CHAPTER 3

Hazard Identification

Hazard Identification

The hazards identified in this SHMP update were based on the previous state mitigation plans, local hazard mitigation plans, and past natural hazard events. The old hazard list was reviewed by the SHMPC in several meetings and also discussed at SHMT meetings to gather input, receive expert opinion, and solicit comments. A newly updated natural hazards listed was created based on the comments and suggestion gathered during the update process. It was decided that Avalanche be its own hazard separate from Severe Weather. A newly created Geologic Hazards chapter would be produced that combined Earthquakes and Landslides, as well as many other geologic hazards. The rest of the hazards would be kept that were identified from the 2014 SHMP.

The 2019 SHMP update addresses the following major natural hazards:

- Avalanche
- Dam Failure
- Drought
- Geologic Hazards (Earthquake, Landslides, etc.)
- Flood
- Severe Weather
- Space Weather
- Wildfire

Challenges in conducting hazard identification and risk assessment analyses continue to include a lack of data availability, lack of current and frequently updated data, conflicting data, and insufficient tools available to conduct detailed and thorough analyses.

PROBABILITY AND RECURRENCE INTERVAL

Various probabilities and recurrence intervals were calculated for many hazards identified in the plan based on the different categories as a result of the different data sets available.

Based on the histories and profiles of the aforementioned hazards, the recurrence interval and frequency were determined. The recurrence interval was calculated by dividing the number of years observed for each hazard by the number of events reported. The hazard probability was calculated by dividing the number of events observed by the number of years. For more information see the specific hazard chapter.

Table 1. Utah Hazard Recurrence and Probability

Hazard	Years	Number of Events	Years in Record	Recurrence Interval (years)	Hazard Probability/Year
Avalanche (fatalities)	1958-2017	116	60	0.52	193%
Dam Failure (events)	1963-2018	6	56	9.3	11%
Drought (< -0.5 PDSI)	1895-2017	54	123	2.3	44%
Drought (< -1.0 PDSI)	1895-2017	34	123	3.6	28%
Drought (< -2.0 PDSI)	1895-2017	17	123	7.2	14%
Drought (< -3.0 PDSI)	1895-2017	5	123	24.6	4%
Drought (< -4.0 PDSI)	1895-2017	1	123	123	0.8%
Earthquakes (≥ 3.0)	1850-2017	1327	168	0.1	790%
Earthquakes (≥ 4.0)	1850-2017	223	168	0.8	133%
Earthquakes (≥ 5.0)	1850-2017	60	168	2.8	36%
Earthquakes (≥ 6.0)	1850-2017	10	168	16.8	6%
Earthquakes (≥ 7.0)	1850-2017	1	168	168	0.6%
Floods	1996-2017	931	22	0.02	4231%
Flash Flood	1996-2017	799	22	0.03	3631%
Flood (injuries)	2000-2017	23	18	0.8	127%
Flood (fatalities)	2000-2017	30	18	0.6	167%
Lightning (fatalities)	1950-2018	67	69	1	97%
Lightning (injuries)	1950-2018	161	69	0.4	233%
Thunderstorm Wind Events (> $50,000 in damage)	1955-2018	45	64	1.4	70%
Tornadoes (observed)	1869-2018	134	150	1.1	89%
High Wind Events (>$50,000 in damage)	2006-2017	19	12	0.6	158%
Hail Events (recorded damage)	1993-2017	32	25	0.8	128%
Ice Storms	1996-2018	3	23	7.7	13%
Heavy Storms (>$50,000 in damage)	1962-2018	61	57	0.9	107%
Dense Fog Events	1996-2018	91	23	0.3	396%
Wind Chill Events (major)	1996-2018	6	23	3.8	26%
Heat Events (fatalities)	2005-2018	7	14	2	50%
Wildfire (>100,000 total burned acres/year)	2002-2016	8	15	1.9	53%
Wildfire (avg. of 100 acres/fire)	2002-2016	5	15	3	33%
Wildfire (fatalities)	1950-2017	22	68	3.1	32%
Wildfire (FMAG declaration)	2003-2018	21	16	0.8	131%

Avalanche data from Utah Avalanche Center, Dam Failure data from Utah Division of Emergency Management, Drought data from NOAA, Earthquake data from University of Utah Seismograph Stations, Flood data from Public Health Indicator Based Information System, Severe Weather data from NOAA, Wildfire data from National Interagency Fire Center, Utah Forestry, Fire, & State Lands, Utah Division of Emergency Management.

An analysis derived from HAZUS-MH of exposed value of residential and non-residential structures by county shows that Utah has around 195 billion dollars in residential value and 54 billion dollars in non-residential value for a total of around 250 billion dollars. The counties with the highest values include Salt Lake, Utah, Davis, Weber, and Washington counties.

Table 2. Total Estimated Exposed Value Per County

County	Residential Value	Non-Residential Value	Total Building Value
Beaver	$441,744,000	$130,675,000	$572,419,000
Box Elder	$3,383,157,000	$828,738,000	$4,211,895,000
Cache	$6,773,344,000	$2,307,624,000	$9,080,968,000
Carbon	$1,508,943,000	$485,995,000	$1,994,938,000
Daggett	$125,097,000	$25,304,000	$150,401,000
Davis	$22,328,303,000	$4,685,119,000	$27,013,422,000
Duchesne	$1,660,528,000	$359,267,000	$2,019,795,000
Emery	$706,705,000	$200,292,000	$906,997,000
Garfield	$571,487,000	$218,196,000	$789,683,000
Grand	$708,879,000	$337,444,000	$1,046,323,000
Iron	$2,884,616,000	$942,022,000	$3,826,638,000
Juab	$664,989,000	$259,952,000	$924,941,000
Kane	$836,847,000	$215,752,000	$1,052,599,000
Millard	$880,869,000	$301,399,000	$1,182,268,000
Morgan	$737,264,000	$167,842,000	$905,106,000
Piute	$134,933,000	$32,702,000	$167,635,000
Rich	$486,755,000	$55,866,000	$542,621,000
Salt Lake	$74,079,664,000	$24,604,780,000	$98,684,444,000
San Juan	$755,552,000	$230,903,000	$986,455,000
Sanpete	$1,835,901,000	$666,313,000	$2,502,214,000
Sevier	$1,509,720,000	$412,897,000	$1,922,617,000
Summit	$5,693,966,000	$1,024,772,000	$6,718,738,000
Tooele	$4,187,635,000	$621,880,000	$4,809,515,000
Uintah	$2,293,741,000	$540,599,000	$2,834,340,000
Utah	$30,557,508,000	$8,197,500,000	$38,755,008,000
Wasatch	$2,344,458,000	$389,906,000	$2,734,364,000
Washington	$10,009,325,000	$2,231,927,000	$12,241,252,000
Wayne	$266,918,000	$70,734,000	$337,652,000
Weber	$16,930,541,000	$4,122,687,000	$21,053,228,000
Total	$195,299,389,000	$54,669,087,000	$249,968,476,000

State-Owned Facilities

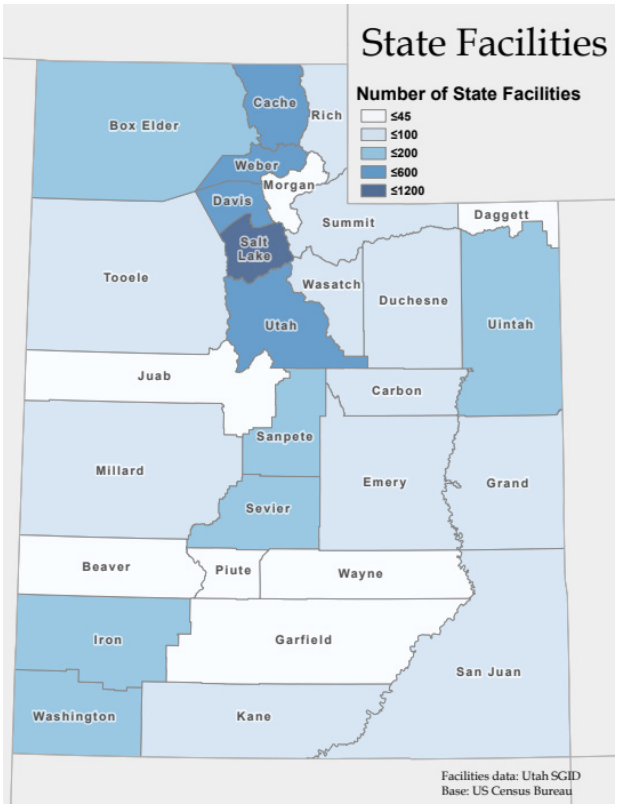
One of the requirements in DMA 2000 is to assess the state-owned facilities and their potential vulnerability to particular hazards. Utah Division of Risk Management provided a geocoded list of state-owned facilities and their total current use value. The list of state-owned facilities used for the 2019 SHMP update including the risk assessment includes 5,695 facilities. It should also be noted that the 5695 facilities includes not only buildings, but also shacks, sheds, outhouses, gravel yards, etc.

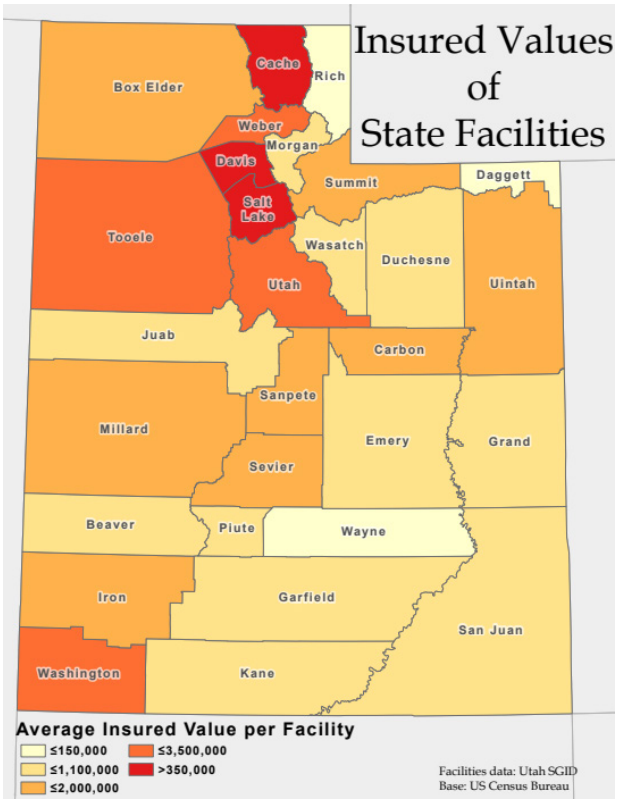
Table 3. State-Owned Facilities and Their Insured Values

County	Count Facilities	Insured Value of Facilities
Beaver	35	$41,032,093
Box Elder	200	$298,041,925
Cache	613	$3,340,693,369
Carbon	113	$162,484,250
Daggett	20	$3,415,881
Davis	278	$1,393,256,017
Duchesne	72	$37,934,210
Emery	108	$41,071,459
Garfield	59	$20,808,298
Grand	81	$62,763,853
Iron	224	$490,154,483
Juab	41	$13,469,125
Kane	51	$15,679,404
Millard	78	$94,808,959
Morgan	48	$25,152,828
Piute	23	$4,841,000
Rich	84	$11,160,077
Salt Lake	1,463	$7,274,528,270
San Juan	111	$111,325,088
Sanpete	204	$437,926,899
Sevier	135	$209,506,871
Summit	128	$158,297,671
Tooele	89	$296,471,019
Uintah	117	$262,341,461
Utah	577	$2,272,452,584
Wasatch	178	$104,105,879
Washington	215	$620,545,353
Wayne	33	$4,730,187
Weber	317	$1,267,926,750
Total	5,695	$19,076,925,263

The counties with the highest number of state-owned facilities include Salt Lake, Utah, Davis, Weber, and Cache counties. The counties with the lowest number of state-owned facilities are “Beaver, Garfield, Juab, Morgan, Piute, and Wayne counties. Salt Lake, Davis, and Cache counties have the highest insured values of state-owned facilities and Wayne County has the lowest insured values of state-owned facilities.

Map 1 & 2. State-Owned Facilities and Insured Values of State-Owned Facilities





STATE FACILITY VULNERABILITY FROM 2014 TO 2019

A comparison of the vulnerability of state-owned facilities from the 2014 SHMP to the 2019 SHMP update shows several differences. However, a straight up comparison of the vulnerability of state-owned facilities will not show a completely accurate picture whether vulnerability has decreased or increased due to different methodologies involving the state facility database, newer hazard data, and analysis decisions involving the hazard data.

The 2019 SHMP update added a new chapter on avalanches and was able to run an analysis of state-owned facilities in avalanche zones which was not done for the 2014 SHMP. Therefore the vulnerability of state-owned facilities in avalanche zones became identified by number, value, and specific facility. In 2014 there was found over 1850 state-owned facilities in dam inundation areas for a total insured value of over $5.4 billion while for the 2019 SHMP update there was found just over a 1000 state-owned facilities in dam inundation areas with around $3.2 billion in insured value. In 2014, the methodology for assessing earthquake vulnerability of state-owned facilities was to calculate the expected building damage using peak ground acceleration (PGA) at 0.25 PGA (g) and 0.55 PGA (g). For the SHMP update, it was decided to calculate vulnerability of state-owned facilities to earthquakes by determining state-owned facilities that were near a Quaternary fault (within 0.5 miles) and those facilities that were in liquefaction zones. This yielded a result of over 1200 state-owned facilities near a Quaternary fault for an insured value of over $5.4 billion and over 1300 state-owned facilities in liquefaction zones for a total insured value of around $5.4 billion.

For flood hazards, the 2014 SHMP showed just over 400 state owned facilities in designated flood zones with a total insured value of over $1.1 billion. These numbers decreased for the 2019 SHMP update analysis that shows 340 state-owned facilities in designated flood zones for a total value of over $850 million.

The landslide vulnerability between the 2 plans varies greatly due to a different approach to the analysis. The 2019 SHMP update analyzed all state facilities that were in any landslide susceptibility area. The results show over 5100 state-owned facilities in landslide susceptibility areas for a total insured value of over $16.6 billion. The 2019 SHMP included a new analysis on problem soils not done in the 2014 SHMP and shows over 1700 state-owned facilities on problem soils for a total insured value of over $5.6 billion. Finally, the results between the 2014 SHMP and 2019 SHMP show a decrease in vulnerability of state-owned facilities to wildfire. In 2014, the analysis shows over 2000 state-owned facilities at risk to wildfire, while the 2019 analysis has over 1000 facilities at risk.

Table 4. State-Owned Facilities Vulnerability from 2014 to 2019

Hazard	2014 SHMP		2019 SHMP	
	State Facilities	Insured Value of State Facilities*	State Facilities	Insured Value of State Facilities*
Avalanche	n/a	n/a	442	$1,512,371,298
Dam Failure	1859	$5,464,778,452	1018	$3,259,132,534
EQ - 0.25 PGA (g)	6717	$1,650,870,610	n/a	n/a
EQ - 0.5 PGA (g)	6717	$7,439,154,505	n/a	n/a
EQ - near a fault	n/a	n/a	1232	$5,405,887,143
EQ - liquefaction	n/a	n/a	1316	$5,399,772,307
Flood	405	$1,126,457,873	340	$859,701,341
Landslide	1275	$1,972,784,860	5116	$16,614,637,823
Problem Soils	n/a	n/a	1730	$5,691,170,867
Wildfire	2069	$2,759,560,010	1059	$1,575,032,324

*For EQ - PGA (g): The amount is the expected building damage at Peak Ground Acceleration (PGA) and not insured value.

Since 2014, great effort has been made to ensure that state-owned facilities comply with proper floodplain management regulations. The state floodplain coordinator has met with and given flood training and technical assistance to state agencies responsible for overseeing state-owned facilities with the goal to reduce vulnerability from floods in the future to state-owned facilities.

Several state-owned facilities and other infrastructure have been seismically retrofitted, including the Utah State Capitol building. The Utah Geological Survey has made extensive efforts to monitor landslides throughout the state.

Presidential Disaster Declarations

Looking at the history of presidentially declared disasters can help determine the hazards that pose some of the most significant hazards in Utah's recorded history. Once a disaster has occurred, and a State has declared a state of emergency, the State will evaluate the recovery capabilities of the State and local governments. If it is determined that the damage is beyond their recovery capability, the governor will usually send a request letter to the President, directed through the Regional Director of the appropriate FEMA region. The President then makes the decision whether or not to declare a major disaster or emergency. Presidential Disaster Declarations were first proclaimed in 1953.

After a presidential declaration has been made, FEMA will designate the area eligible for assistance and announce the types of assistance available. FEMA provides supplemental assistance for State and local government recovery expenses, and the Federal share will always be at least 75 percent of the eligible costs (www.fema.gov).

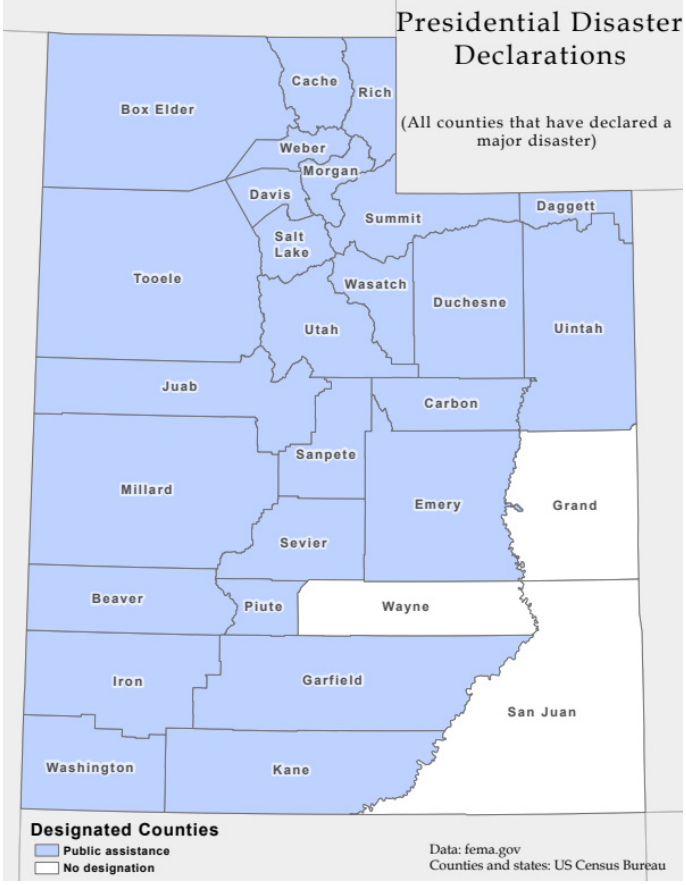
UTAH'S PAST PRESIDENTIAL DISASTER DECLARATIONS

Utah has received eleven presidential disaster declarations. What follows is a brief history and explanation of the past presidential declarations (from year to year) in Utah:

Table 5. Utah's Past Presidential Declarations

#	Year	Description	Declaration No.
1	1983	Severe Storms, Landslides, Flooding	DR-680
2	1984	Severe Storms, Mudslides, Landslides, Flooding	DR-720
3	1986	Heavy Rains, Snowmelt, Flooding	DR-760
4	1989	Quail Creek Dam Failure	DR-820
5	1999	Salt Lake City Tornado	DR-1285
6	2005	Severe Storms and Flooding	DR-1576
7	2005	Utah Flood and Landslide	DR-1598
8	2011	Severe Winter Storms and Flooding	DR-1955
9	2011	Flooding	DR-4011
10	2012	Severe Storm	DR-4053
11	2012	Severe Storm and Flooding	DR-4088
12	2017	Severe Winter Storms and Flooding	DR-4311

Map 3. Counties and Presidential Disaster Declarations



1983 Severe Storms, Landslides, Flooding (DR-680)

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

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

Overall damage totaled $621 million (*Stephens, 1984, p. 20-36*). No deaths were attributed to the floods.

1984 Severe Storms, Mudslides, Landslides, Flooding (DR- 720)

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

1986 Heavy Rains, Snowmelt, Flooding (DR-760)

On March 13, 1986 a major disaster declaration was issued for four counties in Utah. From the period of February 12, 1986 to February 22, 1986 heavy rains and snowmelt brought rare February flooding to many areas of northern Utah. Cache, Morgan, Wasatch, and Weber counties were declared disaster areas with property damage totaling almost $4 million (*UtahWeather.org*).

1989 Quail Creek Dam Failure (DR-820)

The Quail Creek Dam, located in Washington County Utah, failed in the early hours of January 1, 1989. In the months prior to the failure, the dam had been leaking as a result of the solubility of the gypsum in the soil, which dissolved some of the mechanisms used to transport water. Despite crew efforts, leakage of the dam continued before the dam gave way. Failure of Quail Creek Dam resulted in losses to agriculture and livestock, as well as negative impact to public facilities, roads, bridges, and golf courses. 30 homes, 58 apartments and 9 businesses were flooded. In addition, a reduction in the population of wound fin minnow, a type of fish that is listed on the endangered species list, resulted from the dam failure. $1,133,721 was provided for public assistance with a federal share of $850,294.

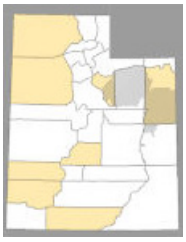
1999 Salt Lake City Tornado (DR-1285)

On August 11, 1999, a tornado moved through downtown Salt Lake City. The tornado developed on the western side of downtown and moved northeast before expiring near Memory Grove Park. The tornado, ranked a strong F2 on the Fujita Scale, resulted in 1 death and 80 injuries. 300 buildings or houses were damaged, with 34 of the homes left uninhabitable. In addition, 500 trees were destroyed, as was a portion of Memory Grove Park. Total damage estimates for this storm are $170 million and federal assistance was provided.

2005 Severe Storms and Flooding (DR-1576)

A stalled storm-system containing abundant moisture caused significant flooding in Washington and Kane Counties in Southern Utah between January 8 and 12, 2005. The storm brought rain and snow throughout much of the State, causing additional precipitation to accumulate in areas already containing deep snow pack. Higher snowfall and water equivalent totals equaled 70" at Cedar Breaks, 60" at Kolob-Zion Park, and 58" at Alta. It is estimated that $300 million dollars in damages was sustained along the Santa Clara and Virgin Rivers in Washington County. 30 homes were destroyed in the flood and another 20 homes were significantly damaged (NCDC, 2005). One fatality associated with this event resulted when a man and his wife inside their vehicle were caught in floodwaters in the Red Cliff Recreation Area near the Quail Creek Reservoir. Six other injuries were reported. Two additional fatalities resulted from avalanches that occurred after the storm. The avalanches occurred primarily due to the considerable amount of wet, heavy snow that fell in the higher mountain elevations during these storms (*UtahWeather.org*). A Presidential Disaster Declaration was declared February 1, 2005.

2005 Utah Flood and Landslide (DR-1598)

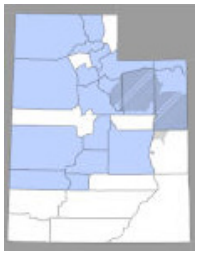


During the period of April 28, 2005 until June 29, 2005, frequent rainfall events, warm spring temperatures, and abundant snowpack melting at accelerated rates resulted in significant flooding and numerous landslide events in nine Utah counties and two Indian Reservations. According to the USGS, on April 28, 2005, localized precipitation, believed to be a rain-on-snow phenomenon, caused flooding in southern Cache Valley in the Lower Bear River basin. Peak discharge in the Little Bear River for this event exceeded the 100-year recurrence interval. Large peak discharges in spring of 2005 in the Duchesne and Sevier River basins were the result of near record snowpack. (USGS, 2005). Total damages resulting from the flooding and landslide incidents are estimated to be over 2.9 million dollars. No deaths have been attributed to the flooding and landslide events. These events caused substantial damage to public and private property. In addition, many miles of roads were destroyed, bridges were damaged, and concerns of health risks, such as vector-borne diseases transmitted by mosquitoes, arose. A Presidential Disaster Declaration was declared on August 1, 2005 and included Beaver, Box Elder, Iron, Kane, Sevier, Tooele, Uintah, and Wasatch counties and the Uintah and Ouray Indian Reservations.

2011 Severe Winter Storms and Flooding (DR-1955)

Winter storms from December 20 to December 24, 2010, brought 16.4 inches of rainfall and 15.3 inches of snow, resulting in the flooding of parts of Garfield, Kane and Washington counties. The precipitation in Kane and Washington counties was record breaking. Washington County's Emergency Operation Center was activated on December 20 to deal with the flooding. The severe winter storms and flooding caused damage to homes, bridges, roads, utility systems, parks, trails and other public facilities. Two dams were evaluated for the threat of failure. Hundreds of residents were also evacuated. Estimated damage was $6 million. A Presidential Disaster Declaration was declared on February 11, 2011 (*www.fema.gov, www.deseretnews.com*).

2011 Flooding (DR-4011)



On August 8, 2011, a Presidential Disaster Declaration was proclaimed as a result of flooding during the period of April 18, 2011, to July 16, 2011. Public Assistance was declared for 18 counties and 1 Indian reservation: Beaver, Box Elder, Cache, Daggett, Duchesne, Emery, Millard, Morgan, Piute, Salt Lake, Sanpete, Sevier, Summit, Tooele, Uintah, Utah, Wasatch and Weber counties and the Uintah and Ouray Reservation. Estimated damage from the flooding was $12.7 million. The causes of the widespread flooding include a record breaking snowpack in certain areas, heavy spring rains (especially in April), and warm temperatures in the summer that led to increased runoff into rivers and streams (*www.fema.gov, www.sltrib.com*).

2012 Severe Storm (DR-4053)

A severe storm with hurricane force winds (up to 104 mph) affected Davis, Salt Lake and Weber Counties late in the evening of November 30, 2011, and throughout the day on December 1, 2011. The high winds uprooted and knocked down thousands of trees, led to closure of public schools, caused widespread power outages, and damaged public infrastructure and entities. Davis County was the hardest hit. The Governor requested support from the Utah National Guard to augment the recovery process and protect the community through collection, removal and disposal of debris from the public Rights-Of-Way. In addition, thousands of local volunteers assisted with cleaning up debris. Estimated damage to public infrastructure was $4.1 million. A Presidential Disaster Declaration was proclaimed for Davis County on February 1, 2012. (*www.fema.gov, www.deseretnews.com*).

2012 Severe Storm and Flooding (DR-4088)

On September 11, 2012, an extreme monsoon rain storm created overland flood water through Washington County and caused damage primarily to the City of Ivins, the City of Santa Clara and the City of St. George. These heavy rains led to the failure of the Laub Detention Dam in the City of Santa Clara. The dam was constructed in 1919 of local materials. There persist ongoing investigations into the cause of the dam break. In the April 2012 report from a regular inspection of the dam, the Utah Division of Water Rights inspector stated, "in general, the dam is in good condition and well maintained." The same report mentions "active rodent burrows were noted on both the upstream and downstream slopes" in the 'Necessary Maintenance and Repair' section of the report (Source: Utah DWR DAMVIEW Dam Safety Database Information Viewer). A total of 66 homes, 18 businesses, and numerous roads, sidewalks, sewer lines and golf courses were damaged (www.utah.gov). Estimated damage to public infrastructure was $3.9 million dollars. A Presidential Disaster Declaration was declared for Washington County on November 3, 2012 (*www.fema.gov)*.

2017 Severe Winter Storms and Flooding (DR-4311)

During the period of February 7-27, 2017 several weather systems moved through Utah bringing unseasonably warm temperatures and over four inches of rain on top of an above average snowpack. Unable to be absorbed by previously saturated and frozen soils, the melting snow and rain caused widespread overland sheet flooding, soil erosion, and landslides. On April 6, 2017, Governor Gary R. Herbert requested a major disaster declaration for Box Elder and Cache counties. While not reaching their disaster impact thresholds the counties of Rich, Weber, Utah, and Morgan were also affected by the event. The preliminary disaster damage assessment identified $5.983 million in statewide damage to public infrastructure. Presidential Disaster Declaration DRUT4311 was approved on April 21 2017, providing $3.311 million in Federal Public Assistance funding for Box Elder and Cache County infrastructure recovery.

Hazard Consequence and Impact Analysis Matrix

IMPACT ON PUBLIC

Historically hazard events in Utah tend to be small to moderate in size. In some instances, widespread flooding would be considered extremely significant. However, it would not necessarily reach catastrophic levels. A magnitude 7.0 earthquake or greater along the Wasatch Front would be considered catastrophic.

Perhaps the hazard with the greatest impact on the public (in terms of numbers of individuals adversely affected statewide) would be an emerging disease/pandemic outbreak or a terrorism event that included a nuclear dispersion device.

IMPACT ON RESPONDERS

Impact on responders was evaluated based on existing mutual aid and the ability to utilize the Emergency Management Assistance Compact (EMAC), although there was an evaluation regarding the impact of responders as it relates to an emerging disease/pandemic outbreak or detonation of a nuclear explosion.

CONTINUITY OF OPERATIONS

Communities and the state continually develop and update their Continuity of Operations Plans (COOP) in the event facilities and/or agencies are impacted. State agencies also maintain disaster recovery plans which are largely IT focused. It is expected that affected agencies would exercise their COOP as appropriate. Private sector businesses are encouraged to develop business continuity plans, but they are not mandated by the state.

PROPERTIES, FACILITIES AND INFRASTRUCTURE

The SHMP has attempted to collect and create risk assessments and vulnerability analyses for the different hazards it profiled. One should take into consideration when using the data that dollar damage and facilities affected as a state, regional or local property, facilities and infrastructure should be used independently for comparison.

ENVIRONMENT

Any hazard event has the potential for environmental impact. Flood events, for example, may result in the pollution of streams and rivers due to combined sewage overflows and a tornado or wind event will disperse materials, trash and debris over a widespread area. A drought may affect the environment in a different way by drying up wetlands and weakening or killing trees and forestlands. An earthquake can destroy and disrupt numerous parts of the environment that may take years to address and recover. The four hazards that have a significant potential for environmental impact are: nuclear detonation/dispersion, emerging disease/pandemic outbreak, earthquakes and flood events.

ECONOMIC

Utah's economy continues to diversify, so most hazards would not result in a statewide catastrophe. The economic impacts, while potentially severe, would be recoverable. From a geographic perspective, an event affecting the densely populated Salt Lake Valley would have a greater impact than a hazard affecting other areas of the state. An event affecting Salt Lake City, the seat of state government, could have a significant impact on Utah's economy by impacting the processing of payments to citizens for a variety of state and federal programs. Similarly, an invasive species or pest affecting a specific crop statewide or a drought could have a more widespread detrimental effect on Utah's economy.

PUBLIC CONFIDENCE IN GOVERNANCE

Public confidence measures the trust that the public has in their government's ability to protect or respond to disasters or emergencies. The public must have confidence in their local government's ability to deal with natural disasters to trust the directives and guidance that their elected leaders are implementing to keep their communities safe.

Table 6. Utah Hazard Consequence and Impact Analysis Matrix

Hazard	Frequency of Occurrence	Public	Responders	COOP	Delivery Services	Property, Facilities, Infrastructure	Environment	Economics and Financial Conditions	Public Confidence in Governance
Avalanche	1	L	L	L	L	L	L	L	H
Dam Failure	5	H	M	M	M	H	H	H	H
Drought	3	L	L	L	L	L	H	H	H
Earthquake	4	C	H	H	H	H	M	C	M
Flooding	3	H	M	M	M	H	H	H	M
Landslides	4	H	M	L	M	M	H	L	M
Problem Soils	1	L	L	L	L	L	M	L	L
Radon Gas	1	H	L	L	L	L	L	M	L
Severe Weather	1	H	H	H	H	M	M	H	H
Space Weather	5	L	L	L	L	L	L	L	L
Wildfire	1	H	H	L	M	H	C	M	H

Frequency of Occurrence: Numerical Value	*Vulnerability Factor: Numerical Value*	*Public Confidence: Numerical Value*
Annual Event 1	Low L	Low L
Every 5 years or less 2	Moderate M	Moderate M
Every 10 years or less 3	High H	High H
Every 30 years or less 4	Catastrophic C	
Greater than 30 years 5		*Based on government's ability to protect or respond to disasters or emergency's*

Vulnerability Factor Measures				
Hazard	Catastrophic	High	Moderate	Low
Description of Loss	Widespread Extended time frame Results in more than 10 fatalities Results in greater than 50 injury's Irreversible environmental damage Closure to business for extended time frame	Widespread 1-10 fatalities 10-50 injury's Environmental damage Temporary economic impact	Localized No fatalities Less than 10 injuries Minimal to moderate environmental damage Minimal economic impact	Localized No damage to improved property No deaths No injuries Minimal damage to the environment No economic impact

Cultural Resources

The Emergency Management for Cultural Resources (EMCR) team consists of various state agencies with a common goal of protecting and preserving Utah's cultural resources. These Utah agencies include the Department of Administrative Services and the Department of Heritage and Arts; the Division of Arts and Museums, the Division of State History, the Division of State Library, the Division of Archives and Record Services, the Division of Facilities and Construction Management, the Division of Risk Management, the Division of Homeland Security; the Capitol Preservation Board and the University of Utah. These agencies house and support the unique documentation of Utah's history.

The Emergency Operations Center has a role in the EMCR team. Their role is to support and secure as much of the state's cultural and natural collections as possible. In support of ESF 11's mission, they assist in seeking funding to accomplish and procure the goals of the Cultural Resources Annex. By working together the EMCR team is able to share ideas that benefit the state.

Mitigation needs vary for each agency. Buildings in which artwork and other cultural resources are displayed or stored vary in capacity to withstand disasters. Each division within the EMCR team that houses cultural resources has identified threats to their collections. These threats include water, smoke, fire, excessive heat or cold, poor security, and any natural or man-made disaster. The divisions have also provided input as to the mitigation efforts needed and any efforts taken to minimize these threats. The buildings that house these unique collections are all in an earthquake zone and several of the buildings are located in a high water table area.

The Utah Division of Arts and Museums is responsible for the exhibition, shipment, storage, conservation and restoration of a collection of approximately 1400 artworks in a 114-year-old collection of Utah artists. This collection is valued at approximately $10M. This irreplaceable collection is in exhibition in several locations around the state with the vast majority in the Utah State Capitol, the Governor's Mansion, the Glendinning Mansion (home office) and the ArtHaus Storage facility.

Disaster mitigation needs for the ArtHaus consist of an analysis of the seismic survivability of the storage facility as well as the Glendinning Mansion. Additionally, the current storage facility needs fire suppression, floor and ceiling mounted screen storage system for art, floor-secured shelving with earthquake netting or bars, and regular and effective pest management.

The Utah Division of State History's collection is important because it is accessible to all of Utah's citizens and because of its diversity. State History has taken a number of steps to improve the storage conditions of its collection. Four post steel shelving was added to the photograph and manuscript storage rooms creating a more secure and stable platform, new flammable materials storage freezers were purchased to isolate and cool down deteriorating negatives, disaster kits were placed in all basement storage areas, and digital environmental monitors have been placed in storage areas to document environmental conditions and to build a case for improved collection storage. Mitigation needs include a seismic evaluation of the Rio Grande Depot, which houses the Department of Heritage and Arts and the Division of State History. Additional mitigation needs include improving the current shelving system by bracing shelving units to secure boxes, placing tops on shelving to protect collections, and padding around boxes. Collections in the basement storage areas are also at risk from underground water seepage. Walls and floors have been damaged in storage areas. Repairs and sealing of walls could improve the situation.

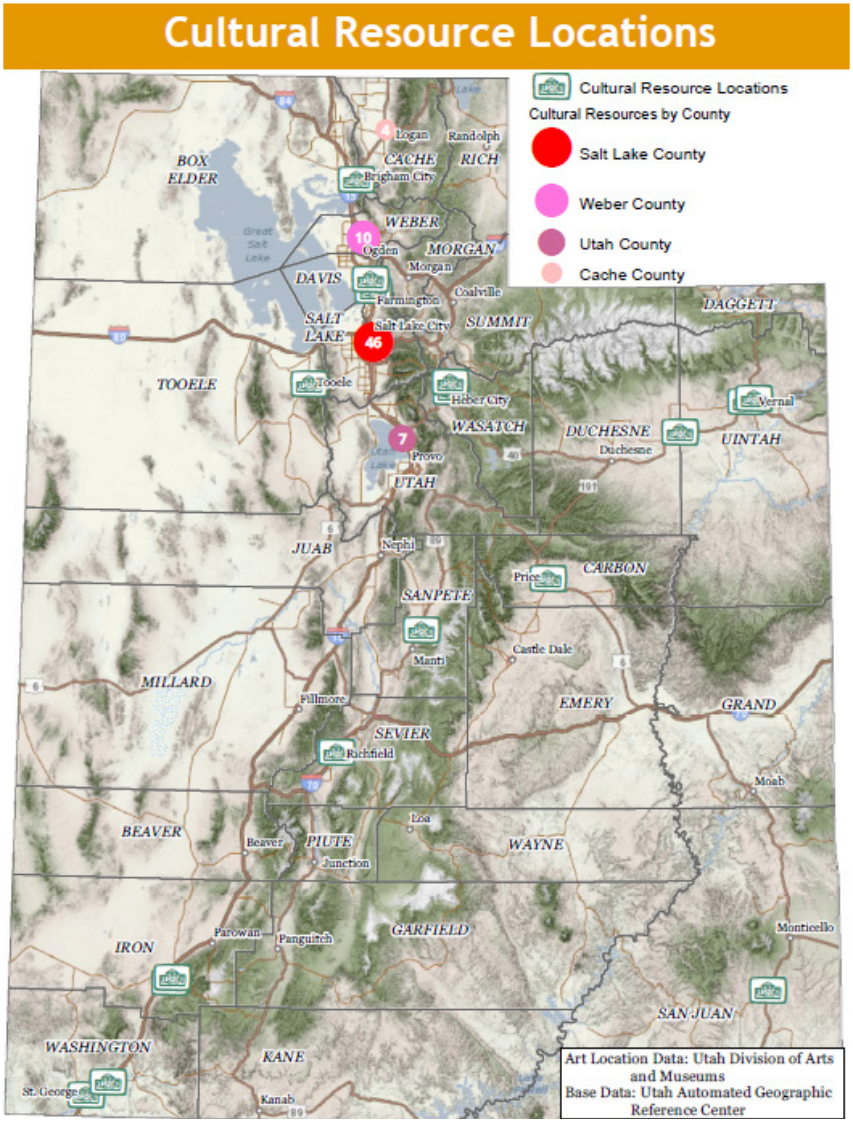
The Utah Division of Archives and Record Service is responsible for government records throughout the state. State records are essential to protecting life, property, and the rights of citizens. They also provide the informational infrastructure necessary to maintain order and accountability in government. In order to mitigate damage and ensure the preservation of the state's essential records, the Archives is committed to continuing its statewide preservation project for local governments. Most recently the Archives focused on microfilming cemetery records. They were able to capture a majority of the cemetery records, however, there are still more cemetery records to microfilm. The Archives is also working on microfilming city and county commission minutes for Tooele County. Additional records that need to be microfilmed include all local governments along the Wasatch Front. All local governments need "crash-kits" to secure the vital documents housed within their buildings following a disaster.

Mitigation needs for the building that the Division of State Archives and Record Service occupies include completing the conversion and upgrade of the fire-suppression system, installing security fencing, upgrading magnetic door locks, eliminating irrigated landscaping abutting the Archives Repository, upgrading the water drainage system, and installing a water alarm system. The mitigation needs at the State Records Center include working with DFCM and other funding sources to build a cold storage vault to house preservation microfilm.

The University of Utah has several cultural heritage organizations within its campus. Each organization houses unique and valuable collections. Needs for these organizations include re-hanging paintings on campus that do not currently conform to three-point security hanging techniques to mitigate potential earthquake damage. Additionally, the Spencer S. Eccles Health Sciences Library building needs to be seismically stable. The Natural History Museum of Utah, the Utah Museum of Fine Arts, and the Marriott Library all need to stabilize and build supports for fragile collections.

Other mitigation needs include ensuring collection records and documentation, both physical and digital, are properly preserved, providing training to improve awareness of hazardous materials in collections, and creating earthquake restraints for bookshelves to prevent rare, high-value collections from being thrown to the floor during an earthquake and subsequent aftershocks.

Map 4. Cultural Resource Locations



HISTORIC SITES

An often neglected aspect of natural hazards and their effects is historic sites. For the 2019 SHMP update the State Historic Preservation Office (SHPO) worked on upgrading their online historic sites database. This is a 30-year-old database (and 50-year-old data set) that has gone through several iterations over the years. Online access is now limited to select users only. A new online version, complete with GIS, is expected to be available.

The overall project includes the following:

- Evaluating all 128,000 records through various queries to identify duplicate records and missing data in some of the most important fields;
- Cleaning up data from 50 years of SHPO record keeping (reconciling thousands of duplicate/multiple records, correcting errors, updating addresses, etc.);
- Re-geocoding some 100,000 properties to improve the accuracy of the spatial data;
- Moving the data into an improved and more versatile data structure; and
- Scanning hard-copy site forms in our files for some 30,000 historic properties and linking those PDFs to the online database. (Most of the buildings in SHPO's database [98,000 of 128,000] have digital information only and do not have site forms with narrative descriptions and histories.)

For the SHMP update SHPO worked on advancing the project goals listed above and improving the quality of and access to the GIS data and other information about properties that are listed on or eligible for the National Register of Historic Places.* This includes approximately 1,400 individually listed National Register properties, 10,000 properties included in NR-listed historic districts, and another 50,000 properties evaluated as eligible for NR listing. (Data on some 57,000 other properties evaluated a "not eligible" are also included in the master data set, providing important "negative" results.)

SHPO provided a file of historic districts for the SHMP update and an analysis was performed. Salt Lake, Utah, Davis, Weber, and Sanpete counties have the highest number of historic districts. An analysis of state-owned facilities in historic districts shows that there are 244 state-owned facilities in historic districts with a value of $637,648,135. Salt Lake, Cache, Weber, and Garfield counties have the highest number of state-owned facilities in historic districts and Salt Lake, Utah, and Weber counties have the highest value of state-owned facilities in historic districts.

Map 5. Number of Historic Districts by County

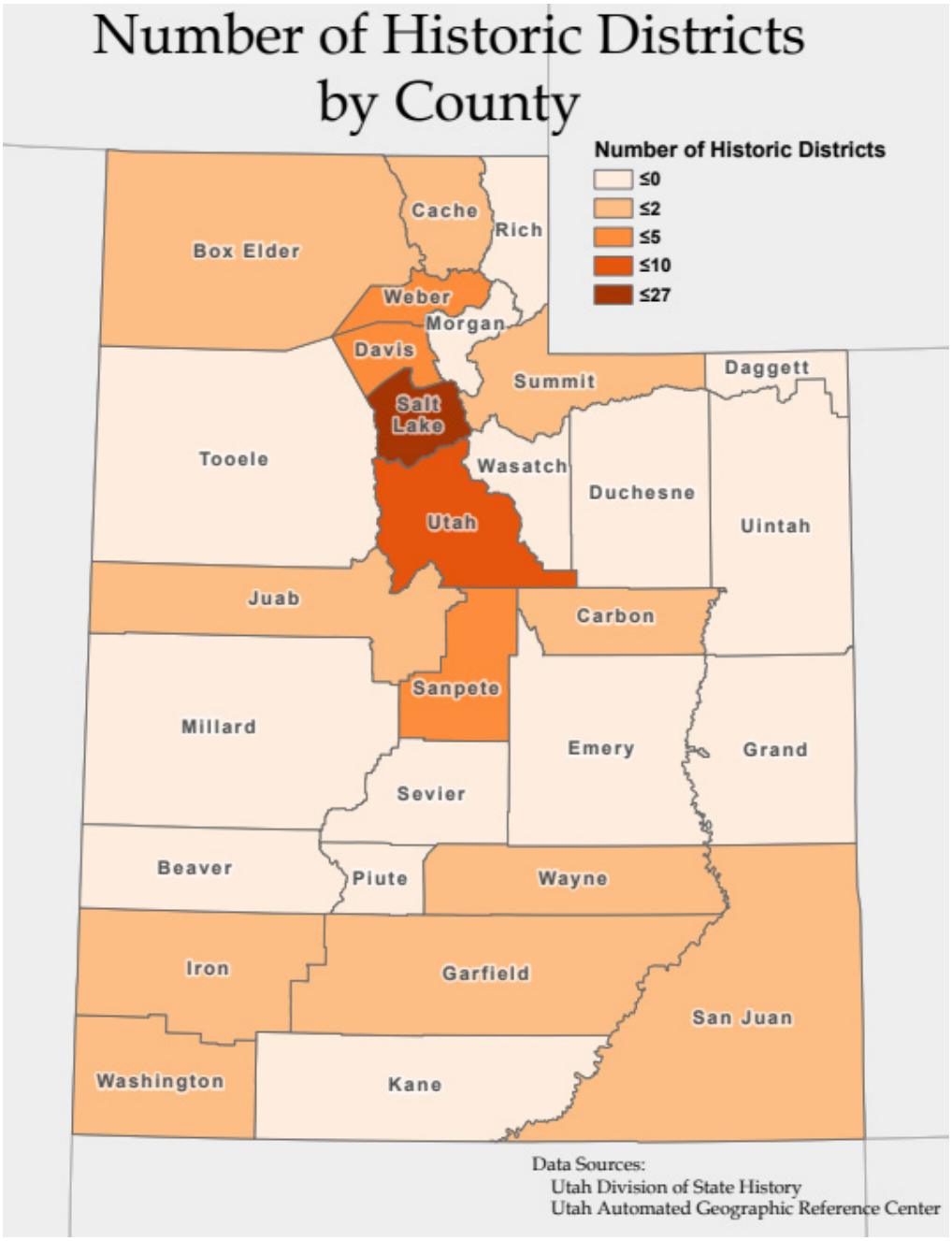
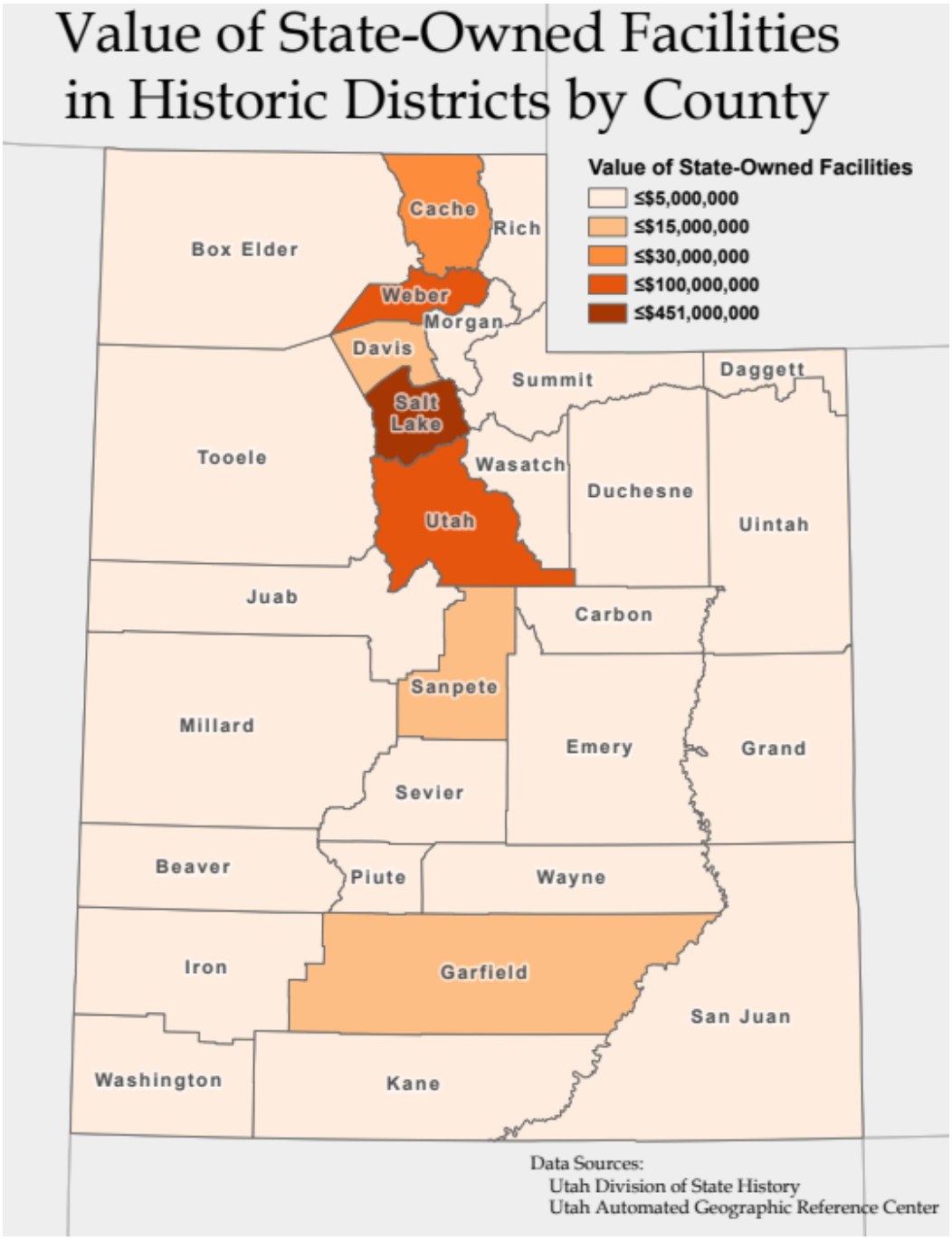


Table 7. Number and Value of State-Owned Facilities in Historic Districts

County	Facilities in Historic Districts	Insured Value of State Facilities
Beaver	0	$0
Box Elder	1	$205,400
Cache	14	$22,001,641
Carbon	6	$2,960,640
Daggett	0	$0
Davis	7	$14,591,250
Duchesne	0	$0
Emery	0	$0
Garfield	15	$12,360,633
Grand	0	$0
Iron	10	$2,279,862
Juab	0	$0
Kane	0	$0
Millard	0	$0
Morgan	0	$0
Piute	0	$0
Rich	0	$0
Salt Lake	159	$450,134,305
San Juan	2	$800
Sanpete	2	$5,593,534
Sevier	0	$0
Summit	0	$0
Tooele	0	$0
Uintah	0	$0
Utah	10	$30,410,805
Wasatch	0	$0
Washington	0	$0
Wayne	0	$0
Weber	18	$97,109,265
Total	244	$637,648,135

SOURCES: Utah AGRC, Utah Division of State History

Map 6. Value of State-Owned Facilities in Historic Districts



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