---|---|
| **GIS** | Y | We use GIS in various ways to identify, monitor, and prepare for hazards. Local dashboards, WebEOC, and Crisis Track, are integrated to track and share information. | More data integration is needed to track mitigation activities over time. Improved situational awareness for all local jurisdictions, agencies, and partners is crucial so everyone is aligned on expectations. |
| **Mutual Aid Agreements** | Y | Mutual aid agreements help in scenarios where local jurisdictions are overwhelmed or need additional resources. | These agreements should be reviewed more frequently to ensure no overlap with other jurisdictions. |
| **Other? (Please describe)** | None | | |

# Financial Capabilities

Identifying current and potential funding sources is critical to the mitigation planning process. Planning partners can select and implement financially viable actions to reduce future disaster risks by exploring, identifying, and assessing various funding options.

FEMA's Hazard Mitigation Assistance (HMA) grants are available to fund eligible mitigation measures to reduce future disaster losses. Eligible applicants include state agencies, local governments, special districts, federally recognized tribes, and private non-profit organizations.

This plan adheres to federal guidelines to ensure that participants remain eligible for specific mitigation funds. As outlined in the Code of Federal Regulations (CFR) Title 44, Part 201.6 (§201.6), local governments must have a Federal Emergency Management Agency (FEMA)-approved plan to apply for and receive hazard mitigation project grant funds. These funds support various hazard mitigation programs, including:

- Hazard Mitigation Grant Program (HMGP)
- HMGP Post Fire Program (HMGP-PF)
- Building Resilient Infrastructure and Communities (BRIC)
- Flood Mitigation Assistance (FMA)
- Safeguarding Tomorrow Revolving Loan Fund Program

It is essential to consider multiple funding sources, as mitigation actions can and should be financed through various avenues. Potential funding opportunities may include federal agencies, state, local, and tribal programs and private funding sources. Below, we outline several federal, state, and local funding opportunities.

**Table 86: Salt Lake County Financial Capabilities**

| Funding Resource | In Place? (Y/N) | Has this funding resource been used in the past and for what types of activities? | Could this resource be used to fund future mitigation actions? | Can this be used as the local cost match for a federal grant? |
|---|---|---|---|---|
| **Capital Improvement Project Funding** | Y | Yes, Flood Control Improvement Projects | Y | Y |
| **General Funds** | Y | Countywide UPDES/MS4 Program | Y | Y |
| **Hazard Mitigation Grant Program (HMGP/404)** | Y | Yes, Flood Control Improvement Projects | Y | Y |
| **Building Resilient Infrastructure & Communities (BRIC)** | Y | Levee Stability Study | Y | |
| **Flood Mitigation Assistance (FMA)** | Y | Yes, Flood Control Improvement Projects | Y | Y |
| **Public Assistance Mitigation (PA Mitigation/406)** | N/A | N/A | Y | N |
| **Community Development Block Grant (CDBG)** | Y | Yes, Stormwater Improvement Projects | Y | Y |
| **Natural Resources Conservation Services (NRCS) Programs** | Y | Yes, Flood Control Improvement Projects | Y | Y |
| **U.S. Army Corps (USACE) Programs** | Y | Federal Recognized Levee System | Unknown | Unknown |
| **Property, Sales, Income, or Special Purpose Taxes** | Y | Flood Control Levee | Unknown | Unknown |
| **Stormwater Utility Fee** | N | No, it would be implemented by the MSD. SW Utility Fee Study conducted in 2018. | N/A | N/A |
| **Fees for Water, Sewer, Gas, or Electric Services** | N/A | N/A | Unknown | Unknown |
| **Impact Fees from New Development and Redevelopment** | N | No, it would be implemented by the MSD. SW Utility Fee Study conducted in 2018. | N/A | N/A |

| Funding Resource | In Place? (Y/N) | Has this funding resource been used in the past and for what types of activities? | Could this resource be used to fund future mitigation actions? | Can this be used as the local cost match for a federal grant? |
|---|---|---|---|---|
| **General Obligation or Special Purpose Bonds** | Y | Implemented by SLCo Flood Control and MSD | Y | Y |
| **Federal-funded Programs (Please describe)** | Unknown | N/A | Y | N |
| **Private Sector or Nonprofit Programs** | N/A | N/A | Unknown | Unknown |
| **Other?** | None | | | |

# Education and Outreach Program Capabilities

Regular engagement with the public on hazard mitigation issues offers a valuable opportunity to directly connect with community members. Assessing this outreach and educational capability highlights the important relationship between the government and the community, promoting a two-way dialogue. Such interactions help build a more resilient community, grounded in education and active public involvement.

**Table 87: Salt Lake County Education and Outreach**

| Education and Outreach Capability | In Place? (Y/N) | Does this resource currently incorporate hazard mitigation? | Could this resource be used to support mitigation in the future? |
|---|---|---|---|
| **Community Newsletter(s)** | Y | Newsletters used during the 2023 spring runoff emergency response. | Yes |
| **Hazard Awareness Campaigns (such as Firewise, Storm Ready, Severe Weather Awareness Week, and School Programs)** | Y | Storm Ready outreach was used during the 2023 spring runoff emergency response. | Yes |
| **Public Meetings/Events (Please Describe)** | Y | Public meetings/events used during the 2023 spring runoff emergency response. | Yes |
| **Emergency Management Listserv** | Y | Unknown | Yes |
| **Local News** | Y | Used during the 2023 spring runoff emergency response. | Yes |

| Education and Outreach Capability | In Place? (Y/N) | Does this resource currently incorporate hazard mitigation? | Could this resource be used to support mitigation in the future? |
|---|---|---|---|
| **Distributing Hard Copies of Notices (e.g., public libraries, door-to-door outreach)** | Y | Door-to-door outreach was used during the 2023 spring runoff emergency response. | Yes |
| **Insurance Disclosures/Outreach** | N/A | N/A | Yes |
| **Organizations that Represent, Advocate for, or Interact with Underserved and Vulnerable Communities (Please Describe)** | Y | Unknown | Yes |
| **Social Media (Please Describe)** | Y | Used social media during the 2023 spring runoff emergency response. We distribute hazard mitigation information through SLCo EM's social media pages, including Facebook, X, and Instagram. | We could leverage social media by posting more frequently, creating videos, etc. |
| **Other? (Please Describe)** | None | | |

# Jurisdictional Capabilities

The following tables compile the capabilities of the participating communities across each of the four capability categories. The jurisdictional annexes in Volume 2 provide additional details regarding these capabilities.

**Table 88: Planning Capabilities by Jurisdiction**

| Jurisdiction | Capital Improvement Plan | Climate Change Action Plan | Community Wildfire Protection Plan | Comprehensive/ General Plan | Continuity of Operations Plan | Economic Development Plan | Land Use Plan | Local Emergency Operations Plan | Stormwater Management Plan | Transportation Plan | Other (Describe) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Salt Lake County** | X | - | X | X | - | - | X | X | X | X | Regional Hydrology and Hydraulics Study |
| **Alta** | X | - | X | X | - | - | X | X | - | - | |
| **Bluffdale** | X | - | - | X | - | - | - | X | X | X | |
| **Brighton** | - | - | X | X | - | - | X | X | - | X | |
| **Copperton** | X | - | X | X | - | - | X | X | X | X | |
| **Cottonwood Heights** | X | - | - | X | - | - | X | X | X | X | |
| **Draper** | X | - | X | X | - | X | X | X | X | X | |
| **Emigration Canyon** | - | - | X | X | - | X | X | X | - | X | |

| Jurisdiction | Capital Improvement Plan | Climate Change Action Plan | Community Wildfire Protection Plan | Comprehensive/ General Plan | Continuity of Operations Plan | Economic Development Plan | Land Use Plan | Local Emergency Operations Plan | Stormwater Management Plan | Transportation Plan | Other (Describe) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Herriman City** | X | - | X | X | - | - | X | X | X | - | |
| **Holladay** | X | X | X | X | - | - | X | X | - | - | |
| **Kearns** | - | - | X | X | - | X | X | X | X | X | |
| **Magna** | X | - | X | X | - | X | X | X | X | X | |
| **Midvale** | - | - | X | X | - | X | X | X | X | X | |
| **Millcreek** | X | - | X | X | - | X | X | X | X | X | |
| **Murray** | X | - | - | X | - | - | - | X | X | X | |
| **Riverton** | X | X | X | X | - | X | X | X | X | X | |
| **Salt Lake City** | X | X | X | X | X | X | X | X | X | X | Upsizing sewer lines, URM retrofit projects? |
| **Sandy** | X | - | X | X | - | X | - | X | X | X | |
| **South Jordan** | X | - | X | X | - | X | X | X | X | X | |

| Jurisdiction | Capital Improvement Plan | Climate Change Action Plan | Community Wildfire Protection Plan | Comprehensive/ General Plan | Continuity of Operations Plan | Economic Development Plan | Land Use Plan | Local Emergency Operations Plan | Stormwater Management Plan | Transportation Plan | Other (Describe) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| South Salt Lake | Unknown | Unknown | Unknown | Unknown | Unknown | Unknown | Unknown | Unknown | Unknown | Unknown | No information provided |
| Taylorsville | x | - | x | x | - | - | - | x | x | x | |
| West Jordan | x | - | - | x | - | - | x | x | x | x | |
| White City | x | - | x | x | - | x | x | x | x | x | |
| West Valley | x | x | x | x | x | x | x | x | x | x | |



**Table 89: Regulations and Ordinances by Jurisdiction**

| Jurisdiction | Acquisition of land for open space and public or recreational use | Building Code | Flood Insurance Rate Maps | Floodplain Ordinance | Substantial Damage Plan | Natural Hazard Specific Ordinance (Stormwater, Flood Protection, Wildfire) | Subdivision Ordinance | Zoning Ordinance | Other (Describe) |
|---|---|---|---|---|---|---|---|---|---|
| Salt Lake County | - | - | x | x | - | x | - | - | |
| Alta | - | x | - | - | - | x | x | x | |

| Jurisdiction | Acquisition of land for open space and public or recreational use | Building Code | Flood Insurance Rate Maps | Floodplain Ordinance | Substantial Damage Plan | Natural Hazard Specific Ordinance (Stormwater, Flood Protection, Wildfire) | Subdivision Ordinance | Zoning Ordinance | Other (Describe) |
|---|---|---|---|---|---|---|---|---|---|
| **Bluffdale** | Unknown | Unknown | Unknown | Unknown | Unknown | Unknown | Unknown | Unknown | No information provided |
| **Brighton** | - | X | X | - | - | X | X | X | |
| **Copperton** | X | X | X | - | - | Y | X | X | |
| **Cottonwood Heights** | Unknown | Unknown | Unknown | Unknown | Unknown | Unknown | Unknown | Unknown | No information provided |
| **Draper** | X | X | X | X | X | X | X | X | |
| **Emigration Canyon** | - | X | X | - | - | X | X | X | |
| **Herriman City** | - | X | X | - | - | X | - | X | |
| **Holladay** | Unknown | Unknown | Unknown | Unknown | Unknown | Unknown | Unknown | Unknown | No information provided |
| **Kearns** | X | X | X | - | - | - | X | X | |
| **Magna** | - | X | X | - | - | X | X | X | |
| **Midvale** | X | X | X | - | - | - | X | X | |

| Jurisdiction | Acquisition of land for open space and public or recreational use | Building Code | Flood Insurance Rate Maps | Floodplain Ordinance | Substantial Damage Plan | Natural Hazard Specific Ordinance (Stormwater, Flood Protection, Wildfire) | Subdivision Ordinance | Zoning Ordinance | Other (Describe) |
|---|---|---|---|---|---|---|---|---|---|
| **Millcreek** | - | x | x | x | - | - | - | - | |
| **Murray** | Unknown | Unknown | Unknown | Unknown | Unknown | Unknown | Unknown | Unknown | No information provided |
| **Riverton** | Unknown | Unknown | Unknown | Unknown | Unknown | Unknown | Unknown | Unknown | No information provided |
| **Salt Lake City** | x | x | x | x | x | x | x | x | |
| **Sandy** | - | x | x | x | - | x | x | x | |
| **South Jordan** | x | x | x | x | - | x | x | x | |
| **South Salt Lake** | Unknown | Unknown | Unknown | Unknown | Unknown | Unknown | Unknown | Unknown | No information provided |
| **Taylorsville** | - | x | - | x | - | x | x | x | |
| **West Jordan** | Unknown | Unknown | Unknown | Unknown | Unknown | Unknown | Unknown | Unknown | No information provided |
| **White City** | x | x | x | - | - | - | x | x | |
| **West Valley** | x | x | - | - | - | x | x | x | |

**Table 90: Administrative/Technical Capabilities by Jurisdiction**

| Jurisdiction | Chief Building Official | Engineer | Community Planner | Emergency Manager | Floodplain Administrator | GIS Coordinator | Grant Writer | Planning Commission | Hazard Data | GIS Analysis | Mutual Aid Agreements | Other (Describe) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Salt Lake County | x | x | x | x | x | x | x | x | x | x | x | |
| Alta | x | x | x | x | - | - | x | x | - | - | x | |
| Bluffdale | x | x | x | x | x | x | - | x | x | x | x | |
| Brighton | x | - | - | x | - | - | - | x | - | - | - | |
| Copperton | x | x | x | x | x | - | x | x | x | x | x | |
| Cottonwood Heights | x | x | x | x | - | x | - | x | x | x | x | |
| Draper | x | x | x | x | x | x | x | x | x | x | x | |
| Emigration Canyon | x | x | x | x | x | x | x | x | x | x | x | |
| Herriman City | x | x | x | x | x | x | - | x | x | x | x | |
| Holladay | x | x | x | x | x | x | - | x | x | x | - | |
| Kearns | x | x | x | x | x | - | - | x | - | - | - | |
| Magna | x | x | x | x | x | x | x | x | x | x | x | |

| Jurisdiction | Chief Building Official | Engineer | Community Planner | Emergency Manager | Floodplain Administrator | GIS Coordinator | Grant Writer | Planning Commission | Hazard Data | GIS Analysis | Mutual Aid Agreements | Other (Describe) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Midvale** | x | x | x | x | x | x | x | x | x | x | x | |
| **Millcreek** | x | x | x | x | - | x | x | x | - | x | x | |
| **Murray** | x | x | x | x | x | x | - | x | x | x | x | |
| **Riverton** | x | x | x | x | x | x | - | x | x | x | x | |
| **Salt Lake City** | x | x | x | x | x | x | x | x | x | x | x | |
| **Sandy** | x | x | x | x | x | x | - | x | - | x | x | |
| **South Jordan** | x | x | x | x | x | x | x | x | x | x | x | |
| **South Salt Lake** | Unknown | Unknown | Unknown | Unknown | Unknown | Unknown | Unknown | Unknown | Unknown | Unknown | Unknown | No information provided |
| **Taylorsville** | x | x | x | x | x | x | - | x | x | x | x | |
| **West Jordan** | x | x | x | x | x | x | - | x | x | x | x | |
| **White City** | x | x | x | x | x | x | x | x | x | x | x | |
| **West Valley** | x | x | x | x | x | x | - | x | x | x | x | |

**Table 91: Financial Capabilities by Jurisdiction**

| Jurisdiction | Capital Improvements Project Funding | Community Development Block Grant | Federal Grant Programs (Non-FEMA) | Fees for Water, Sewer, Gas, or Electrical Services | Impact Fees for New Development | State Funding Programs | Stormwater Utility Fee | Other (Describe) |
|---|---|---|---|---|---|---|---|---|
| Salt Lake County | X | X | - | - | - | - | - | |
| Alta | X | - | X | X | - | - | - | |
| Bluffdale | Unknown | Unknown | Unknown | Unknown | Unknown | Unknown | Unknown | No information provided |
| Brighton | - | - | - | X | - | - | - | Brighton and Solitude Resorts |
| Copperton | X | - | - | X | X | - | X | |
| Cottonwood Heights | Unknown | Unknown | Unknown | Unknown | Unknown | Unknown | Unknown | No information provided |
| Draper | X | X | X | X | X | - | X | |
| Emigration Canyon | X | - | - | X | X | - | X | |
| Herriman City | Unknown | Unknown | Unknown | Unknown | Unknown | Unknown | Unknown | No information provided |
| Holladay | Unknown | Unknown | Unknown | Unknown | Unknown | Unknown | Unknown | No information provided |
| Kearns | Unknown | Unknown | Unknown | Unknown | Unknown | Unknown | Unknown | No information provided |
| Magna | X | X | X | X | X | - | X | |
| Midvale | X | - | - | X | X | - | X | |

| Jurisdiction | Capital Improvements Project Funding | Community Development Block Grant | Federal Grant Programs (Non-FEMA) | Fees for Water, Sewer, Gas, or Electrical Services | Impact Fees for New Development | State Funding Programs | Stormwater Utility Fee | Other (Describe) |
|---|---|---|---|---|---|---|---|---|
| **Millcreek** | X | - | - | - | - | - | - | |
| **Murray** | Unknown | Unknown | Unknown | Unknown | Unknown | Unknown | Unknown | No information provided |
| **Riverton** | Unknown | Unknown | Unknown | Unknown | Unknown | Unknown | Unknown | No information provided |
| **Salt Lake City** | X | X | X | X | X | X | X | |
| **Sandy** | X | - | X | X | X | - | X | |
| **South Jordan** | X | - | X | X | X | X | X | |
| **South Salt Lake** | Unknown | Unknown | Unknown | Unknown | Unknown | Unknown | Unknown | No information provided |
| **Taylorsville** | Unknown | Unknown | Unknown | Unknown | Unknown | Unknown | Unknown | No information provided |
| **West Jordan** | Unknown | Unknown | Unknown | Unknown | Unknown | Unknown | Unknown | No information provided |
| **White City** | X | - | - | X | X | - | X | |
| **West Valley** | X | X | - | - | X | - | X | |

**Table 92: Educational Capabilities by Jurisdiction**

| Jurisdiction | Community Newsletters | Hazard Awareness Campaigns | Organizations That Represent/Advocate Underserved and Vulnerable Populations | Social Media | Websites | Community Events | Community Training | Other (Describe) |
|---|---|---|---|---|---|---|---|---|
| **Salt Lake County** | X | X | X | X | - | X | - | |
| **Alta** | X | - | X | X | - | X | - | |
| **Bluffdale** | - | - | - | X | - | X | - | |
| **Brighton** | X | X | - | X | - | X | - | |
| **Copperton** | X | X | X | X | - | X | - | |
| **Cottonwood Heights** | Unknown | Unknown | Unknown | Unknown | Unknown | Unknown | Unknown | No information provided |
| **Draper** | X | X | - | X | - | X | - | |
| **Emigration Canyon** | X | X | X | X | - | X | - | |
| **Herriman City** | X | X | - | X | - | X | X | |
| **Holladay** | X | X | - | X | - | X | - | |
| **Kearns** | X | X | - | X | - | X | - | |
| **Magna** | X | X | X | X | - | X | - | |

| Jurisdiction | Community Newsletters | Hazard Awareness Campaigns | Organizations That Represent/Advocate Underserved and Vulnerable Populations | Social Media | Websites | Community Events | Community Training | Other (Describe) |
|---|---|---|---|---|---|---|---|---|
| **Midvale** | x | x | x | x | - | x | - | |
| **Millcreek** | x | x | - | - | - | x | - | |
| **Murray** | - | - | - | x | - | - | - | |
| **Riverton** | x | x | - | - | - | - | - | |
| **Salt Lake City** | x | x | x | x | - | x | - | |
| **Sandy** | x | x | x | x | - | x | - | |
| **South Jordan** | x | x | x | x | - | x | x | |
| **South Salt Lake** | Unknown | Unknown | Unknown | Unknown | Unknown | Unknown | Unknown | No information provided |
| **Taylorsville** | x | - | - | x | - | x | - | |
| **West Jordan** | - | - | - | x | - | x | - | |
| **White City** | x | x | x | x | - | x | - | |
| **West Valley** | x | - | - | x | - | x | - | |

# National Flood Insurance Program (NFIP) Capabilities

Flooding is the costliest natural hazard in the United States, and recent federal regulations have led to rising flood insurance premiums for homeowners nationwide. Community participation in the National Flood Insurance Program (NFIP) allows access to additional grant funding to address flood-related issues. By assessing a jurisdiction's current NFIP status and compliance, planners can better understand local flood management efforts, identify areas for improvement, and explore available grant funding opportunities.

The NFIP's Community Rating System (CRS) is a voluntary program that recognizes and incentivizes community floodplain management activities that exceed the minimum NFIP requirements. Communities participating in the CRS receive discounted flood insurance premiums, reflecting the reduced flood risk resulting from their proactive flood management efforts. The CRS has three main goals: to reduce flood damage to insurable properties, reinforce and enhance the insurance aspects of the NFIP, and encourage a comprehensive approach to floodplain management.

This section of the capability assessment focuses on identifying and evaluating existing programs within each participating jurisdiction. According to the FEMA Community Status Book Report, no Salt Lake County planning area jurisdictions currently participate in the Community Rating System.[253]

**Table 93: CRS Participation**

| Jurisdiction | NFIP Community Rating |
|---|---|
| Salt Lake County | - |
| Alta | - |
| Bluffdale | - |
| Brighton | - |
| Copperton | - |
| Cottonwood Heights | - |
| Draper | - |
| Emigration Canyon | - |
| Herriman City | - |
| Holladay | - |
| Kearns | - |
| Magna | - |
| Midvale | - |
| Millcreek | - |
| Murray | - |
| Riverton | - |
| Salt Lake City | - |

[253] FEMA. "Community Rating System." https://www.fema.gov/floodplain-management/community-rating-system

| Jurisdiction | NFIP Community Rating |
|---|---|
| Sandy | - |
| South Jordan | - |
| South Salt Lake | - |
| Taylorsville | - |
| West Jordan | - |
| White City | - |
| West Valley | - |

# Mitigation Strategy

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 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. The 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 to be taken and are not dependent on implementation feasibility. Objectives—which are different than goals—define strategies that will accomplish the goals and are specific and measurable. The following are the goals, listed in order of priority:

- **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 from hazards.
- **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 and both private and public entities to mitigate and become more resilient to disasters.
- **Goal 5:** Ensure and promote ways to sustain 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 at mitigating hazards and enhancing resiliency.
- **Goal 8:** Preserve and protect natural systems, natural resources, and other environmental assets against the effects of hazards.

# Mitigation Action Plan

The action plan helps prioritize mitigation initiatives according to a benefit/cost analysis of the proposed projects (44 CFR, Section 201.6(c)(3)(iii)). The action plan also provides a 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, while actions for each participating jurisdiction will be listed in their respective annexes in Volume 2. Each mitigation project identified during the 2025 plan update for both the county and jurisdictions has been organized based on the parameters below, which is meant to guide the updates and progress for each mitigation initiative by helping implement a programmatic approach.

## 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 1–5 years
- **Long Term:** To be completed in more 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 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 reapportionment 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. It 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 (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, for each project, a review was conducted of the apparent benefits versus the apparent cost. 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 addresses numerous goals or hazards, has benefits that exceed costs, 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 (1–5 years).
- **Medium Priority:** A project that addresses multiple goals and hazards, has benefits that exceed costs, and is grant-eligible under HMGP, PDM, or other grant programs, although funding has not yet been secured. 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 addresses few goals, mitigates the risk of one or few hazards, has benefits that do not exceed costs or are difficult to quantify, lacks secured funding, is not eligible for HMGP or PDM grant funding, and has a long-term timeline for completion (1–10 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 2019 Salt Lake County Hazard Mitigation Plan, and suggestions from participating communities and their respective stakeholders during workshops and meetings with individual agencies that took place throughout the county in the fall of 2024.

Each of the participating communities, including Salt Lake County, was invited to participate in a workshop in which goals, objectives, and strategies were discussed. 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 priorities.

## Countywide Actions

In this section, mitigation actions/projects were updated/amended, identified, evaluated, and prioritized. This section is organized as follows:

- **Status Update of Previous Mitigation Actions**
- **New Mitigation Actions:** New actions identified during this 2025 update process
- **Existing Mitigation Actions:** Actions still in progress; during the 2025 update, these mitigation actions and projects were modified and/or amended as needed
- **Completed Mitigation Actions:** An archive of all identified and completed projects

# Review of Previous Mitigation Actions

Because the implementation of this plan is critical to creating greater community resilience, the completion of mitigation actions is an important indicator of implementation and activity in the county. Table 94 below presents all completed mitigation actions from the 2015 and 2019 MJHMP.

**Table 94: Completed Mitigation Actions from the 2015 and 2019 Multijurisdictional Hazard Mitigation Plans**

| Action | Hazard(s) | Agency Lead | Support Agency(ies) | Status Update (if ongoing, explain) |
| --- | --- | --- | --- | --- |
| Develop an enhanced emergency notification communication system for the county | All hazards | SLCo EM | Local emergency management | Ongoing; preparing IPAWS templates, identifying streamlined communications platforms |
| Coordinate conservation, preservation, and mitigation actions with community development and community planning divisions to ensure integration of programs across all communities | Dam/levee failures, drought, earthquakes, floods, hazardous materials incidents (transportation and fixed facility), wildfires | Salt Lake County Public Works (PW) & Municipal Services, Municipal Services District (MSD) | All participating jurisdictions | Ongoing |

| Action | Hazard(s) | Agency Lead | Support Agency(ies) | Status Update (if ongoing, explain) |
|---|---|---|---|---|
| Enhance security at critical public safety and technology infrastructure sites. Develop and implement a critical infrastructure and key resources (CIKR) security/ hardening program | All hazards | SLCo EM, local emergency management | PW Operations | Ongoing; have completed security updates to the Emergency Coordination Center (ECC) with card access and cameras. We are in the process of creating a new access and lobby management policy.<br><br>Ongoing; PW Operations has increased the number and quality of security cameras at public works yards. |
| Enhance interoperable radio communications systems throughout the county | All hazards | SLCo EM, local emergency management | All jurisdictions within the county | Ongoing; PW Operations is in the process of upgrading two-way radios. |
| Elevating and/or mitigating roadways in low-lying areas prone to overland flooding | Floods (flash and riverine) | Salt Lake County PW & Municipal Services, local PW/engineering departments, MSD | | Incomplete; PW Operations road maintenance/ improvements are ongoing for local jurisdictions. |
| Conduct flood-specific impact studies (Eastside Canal and Creek Study) | Floods (flash and riverine), severe thunderstorms | Salt Lake County PW & Municipal Services, local PW/engineering departments, MSD | | In progress; 80% complete |
| Work with communities (newly incorporated and metro townships) not currently in the National Flood Insurance Program (NFIP) to adopt the program | Floods (flash and riverine) | Salt Lake County PW & Municipal Services, MSD | SLCo EM, local emergency management | Complete; all newly incorporated cities have joined the NFIP. |

| Action | Hazard(s) | Agency Lead | Support Agency(ies) | Status Update (if ongoing, explain) |
|---|---|---|---|---|
| Develop a countywide program to purchase repetitive loss properties and develop a program to monitor locations of buyouts; encourage local jurisdictions to institute a buyout plan for flood-prone structures or those susceptible to landslides and other geological concerns | Floods (riverine), earthquakes, landslides | Salt Lake County PW & Municipal Services, MSD | SLCo EM, local emergency management | Incomplete |
| Develop and implement a water conservation plan | Drought, extreme heat incidents | Salt Lake County PW & Municipal Services, MSD | SLCo EM, local emergency management, Salt Lake County Emergency Services | Incomplete |
| Provide information to property owners in flood-prone areas, including the need for NFIP coverage | Floods (flash and riverine) | SLCo EM, Salt Lake County PW & Municipal Services, local emergency management | Salt Lake County Emergency Services: A division of PW & Municipal Services | Ongoing; SLCo Flood Control runoff ready website and social media posts |
| Develop and implement public education programs on disaster awareness | All hazards | SLCo EM, local emergency management | | Ongoing |
| Procure generators and transfer switches for schools, public facilities, and critical facilities, including generators/redundant backup power at traffic signals in key locations | All hazards | SLCo EM, local emergency management | | Ongoing; Unified Fire Authority (UFA) did some BRIC (Building Resilient Infrastructure and Communities) work for seismic upgrades that included generators. Generators were installed at stations |

| Action | Hazard(s) | Agency Lead | Support Agency(ies) | Status Update (if ongoing, explain) |
|---|---|---|---|---|
| | | | | 103, 107, and 113. Seismic upgrades were completed at stations 107, 109, 110, 112, 115, and 116. Nonstructural upgrades were completed at 20 stations.<br><br>PW Operations: incomplete. We have a few portable generators but need to get more. |
| Assess and prioritize burying utilities (especially in areas where new development is occurring) | Dam failures, floods (flash and riverine), high winds and tornadoes, landslides, severe thunderstorms, severe winter storms, wildfires | Salt Lake County PW & Municipal Services, local PW/engineering departments, MSD | | Incomplete |
| Commodity flow allocation study for rail and road transportation | Hazardous materials incidents | SLCo EM, local emergency management | Dept. Regional Transportation, Housing & Economic Development | Incomplete |
| Move electrical panels, mechanical, and generators above base flood elevation (BFE) in facilities located in flood-prone areas | Floods (flash and riverine) | Salt Lake County PW & Municipal Services, local PW/engineering departments, MSD | Salt Lake County Emergency Services | Incomplete |
| Enhancement and expansion of green space | Floods (flash and riverine) | Salt Lake County PW & Municipal Services, local PW/engineering departments, MSD | | Incomplete due to a lack of funding |
| Emergency operations center enhancements for situational awareness and coordination | All hazards | SLCo EM | | Ongoing; WebEOC and Crisis Track integration |

| Action | Hazard(s) | Agency Lead | Support Agency(ies) | Status Update (if ongoing, explain) |
|---|---|---|---|---|
| Integrate WebEOC and other technological enhancements and integration throughout the county | All hazards | SLCo EM, local emergency management | | Ongoing; implementing Crisis Track and WebEOC training for local jurisdictions/ agencies |
| Construct snow sheds for avalanche mitigation in Little Cottonwood Canyon | Avalanches | Salt Lake County PW & Municipal Services, Salt Lake Emergency Management | Utah Department of Transportation (UDOT) | Ongoing; Phase 2 of UDOT's work |
| Enhance and continue to promote the implementation of the community emergency response teams (CERTs) and other related programs | All hazards | SLCo EM, local emergency management | Local emergency management | Ongoing |
| Establish functional and access needs registry or similar program | All hazards | SLCo EM, local emergency management | Salt Lake County Dept. of Human Services | Ongoing; with the Special Needs Registry dissolving, SLCo EM needs to establish a system. |
| Mutual aid agreement development and/or updates | All hazards | SLCo EM, local emergency management | All participating jurisdictions within the county | Ongoing; PW has mutual aid interlocal agreement; all Salt Lake County municipalities and Salt Lake County have signed it. |
| Develop and implement countywide green infrastructure plan | All hazards | Salt Lake County PW & Municipal Services, MSD | All participating jurisdictions within the county | Incomplete |
| Evaluate capability and capacity for all local governments to provide and sustain emergency power to critical infrastructure resources under their control | All hazards | SLCo EM, local emergency management | All participating jurisdictions within the county | Ongoing |

| Action | Hazard(s) | Agency Lead | Support Agency(ies) | Status Update (if ongoing, explain) |
|---|---|---|---|---|
| Continue implementing and improving Salt Lake County's disaster recovery program by developing and updating key plans, strategies, and recovery protocols | All hazards | SLCo EM | All participating jurisdictions within the county, Salt Lake County Emergency Services (A Division of PW & Municipal Services) | Ongoing |
| Retrofit critical facilities and infrastructure to withstand avalanches | Avalanches | Salt Lake County PW & Municipal Services, MSD, local governments, ski resorts, private owners | SLCo EM, local emergency management | Ongoing; UDOT installed 16 new remote avalanche control systems (RACS) on Mt. Superior in Little Cottonwood Canyon in summer 2024. |
| Bring deficient high-hazard dams up to current industry standards | Floods (flash and riverine), dam failures | Salt Lake County and all participating jurisdictions | Salt Lake County, local governments | In progress |
| Increase the size of culverts and bridges | Floods (flash and riverine) | Salt Lake County PW & Municipal Services, local PW/engineering departments, MSD, canal districts | | In progress but lacks funding |
| Remove debris and vegetation from floodway and drainage structures through a systematic maintenance program | Floods (flash and riverine) | Salt Lake County PW & Municipal Services, local PW/engineering departments, MSD, canal districts | | Ongoing; lack of funding and personnel<br><br>PW Operations assists |
| Improve flood resistance through enhancement of wing walls, flood barriers, foundations, etc. at likely flood impact points | Floods (flash and riverine) | Salt Lake County PW & Municipal Services, local PW/engineering departments, MSD, canal districts | | Incomplete |
| Construct debris basins, flood retention ponds, and energy flow | Floods (flash and riverine) | Salt Lake County PW & Municipal Services, local PW/engineering | | Ongoing; lack of funding |

| Action | Hazard(s) | Agency Lead | Support Agency(ies) | Status Update (if ongoing, explain) |
|---|---|---|---|---|
| dissipaters to control the flow and release of floodwaters | | departments, MSD, canal districts | | |
| Construct temporary debris traps and other flood-mitigating structures in wildfire-burned areas | Floods (flash and riverine), wildfires | Salt Lake County PW & Municipal Services, local PW/engineering departments, MSD | Utah Department of Natural Resources (DNR), Natural Resources Conservation Service (NRCS), UDOT | Incomplete |
| Retrofit critical facilities and infrastructure to withstand earthquakes and other geologic hazards | Earthquakes | Salt Lake County PW & Municipal Services, local PW/engineering departments, MSD, owners of facilities | | UFA station retrofits<br><br>Incomplete; PW Operations: master plan for update of PW yard is complete but need funding to move forward. |
| Retrofit businesses, residential structures, infrastructure, and public buildings (especially in historic districts) to withstand moderate earthquakes and other geologic hazards | Earthquakes | Owners of facilities, Salt Lake County PW & Municipal Services, local PW/engineering departments, MSD | | Incomplete |
| Use flexible piping when extending water, sewer, or natural gas service | Earthquakes | Utility companies, Salt Lake County PW & Municipal Services, local PW/engineering departments, MSD | | Incomplete |
| Install shutoff valves and emergency connector hoses where water mains cross fault lines | Earthquakes | Utility companies, Salt Lake County PW & Municipal Services, local PW/engineering departments, MSD | | Incomplete |

| Action | Hazard(s) | Agency Lead | Support Agency(ies) | Status Update (if ongoing, explain) |
|---|---|---|---|---|
| Encourage all new construction to meet enhanced standards for wind loading, snow loading, and other weather-related hazards | Severe weather | Facility owners, Salt Lake County PW & Municipal Services, local PW/engineering departments, MSD | | Incomplete |
| Plan for and maintain adequate road and debris clearing capabilities | Severe weather | Salt Lake County PW & Municipal Services, local PW/engineering departments, MSD | | Ongoing; PW Operations has emergency action plan to respond to disasters, including road and debris clearing. |
| Install pump stations in strategic locations to mitigate flooding | Floods (flash and riverine) | Salt Lake County PW & Municipal Services, Local PW/engineering departments, MSD, canal districts | | In progress; currently bidding out City Drain pump station |
| Collaborate with private canal companies to mitigate drainage, leakage, and capacity issues | Floods (flash and riverine) | Salt Lake County PW & Municipal Services, local PW/engineering departments, MSD, canal districts | | Ongoing; lack of funding and personnel |
| Conduct levee upgrades and certification | Floods (flash and riverine) | Salt Lake County PW & Municipal Services, local Pw/engineering departments, MSD | | Ongoing; making progress and the accreditation of the Surplus Canal levee system |
| Assess high-pressure pipelines to ensure they meet seismic standards; conduct upgrades as needed | Earthquakes | Utility companies, Salt Lake County PW & Municipal Services, local PW/engineering departments, MSD | | Incomplete |
| Promote Firewise initiative and develop community wildfire protection plans (CWPP) within at-risk communities | Wildfires | Salt Lake County UFA | All participating communities within the county | Ongoing |

| Action | Hazard(s) | Agency Lead | Support Agency(ies) | Status Update (if ongoing, explain) |
|---|---|---|---|---|
| Promote the Fix the Brick program throughout the county | Earthquakes | Salt Lake County and all participating jurisdictions | State of Utah | Incomplete; mainly promoted in Salt Lake City |
| Help county jurisdictions procure Flood Mitigation Assistance (FMA) grants | Floods | SLCo EM | All participating jurisdictions within the county | Ongoing; not complete or initiated |
| Assist Emergency Managers in designing pandemic mitigation programs | Public health epidemics/ pandemics | SLCo EM, Salt Lake County Health Department | All participating jurisdictions within the county | Complete; County Health Department updates plans annually for pandemic and infectious disease |
| Conduct seminar to assist Emergency Managers in public education about radon kits | Radon | SLCo EM | Salt Lake County Health Department | Incomplete; was not a priority during COVID-19 and there has not been a discussion on radon education since |
| Help county jurisdictions procure FMA grants | | | | Ongoing |
| Elevate and/or mitigate roadways in low-lying areas prone to flooding | | | | Incomplete; PW Operations assisting |
| Conduct flood-specific impact studies | | | | Ongoing |
| Work with communities not currently in the NFIP to adopt the program | | | | Complete |
| Develop a countywide program to purchase repetitive loss properties | | | | Incomplete |
| Provide information to flood-prone areas about the need for NFIP coverage | | | | Ongoing |

# New Mitigation Actions

**Table 95: New Mitigation Actions Created During the 2025 Update**

| Number | Action | Hazard(s) | Lead Agency | Potential Partners | Benefits (Losses Avoided) | Cost Estimate | Funding Source | Time Frame | Priority | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Enhance security at critical infrastructure locations to prevent potential for terrorist acts | Terrorism | SLCo EM | Local jurisdictions, Unified Police Department (UPD), UFA, MSD, SLCo IT, SLCo PW, SLCo Clerks Office, Sheriff's Office | Increased security protocols (both in technology and policy) for staff/first responders, clear expectations/ understanding for local jurisdictions and the public | Unknown | SLCo EM, local jurisdictions, UPD, Sheriff's office, UFA, MSD | 1–3 years | Medium | |
| 2 | Develop and implement public education programs on disaster awareness | Avalanches, civil disturbances, dam failures, drought, wildfires, earthquakes, extreme heat, floods, hazardous materials incidents, heavy rain, high winds, landslides, lightning, public health epidemics, radon, severe winter weather, terrorism, tornadoes, wildfires | SLCo EM | Local jurisdictions, UFA, UPD, Sheriff's office, SLCo PW | Improve understanding of local resources, improve relationships with the public and stakeholders; outlined plans/standard operating procedures (SOPs) for programs | Unknown | SLCo EM, local jurisdictions | 1–3 years | Medium | |
| 3 | Integrate WebEOC, Crisis Track, Geographic Information System (GIS), and other technological | Avalanches, civil disturbances, dam failures, drought, wildfires, earthquakes, extreme heat, floods, hazardous materials incidents, heavy rain, | SLCo EM | Local jurisdictions, UFA, UPD, SLCo PW, SLCo Health Dept | Common operating platform for stakeholders, increased situational awareness, improved response time | Unknown | SLCo EM, UFA, local jurisdictions | 3–5 years | Medium | Existing software requiring updates to documentation/training |

| Number | Action | Hazard(s) | Lead Agency | Potential Partners | Benefits (Losses Avoided) | Cost Estimate | Funding Source | Time Frame | Priority | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| | enhancements throughout the county | high winds, landslides, lightning, public health epidemics, radon, severe winter weather, terrorism, tornadoes, wildfires | | | | | | | | |
| 4 | Enhance and continue to promote the implementation of CERT and SAFE Hubs | Avalanches, civil disturbances, dam failures, drought, wildfires, earthquakes, extreme heat, floods, hazardous materials incidents, heavy rain, high winds, landslides, lightning, public health epidemics, radon, severe winter weather, terrorism, tornadoes, wildfires | SLCo EM | Local jurisdictions | Improved awareness of local resources | Unknown | SLCo EM, local jurisdictions, State of Utah | 1–3 years | Medium | SAFE Hubs (previously S.A.F.E. Neighborhoods) is currently going through a rebrand with new public awareness campaign and information for all partners. |
| 5 | Establish access and functional needs registry and improve incorporation of those with access and functional needs in plans | Avalanches, civil disturbances, dam failures, drought, wildfires, earthquakes, extreme heat, floods, hazardous materials incidents, heavy rain, high winds, landslides, lightning, public health epidemics, radon, severe winter | SLCo EM | Local jurisdictions, MSD, UFA, UPD, Sheriff's office | Improved situational awareness for the public and stakeholders, greater understanding of resources available for those with access and functional needs | Unknown | SLCo EM, local jurisdictions, MSD, State of Utah | 1–3 years | High | The State of Utah's Access and Functional Needs Registry is dissolving in 2025. The county needs a way to account for those with access and functional needs, including incorporation into plans/SOPs. |

| Number | Action | Hazard(s) | Lead Agency | Potential Partners | Benefits (Losses Avoided) | Cost Estimate | Funding Source | Time Frame | Priority | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| | | weather, terrorism, tornadoes, wildfires | | | | | | | | |
| 6 | Construct snow sheds for avalanche mitigation in Little Cottonwood Canyon | Avalanches | UDOT | SLCo EM, local jurisdictions, UFA UPD | Diminish road closure time, preserve life and safety from avalanches (personal injuries, car/infrastructure damage, safety of first responders and UDOT staff | $72–$90 million | UDOT, local jurisdictions | 5 years | Medium | |
| 7 | Bring deficient high-hazard dams up to current industry standards | Dam failures | Dam owners/water companies | SLCo EM, local jurisdictions | Life and safety (personal injuries, safety of first responders), damage to critical infrastructure | Unknown | SLCo PW, local jurisdictions (dam owners), water districts, State of Utah | 5 years | High | |
| 8 | Procure generators and transfer switches for schools, public facilities, and critical facilities | Extreme heat | SLCo EM | SLCo Parks & Recreation, school districts | Provide backup generators for cooling centers and code blue centers; accurate inventory of what the county must provide to other agencies or jurisdictions as needed | Unknown | SLCo, MSD, school districts | 5 years | Medium | |
| 9 | Increase the size of culverts and bridges | Floods | SLCo PW | SLCo EM | Allow for larger runoff during spring melt season, decrease the amount of debris buildup | Unknown | SLCo PW, UDOT, MSD | 5 years | Medium | |
| 10 | Help local jurisdictions procure FMA grants | Floods | SLCo EM | Local jurisdictions, SLCo PW, MSD | Improved understanding of grants available and how money can be used for mitigation efforts | Unknown | Grants, SLCo EM, local jurisdictions, MSD, State of Utah | 3–5 years | Medium | |

| Number | Action | Hazard(s) | Lead Agency | Potential Partners | Benefits (Losses Avoided) | Cost Estimate | Funding Source | Time Frame | Priority | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| 11 | Develop an enhanced emergency notification communication system for the county | Avalanches, civil disturbances, dam failures, drought, earthquakes, extreme heat, floods, hazardous materials incidents, heavy rain, high winds, landslides, lightning, public health epidemics, radon, severe winter weather, terrorism, tornadoes, wildfires | SLCo EM | MSD, UFA, UPD, local jurisdictions, UDOT | Early notification of impending wildfire to decrease loss of life; improved relationships with the public and stakeholders; faster delivery of information with templates/plans ready to go | $1 million | SLCo, MSD, local jurisdictions, grant program | 1–3 years | Medium | |
| 12 | Promote the Firewise initiative and regularly review/update the community wildfire protection plans (CWPP) for at-risk communities | Wildfires | UFA | SLCo EM, local jurisdictions | Increased awareness of plans (for the public and stakeholders); improved eligibility for grants/other funding sources; regular review of CWPP | Unknown | SLCo EM, MSD, local jurisdictions, grant | 1–3 years | Medium | |
| 13 | Conduct public awareness campaign on Tier 2 reporting software for chemical reporting | Hazardous materials incidents | UFA | SLCo EM, UPD, local jurisdictions, Sheriff's office, Rio Tinto | Improved understanding of Tier 2 reporting and how local agencies/jurisdictions can find and submit information; a common operating platform for hazardous materials reporting | Unknown | Grants, SLCo EM, LEPC, local jurisdictions, State of Utah | 5 years | Medium | |
| 14 | Enact countywide regulations and codes for development to | Landslides, slope failures | SLCo Office of Regional Development | SLCo EM, UFA, local jurisdictions | Reduce the likelihood of landslides and critical infrastructure/building damage; ensure future development is up to code | Unknown | SLCo, MSD, State of Utah | 5 years | Medium | |

| Number | Action | Hazard(s) | Lead Agency | Potential Partners | Benefits (Losses Avoided) | Cost Estimate | Funding Source | Time Frame | Priority | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| | reduce landslide and slope failure damage to critical infrastructure and buildings | | | | and follows policy to avoid repetitive loss properties | | | | | |
| 15 | Leverage WebEOC and GIS to track the spread of contagious disease | Public health epidemics/pandemics | SLCo Health Dept | SLCo EM, UFA, MSD, UPD, Sheriff's office, local jurisdictions | Use GIS and WebEOC software to maintain situational awareness and track illnesses throughout the county. | Unknown | SLCo EM, grant program, local jurisdictions, SLCo Health Dept, State of Utah | 1–3 years | Medium | County/local jurisdictions already have existing software; improved training/documentation required |
| 16 | Create public awareness campaigns and public education programs on radon risks and provide home testing for radon | Radon | SLCo EM | Aging & Adult Services, SLCo Health Dept, local jurisdictions | Decrease radon-caused cancer deaths; increase engagement/understanding with the public on what SLCo can do or help with | Unknown | SLCo, local jurisdictions, State of Utah | 1–3 years | Low | |
| 17 | Develop road resurfacing project to include permeable pavement for areas with rain-based flooding | Severe weather: heavy rain | SLCo PW | SLCo Parks and Recreation Dept, MSD, local jurisdictions | Reduce pollutants discharged in runoff; reduce maintenance time/costs on roads; improve traction on roads | Unknown | SLCo, UDOT, grant program | 5 years | Low | |
| 18 | Create a public education program for property owners to learn about | Severe weather: high winds | SLCo EM | Aging & Adult Services, SLCo PW, UFA, local jurisdictions, MSD | Reduce damage to critical infrastructure during high wind events; prevent personal injuries (people driving on roads or walking | Unknown | SLCo PW, SLCo EM, UFA | 1–3 years | Low | |

| Number | Action | Hazard(s) | Lead Agency | Potential Partners | Benefits (Losses Avoided) | Cost Estimate | Funding Source | Time Frame | Priority | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| | tree maintenance and high-strength windows | | | | in neighborhood); improve relationships with stakeholders and the public | | | | | |
| 19 | Develop a severe winter weather mitigation program to maintain access to primary roadways and evacuation routes | Severe winter weather: heavy snow, blizzards | SLCo PW for the MSD, Taylorsville, Millcreek, and Holladay<br><br>Local jurisdiction public works for all others | SLCo EM, local jurisdictions, MSD, UDOT | Emergency services like police, fire, and paramedics can utilize roads to provide their services. | Unknown | MSD, Taylorsville, Millcreek, Holladay, local jurisdictions | 1 year | High | A severe winter storm with heavy snowfall requires our operators and equipment to be used to clear roads and streets for the public and emergency vehicles to use. The primary efforts will be to keep the roads open by clearing snow. |
| 20 | Conduct public awareness campaign about lightning safety | Severe weather: lightning | SLCo EM | SLCo Parks and Recreation, UFA, SLCo PW, local jurisdictions, MSD | Lightning strike awareness for the public | Unknown | SLCo, MSD, local jurisdictions | 1–3 years | Low | |
| 21 | Improve outreach for "see something, say something" QR code to deter terrorist acts | Terrorism (including cyberattacks) | SLCo Sheriff's office | SLCo EM, UPD, UFA, MSD, local jurisdictions, SLCo IT | Ensure residents and local agencies/jurisdictions are aware of local intelligence resources and how to report suspicious activity; encourage QR code use/outreach at special events throughout the county | Unknown | SLCo EM, local jurisdictions | 1–3 years | Medium | |
| 22 | Develop a countywide intelligence group/division to monitor and analyze threats prior to an | Terrorism (including cyberattacks) | SLCo EM | Local jurisdictions, SLCo Sheriff's office; Statewide Information & Analysis Center (SIAC); Department of Homeland Security | | $50K | Grants, SLCo, local jurisdictions | 1–3 years | Medium | This would be a core group of stakeholders that meet on a regular basis to share and collaborate on intelligence data. |

| Number | Action | Hazard(s) | Lead Agency | Potential Partners | Benefits (Losses Avoided) | Cost Estimate | Funding Source | Time Frame | Priority | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| | incident occurring | | | (DHS); Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF); Federal Bureau of Investigation (FBI) | | | | | | |
| 23 | Code enforcement: review critical infrastructure facilities to ensure building materials are up to code and tornado-resistant | Tornadoes | SLCo EM | MSD, local jurisdictions, SLCo PW | Ensure critical infrastructure facilities are operational/functional in the event of a disaster; preserve life and safety | Unknown | SLCo EM, MSD, local jurisdictions, UFA | 1–3 years | Low | |
| 24 | Enhance interoperable radio communications systems throughout the county | Avalanches, civil disturbances, dam failures, drought, earthquakes, extreme heat, floods, hazardous materials incidents, heavy rain, high winds, landslides, lightning, public health epidemics, radon, severe winter weather, terrorism, tornadoes, wildfires | SLCo EM | Local jurisdictions, UFA, UPD, Sheriff's office | Improved communication between different agencies; common operating platform | Unknown | SLCo EM, local jurisdictions | 1–3 years | Medium | |
| 25 | Develop a countywide single source of information sharing/gathering for intelligence | Civil disturbance, terrorism | SLCo EM | Local jurisdictions, SLCo Sheriff's office, SIAC | Improved coordination between local agencies/jurisdictions | $100K | Grants, county, local jurisdictions | 1–3 years | Medium | Have one common operating platform to be used by all agencies in Salt Lake County to collect suspicious activity reports; develop a public awareness |

| Number | Action | Hazard(s) | Lead Agency | Potential Partners | Benefits (Losses Avoided) | Cost Estimate | Funding Source | Time Frame | Priority | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | campaign to educate the public on how and what to report |
| 26 | Install xeriscaping on government-owned buildings | Drought | SLCo facilities | Water companies/districts, local jurisdictions, MSD, State of Utah | Decrease the cost of landscape irrigation, decrease water usage | Unknown | SLCo facilities, State of Utah, local jurisdictions, MSD | 1–3 years | Low | |
| 27 | Improve communication to the public and stakeholders on resources available when Code Blue is in effect during severe winter weather | Severe winter weather | SLCo EM | Local jurisdictions, Office of Homeless and Criminal Justice Reform | Prevent further damage to critical infrastructure; ensure homeless individuals have warming resources available, offload some of the pressure on local homeless resource providers with standard protocols to follow with Code Blue | Unknown | SLCo EM, SLCo Health Dept, State of Utah | 1–3 years | Low | |
| 28 | Surplus canal rehabilitation | Floods | Flood Control Engineering | FEMA, State of Utah, SLC, SLC airports | Unknown | $500K+ | FEMA's BRIC grant, State of Utah, SLCo, local jurisdictions | 5 years | High | |

# NFIP-Specific Mitigation Actions and Implementation

The following mitigation strategy demonstrates Salt Lake County and its participating jurisdictions' continued support and compliance with National Flood Insurance Program (NFIP) requirements, as appropriate.

- Countywide Action—Help County Jurisdictions Procure FMA Grants

Other priorities within Salt Lake County related to NFIP participation include:

1. Increased Community Rating System (CRS) participation throughout the county
2. Increase in the number of flood insurance policies
3. Increased number of Certified Floodplain Managers (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 the respective capability assessments.

# 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 Code of Federal Regulations [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. Salt Lake County Emergency Management 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 Mechanisms

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 Salt Lake County Multi-Jurisdictional Hazard 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 may 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 for annual reviews of the 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. Salt Lake County Emergency Management, which will regularly monitor the plan, is responsible for making 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 Salt Lake County Emergency Management, 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 Salt Lake County Emergency Management Hazard Mitigation Officer, the Local Mitigation Committee, or the Mayor/City Manager of an affected community will initiate amendments and updates to the Plan.

Upon initiation of an amendment to the plan, Salt Lake County Emergency Management 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 Emergency Management website www.slcoem.org. The review and comment period for the proposed plan amendment will last for not less than 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. Salt Lake County Emergency Management will review the proposed amendment along with comments received from other parties and submit a recommendation to the Utah State Hazard Mitigation Officer and FEMA within 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.
- New issues or needs have been identified which were not adequately addressed in the plan.
- 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 Salt Lake County Emergency Management, a public hearing will be held. Salt Lake County Emergency Management will review the recommendation (including the factors listed above) and any oral or written comments received at the public hearing. Following that review, Salt Lake County Emergency Management 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 Disaster Mitigation Act (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's 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 Salt Lake County Emergency Management.

Salt Lake County Emergency Management 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. Limited resources make it difficult to identify and individually contact all the people and agencies that may stand to benefit from the plan. Because of this, the following course of action has been established.

- **Step 1:** Salt Lake County Emergency Management 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, because 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, Salt Lake County Emergency Management 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, Salt Lake County Emergency Management 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, and phone call. In addition, every public jurisdiction advertises and conducts public hearings on their planning and budget, 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 Salt Lake County Emergency Management 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. Salt Lake County Emergency Management will take whatever actions possible to accommodate individuals including the impaired, non-English speaking, persons of limited mobility, and others with special needs.

### 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 Salt Lake County Emergency Management that may be adopted as part of the plan by reference. Salt Lake County Emergency Management 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. Salt Lake County Emergency Management staff will assist to the extent practical; however, limited staff time and resources may prohibit staff from giving all the assistance requested. Salt Lake County Emergency Management 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 the following:

- Continuation of the search for more specific mitigation actions
- An analysis of progress of the plan as it is revised

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