

HAZUS-MH: Earthquake Event Report

Region Name: Weber Segment Mw 7.0 ShakeMap Scenario

Earthquake Scenario: Weber Segment Mw 7.0 ShakeMap Scenario

Print Date: October 19, 2009

Totals only reflect data for those census tracts/blocks included in the user's study region.

Disclaimer:

The estimates of social and economic impacts contained in this report were produced using HAZUS loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific earthquake. These results can be improved by using enhanced inventory, geotechnical, and observed ground motion data.

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General Description of the Region

HAZUS is a regional earthquake loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences. The primary purpose of HAZUS is to provide a methodology and software application to develop earthquake losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from earthquakes and to prepare for emergency response and recovery.

The earthquake loss estimates provided in this report was based on a region that includes 29 county(ies) from the following state(s):

Utah

Note:

Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 84,798.76 square miles and contains 496 census tracts. There are over 773 thousand households in the region and has a total population of 2,474,258 people (2005 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 653 thousand buildings in the region with a total building replacement value (excluding contents) of 131,629 (millions of dollars). Approximately 95.00 % of the buildings (and 0.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 54,677 and 9,370 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

HAZUS estimates that there are 653 thousand buildings in the region which have an aggregate total replacement value of 131,629 (millions of dollars) . Appendix B provides a general distribution of the building value by State and County.

In terms of building construction types found in the region, wood frame construction makes up 46% of the building inventory. The remaining percentage is distributed between the other general building types.

Critical Facility Inventory

HAZUS breaks critical facilities into two (2) groups: essential facilities and high potential loss (HPL) facilities. Essential facilities include hospitals, medical clinics, schools, fire stations, police stations and emergency operations facilities. High potential loss facilities include dams, levees, military installations, nuclear power plants and hazardous material sites.

For essential facilities, there are 56 hospitals in the region with a total bed capacity of 6,868 beds. There are 1,076 schools, 358 fire stations, 133 police stations and 7 emergency operation facilities. With respect to HPL facilities, there are 599 dams identified within the region. Of these, 212 of the dams are classified as 'high hazard'. The inventory also includes 711 hazardous material sites, 0 military installations and 0 nuclear power plants.

Transportation and Utility Lifeline Inventory

Within HAZUS, the lifeline inventory is divided between transportation and utility lifeline systems. There are seven (7) transportation systems that include highways, railways, light rail, bus, ports, ferry and airports. There are six (6) utility systems that include potable water, wastewater, natural gas, crude & refined oil, electric power and communications. The lifeline inventory data are provided in Tables 1 and 2.

The total value of the lifeline inventory is over 64,047.00 (millions of dollars). This inventory includes over 8,874 kilometers of highways, 3,009 bridges, 242,427 kilometers of pipes.

Table 1: Transportation System Lifeline Inventory

System	Component	# locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	3,009	3,453.80
	Segments	1,303	46,184.60
	Tunnels	4	2.00
	Subtotal		49,640.40
Railways	Bridges	33	3.90
	Facilities	12	32.00
	Segments	1,485	2,821.00
	Tunnels	0	0.00
	Subtotal		2,856.90
Light Rail	Bridges	0	0.00
	Facilities	24	63.90
	Segments	24	37.20
	Tunnels	0	0.00
	Subtotal		101.10
Bus	Facilities	10	10.70
	Subtotal		10.70
Ferry	Facilities	2	2.70
	Subtotal		2.70
Port	Facilities	0	0.00
	Subtotal		0.00
Airport	Facilities	30	319.50
	Runways	46	1,746.30
	Subtotal		2,065.90
		Total	54,677.60

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	2,948.60
	Facilities	2	65.30
	Pipelines	0	0.00
	Subtotal		3,013.90
Waste Water	Distribution Lines	NA	1,769.20
	Facilities	56	3,655.00
	Pipelines	0	0.00
	Subtotal		5,424.20
Natural Gas	Distribution Lines	NA	1,179.50
	Facilities	8	8.50
	Pipelines	957	2,089.80
	Subtotal		3,277.80
Oil Systems	Facilities	31	3.00
	Pipelines	465	733.60
	Subtotal		736.60
Electrical Power	Facilities	26	2,802.80
	Subtotal		2,802.80
Communication	Facilities	128	12.50
	Subtotal		12.50
		Total	15,267.90

Earthquake Scenario

HAZUS uses the following set of information to define the earthquake parameters used for the earthquake loss estimate provided in this report.

Scenario Name	Weber Segment Mw 7.0 ShakeMap Scenario
Type of Earthquake	User-defined
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	NA
Longitude of Epicenter	NA
Latitude of Epicenter	NA
Earthquake Magnitude	7.00
Depth (Km)	NA
Rupture Length (Km)	NA
Rupture Orientation (degrees)	NA
Attenuation Function	NA

Building Damage

Building Damage

HAZUS estimates that about 96,418 buildings will be at least moderately damaged. This is over 15.00 % of the total number of buildings in the region. There are an estimated 7,307 buildings that will be damaged beyond repair. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the HAZUS technical manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 summarizes the expected damage by general building type.

Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	297	0.06	93	0.10	79	0.13	42	0.14	11	0.15
Commercial	15,806	3.41	2,131	2.30	1,724	2.88	941	3.21	479	6.55
Education	581	0.13	86	0.09	81	0.14	77	0.26	59	0.81
Government	1,190	0.26	122	0.13	201	0.34	233	0.79	125	1.71
Industrial	4,846	1.04	954	1.03	936	1.56	434	1.48	231	3.17
Other Residential	42,900	9.24	12,320	13.30	13,220	22.11	6,332	21.60	1,334	18.25
Religion	1,666	0.36	318	0.34	338	0.57	306	1.04	182	2.49
Single Family	396,897	85.50	76,599	82.70	43,219	72.28	20,948	71.46	4,886	66.86
Total	464,182		92,622		59,798		29,313		7,308	

Table 4: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	255,136	54.96	39,749	42.91	3,857	6.45	1,677	5.72	412	5.64
Steel	4,079	0.88	566	0.61	702	1.17	466	1.59	405	5.54
Concrete	3,527	0.76	398	0.43	473	0.79	481	1.64	302	4.13
Precast	2,934	0.63	217	0.23	176	0.29	163	0.56	201	2.75
RM	100,853	21.73	11,424	12.33	5,660	9.47	1,571	5.36	486	6.65
URM	76,297	16.44	39,081	42.19	45,768	76.54	22,306	76.10	4,975	68.08
MH	21,356	4.60	1,188	1.28	3,161	5.29	2,649	9.04	527	7.22
Total	464,182		92,622		59,798		29,313		7,308	

*Note:

RM Reinforced Masonry
URM Unreinforced Masonry
MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 6,868 hospital beds available for use. On the day of the earthquake, the model estimates that only 5,666 hospital beds (83.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 97.00% of the beds will be back in service. By 30 days, 100.00% will be operational.

Table 5: Expected Damage to Essential Facilities

Classification	Total	# Facilities		
		At Least Moderate Damage > 50%	Complete Damage > 50%	With Functionality > 50% on day 1
Hospitals	56	0	0	49
Schools	1,076	0	0	904
EOCs	7	0	0	6
PoliceStations	133	0	0	117
FireStations	358	0	0	328

Transportation and Utility Lifeline Damage

Table 6 provides damage estimates for the transportation system.

Table 6: Expected Damage to the Transportation Systems

System	Component	Number of Locations_				
		Locations/ Segments	With at Least Mod. Damage	With Complete Damage	With Functionality > 50 %	
					After Day 1	After Day 7
Highway	Segments	1,303	0	0	1,303	1,303
	Bridges	3,009	173	47	2,840	2,870
	Tunnels	4	0	0	4	4
Railways	Segments	1,485	0	0	1,485	1,485
	Bridges	33	0	0	33	33
	Tunnels	0	0	0	0	0
	Facilities	12	0	0	12	12
Light Rail	Segments	24	0	0	24	24
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	24	0	0	24	24
Bus	Facilities	10	0	0	10	10
Ferry	Facilities	2	0	0	2	2
Port	Facilities	0	0	0	0	0
Airport	Facilities	30	0	0	30	30
	Runways	46	0	0	46	46

Note: Roadway segments, railroad tracks and light rail tracks are assumed to be damaged by ground failure only. If ground failure maps are not provided, damage estimates to these components will not be computed.

Tables 7-9 provide information on the damage to the utility lifeline systems. Table 7 provides damage to the utility system facilities. Table 8 provides estimates on the number of leaks and breaks by the pipelines of the utility systems. For electric power and potable water, HAZUS performs a simplified system performance analysis. Table 9 provides a summary of the system performance information.

Table 7 : 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	2	1	0	1	2
Waste Water	56	6	0	43	56
Natural Gas	8	0	0	7	8
Oil Systems	31	9	0	22	31
Electrical Power	26	1	0	21	26
Communication	128	14	0	128	128

Table 8 : Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	147,432	4685	2034
Waste Water	88,459	3706	1609
Natural Gas	4,166	28	39
Oil	2,370	45	72

Table 9: 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	773,352	279,159	263,505	227,305	0	0
Electric Power		0	0	0	0	0

Induced Earthquake Damage

Fire Following Earthquake

Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. HAZUS uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there will be 72 ignitions that will burn about 3.16 sq. mi 0.00 % of the region's total area.) The model also estimates that the fires will displace about 8,303 people and burn about 453 (millions of dollars) of building value.

Debris Generation

HAZUS estimates the amount of debris that will be generated by the earthquake. The model breaks the debris into two general categories: a) Brick/Wood and b) Reinforced Concrete/Steel. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 7.940 million tons of debris will be generated. Of the total amount, Brick/Wood comprises 47.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 317,400 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Social Impact

Shelter Requirement

HAZUS estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 20,175 households to be displaced due to the earthquake. Of these, 14,433 people (out of a total population of 2,474,258) will seek temporary shelter in public shelters.

Casualties

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

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

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

Table 10 provides a summary of the casualties estimated for this earthquake

Table 10: Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	65	18	3	6
	Commuting	1	1	2	0
	Educational	0	0	0	0
	Hotels	55	14	2	4
	Industrial	126	37	6	12
	Other-Residential	1,677	394	53	104
	Single Family	4,260	965	132	258
	Total	6,184	1,428	198	384
2 PM	Commercial	3,872	1,074	174	343
	Commuting	6	8	14	3
	Educational	1,448	445	77	150
	Hotels	11	3	0	1
	Industrial	926	271	43	84
	Other-Residential	333	81	11	21
	Single Family	822	192	27	51
	Total	7,419	2,074	347	654
5 PM	Commercial	2,988	836	138	265
	Commuting	234	315	528	102
	Educational	185	56	10	19
	Hotels	17	4	1	1
	Industrial	579	169	27	53
	Other-Residential	660	157	22	41
	Single Family	1,708	394	56	104
	Total	6,371	1,931	780	585

Economic Loss

The total economic loss estimated for the earthquake is 12,082.78 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

Building-Related Losses

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

The total building-related losses were 11,361.03 (millions of dollars); 26 % of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 43 % of the total loss. Table 11 below provides a summary of the losses associated with the building damage.

Table 11: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.00	79.73	323.92	28.05	108.62	540.32
	Capital-Related	0.00	34.28	274.16	17.28	28.06	353.78
	Rental	145.12	227.24	224.01	15.91	39.79	652.06
	Relocation	526.61	134.00	337.70	82.60	363.38	1,444.28
	Subtotal	671.73	475.25	1,159.79	143.83	539.85	2,990.44
Capital Stock Losses							
	Structural	634.31	205.56	403.34	150.93	316.36	1,710.49
	Non_Structural	1,500.81	767.51	978.43	517.47	970.49	4,734.71
	Content	437.96	170.20	481.17	339.85	396.65	1,825.83
	Inventory	0.00	0.00	22.95	74.90	1.72	99.56
	Subtotal	2,573.08	1,143.27	1,885.89	1,083.14	1,685.21	8,370.59
	Total	3,244.81	1,618.52	3,045.67	1,226.97	2,225.06	11,361.03

Transportation and Utility Lifeline Losses

For the transportation and utility lifeline systems, HAZUS computes the direct repair cost for each component only. There are no losses computed by HAZUS for business interruption due to lifeline outages. Tables 12 & 13 provide a detailed breakdown in the expected lifeline losses.

HAZUS estimates the long-term economic impacts to the region for 15 years after the earthquake. The model quantifies this information in terms of income and employment changes within the region. Table 14 presents the results of the region for the given earthquake.

Table 12: Transportation System Economic Losses
(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	46,184.62	\$109.12	0.24
	Bridges	3,453.84	\$231.10	6.69
	Tunnels	1.96	\$0.00	0.00
	Subtotal	49640.40	340.20	
Railways	Segments	2,821.00	\$3.93	0.14
	Bridges	3.92	\$0.10	2.60
	Tunnels	0.00	\$0.00	0.00
	Facilities	31.96	\$6.20	19.39
	Subtotal	2856.90	10.20	
Light Rail	Segments	37.15	\$0.24	0.65
	Bridges	0.00	\$0.00	0.00
	Tunnels	0.00	\$0.00	0.00
	Facilities	63.91	\$12.10	18.94
	Subtotal	101.10	12.30	
Bus	Facilities	10.68	\$1.13	10.62
	Subtotal	10.70	1.10	
Ferry	Facilities	2.66	\$0.00	0.11
	Subtotal	2.70	0.00	
Port	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
Airport	Facilities	319.53	\$15.73	4.92
	Runways	1,746.34	\$5.91	0.34
	Subtotal	2065.90	21.60	
	Total	54677.60	385.60	

Table 13: 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	65.30	\$7.91	12.11
	Distribution Lines	2,948.60	\$29.71	1.01
	Subtotal	3,013.92	\$37.61	
Waste Water	Pipelines	0.00	\$0.00	0.00
	Facilities	3,655.00	\$142.32	3.89
	Distribution Lines	1,769.20	\$23.50	1.33
	Subtotal	5,424.20	\$165.82	
Natural Gas	Pipelines	2,089.80	\$0.37	0.02
	Facilities	8.50	\$0.15	1.73
	Distribution Lines	1,179.50	\$25.12	2.13
	Subtotal	3,277.83	\$25.63	
Oil Systems	Pipelines	733.60	\$0.40	0.05
	Facilities	3.00	\$0.19	6.14
	Subtotal	736.60	\$0.59	
Electrical Power	Facilities	2,802.80	\$106.04	3.78
	Subtotal	2,802.80	\$106.04	
Communication	Facilities	12.50	\$0.50	3.95
	Subtotal	12.54	\$0.50	
	Total	15,267.88	\$336.19	

Table 14. Indirect Economic Impact with outside aid
(Employment as # of people and Income in millions of \$)

	LOSS	Total	%
First Year			
	Employment Impact	190,550	24.53
	Income Impact	397	1.38
Second Year			
	Employment Impact	82,003	10.55
	Income Impact	59	0.21
Third Year			
	Employment Impact	1,988	0.26
	Income Impact	(218)	-0.76
Fourth Year			
	Employment Impact	113	0.01
	Income Impact	(298)	-1.04
Fifth Year			
	Employment Impact	6	0.00
	Income Impact	(303)	-1.05
Years 6 to 15			
	Employment Impact	0	0.00
	Income Impact	(303)	-1.05

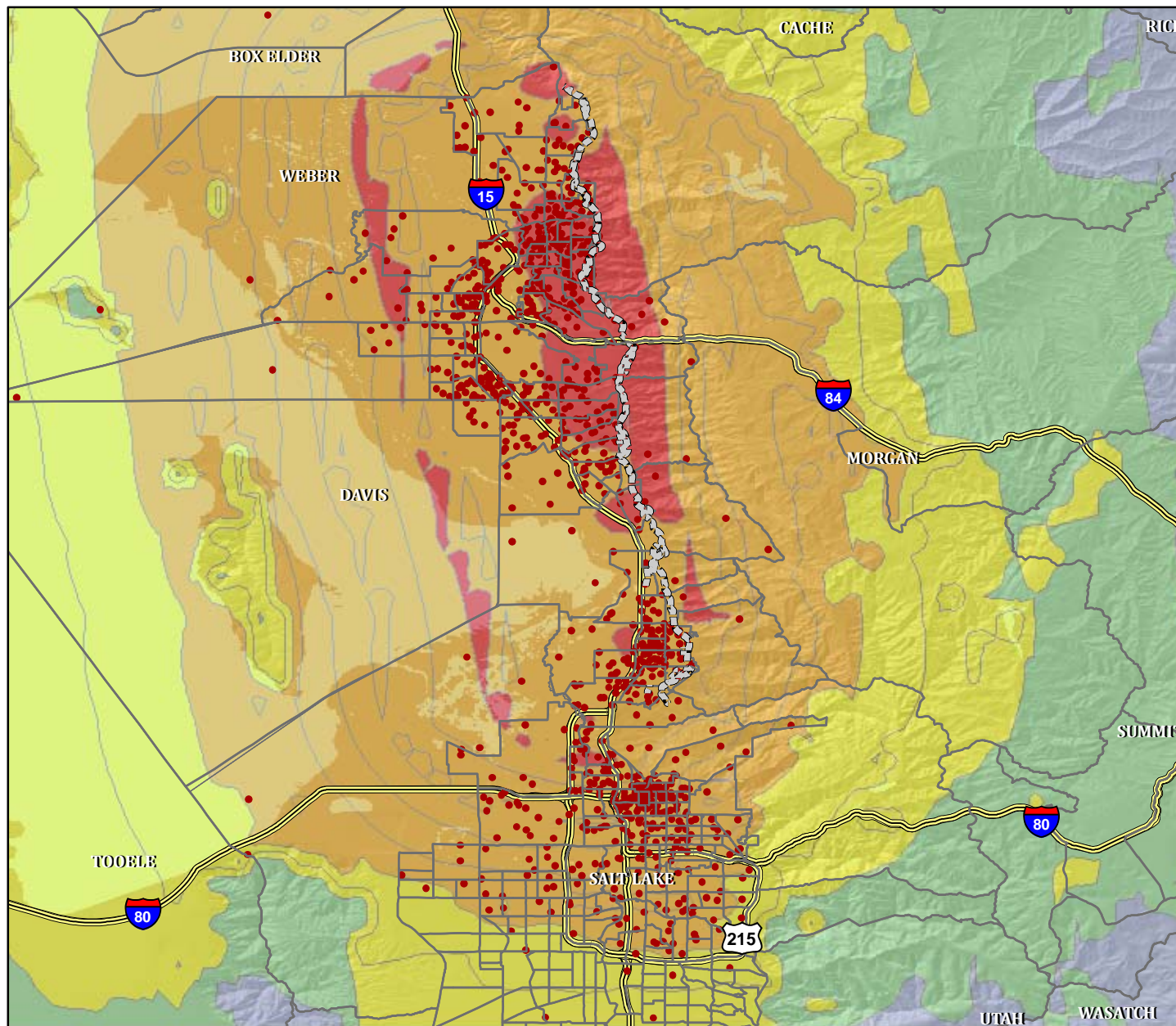
Appendix A: County Listing for the Region

Beaver,UT
Box Elder,UT
Cache,UT
Carbon,UT
Daggett,UT
Davis,UT
Duchesne,UT
Emery,UT
Garfield,UT
Grand,UT
Iron,UT
Juab,UT
Kane,UT
Millard,UT
Morgan,UT
Piute,UT
Rich,UT
Salt Lake,UT
San Juan,UT
Sanpete,UT
Sevier,UT
Summit,UT
Tooele,UT
Uintah,UT
Utah,UT
Wasatch,UT
Washington,UT
Wayne,UT
Weber,UT

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Utah	Beaver	6,295	252	89	341
	Box Elder	45,659	1,658	687	2,346
	Cache	100,585	3,382	1,703	5,085
	Carbon	19,947	825	395	1,220
	Daggett	884	74	18	92
	Davis	270,344	10,230	3,870	14,101
	Duchesne	15,233	496	248	744
	Emery	10,885	403	142	546
	Garfield	4,957	276	94	370
	Grand	8,891	350	195	546
	Iron	37,498	1,323	741	2,065
	Juab	9,240	291	190	481
	Kane	6,385	323	127	450
	Millard	12,713	447	233	681
	Morgan	7,910	305	139	444
	Piute	1,439	69	24	93
	Rich	2,327	249	38	288
	Salt Lake	962,837	39,526	18,636	58,162
	San Juan	14,341	443	164	608
	Sanpete	24,037	708	387	1,095
	Sevier	19,623	697	315	1,013
	Summit	35,804	2,598	708	3,307
	Tooele	50,184	1,782	564	2,347
	Uintah	26,973	851	460	1,312
	Utah	429,727	9,780	6,285	16,065
	Wasatch	18,879	0	89	89
	Washington	113,489	3,900	1,839	5,739
	Wayne	2,590	115	38	154
	Weber	214,582	8,462	3,369	11,831
Total State		2,474,258	89,815	41,787	131,615
Total Region		2,474,258	89,815	41,787	131,615

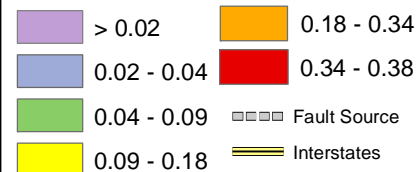
Direct Building Economic Loss - Earthquake Scenario: Weber, UT



M7.0 Weber Segment

1 Dot = \$10,000,000

PGA (%g's)



Total Direct Economic Loss \$11.3B

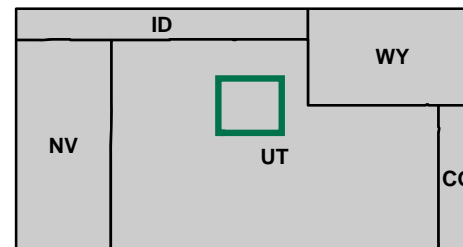
	Cost Structural Damage	Cost Non Structural Damage	Total Loss (Including Contents)
Utah	1,742	9,639	20,342
Sanpete	6	21	46
Wasatch	3	25	53
Box Elder	15,034	31,280	85,067
Tooele	614	2,089	4,470
Salt Lake	559,004	1,379,080	3,847,829
Juab	11	45	94
Weber	562,357	1,588,148	3,593,707
Summit	174	1,668	3,146
Cache	2,170	9,546	20,318
Duchesne	5	18	36
Morgan	233	820	1,735
Rich	8	22	44
Davis	589,128	1,712,304	3,784,134
Millard	0	4	8
Uintah	0	2	3
Total	1,710,488	4,734,709	11,361,033

* All values are thousands of dollars

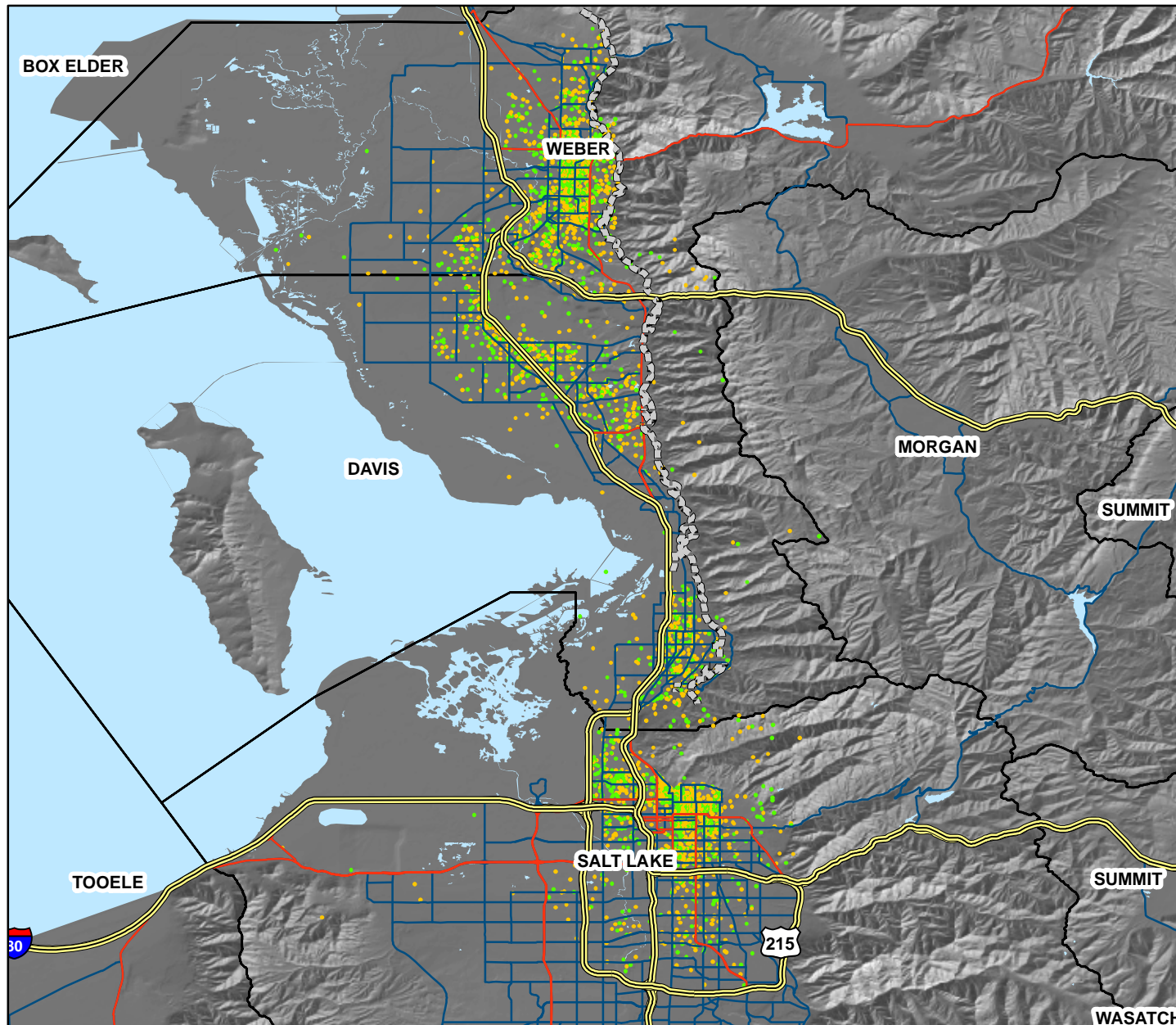
0 2 4 6 8 10 12

Miles

12/21/09 FEMA & URS Corporation



Estimated Displaced Households & Short Term Public Shelter Needs - Earthquake Scenario: Weber, UT

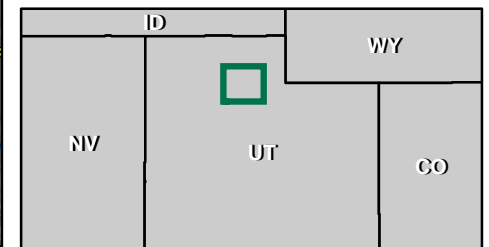
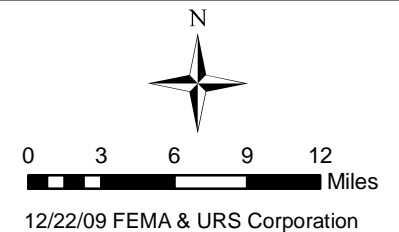


M 7.0 Weber Segment Eq.

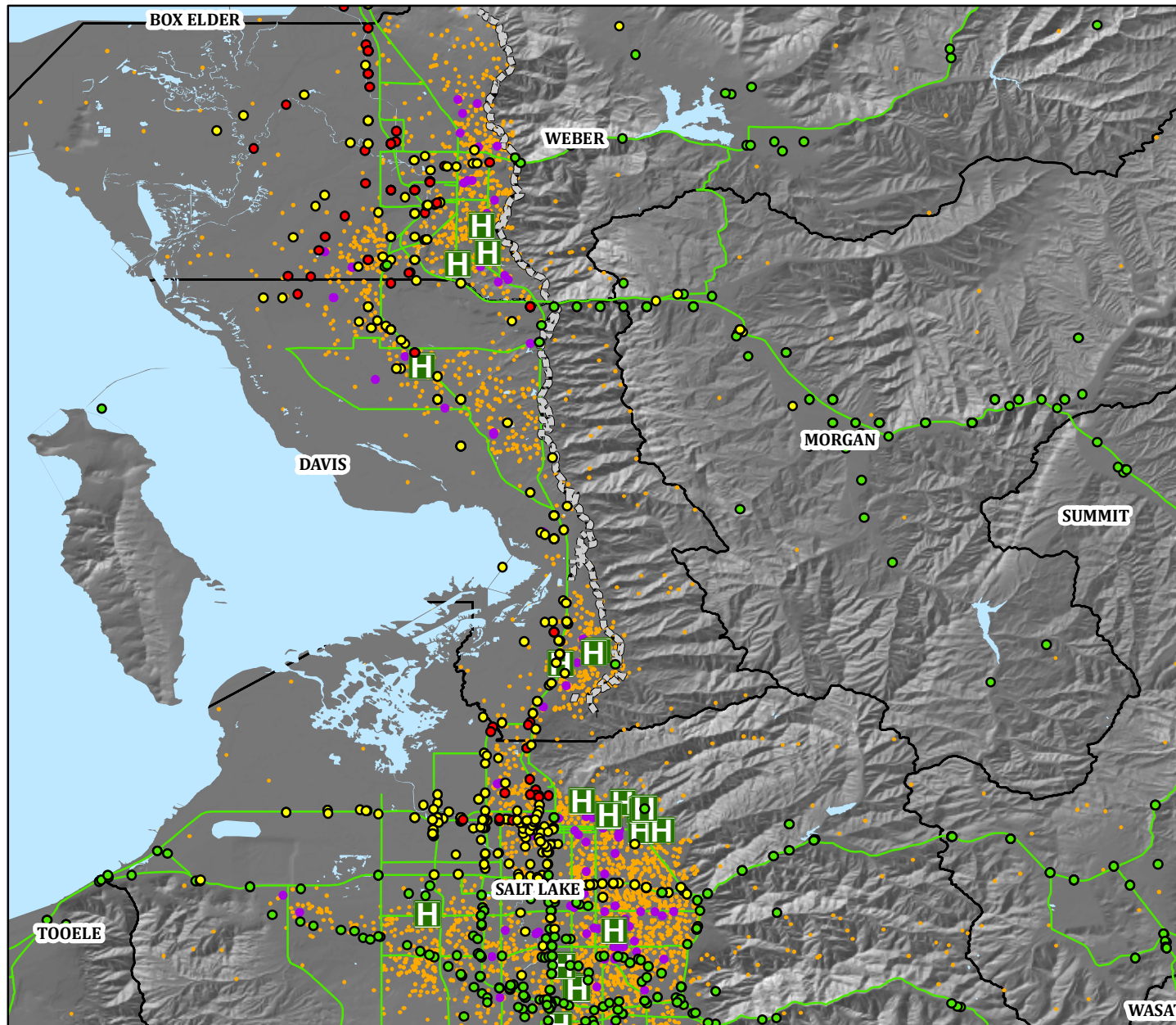
Public Shelter Needs (Individuals)	14,434
Displaced Households	20,176

- 1 Dot = 10 Displaced Households*
 - 1 Dot = 10 Public Shelter Needs (Individuals)*
- * delineated by census tract

▤▤▤▤ Fault Source — Roads
▬▬▬▬ Interstates □ Counties
— Highways



Distribution of Elderly, Impaired Hospitals (Day 1), & Hospital Bed Availability - Earthquake Scenario: Weber, UT



M 7.0 Weber Segment Eq.

Highway Damage

Damage is expressed as the probability that a given bridge or highway segment will realize at least moderate damage.

Major Roadway Bridge Impact	Highway Segment Impact
● Low	— Low
● Moderate	— Moderate
● High	— High

Impaired Hospitals (Day 1)

Damage is expressed as the probability that a given hospital will be at least moderately damaged.

■ Low
■ Moderate
■ High

1 Dot = 30 People over 65

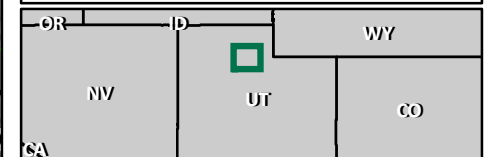
Nursing Home

County	Total # Hospital Beds	Hospital Beds Available	Injuries Requiring Hospital Treatment 2pm
Box Elder	107	90	1
Cache	158	156	0
Davis	468	171	145
Salt Lake	3,440	2,627	54
Utah	1,013	1,010	0
Wasatch	20	20	0
Weber	655	211	148
Total	5,861	4,285	348

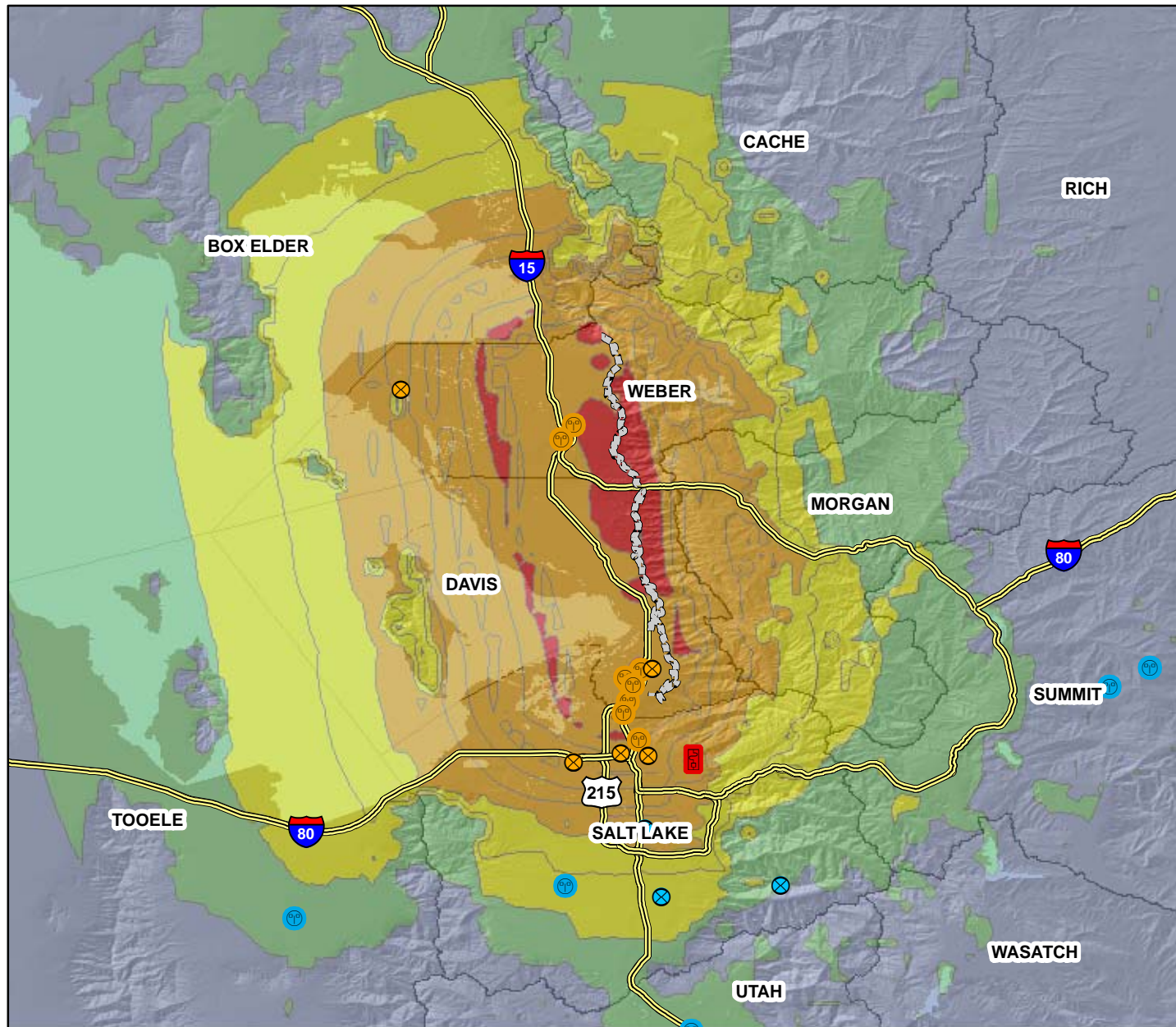
0 2 4 6 8 10 12
Miles



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Electrical, Natural Gas, and Oil Facility Damage - Earthquake Scenario: Weber, UT

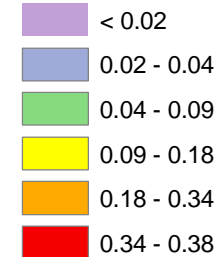


M 7.0 Weber Segment Eq.

Utility Damage (at least moderate)

Damage is expressed as the probability that a given Utility System will realize at least moderate damage.

PGA (%g's)



- Counties
- Fault Source
- Interstates

Oil Facility

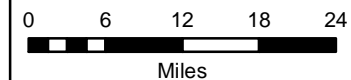
- Low
- Moderate
- High

Electric Power Facility

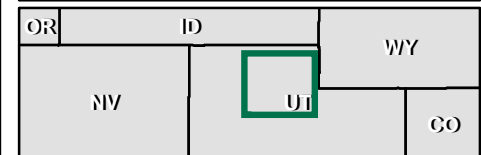
- Low
- Moderate
- High

Natural Gas Facility

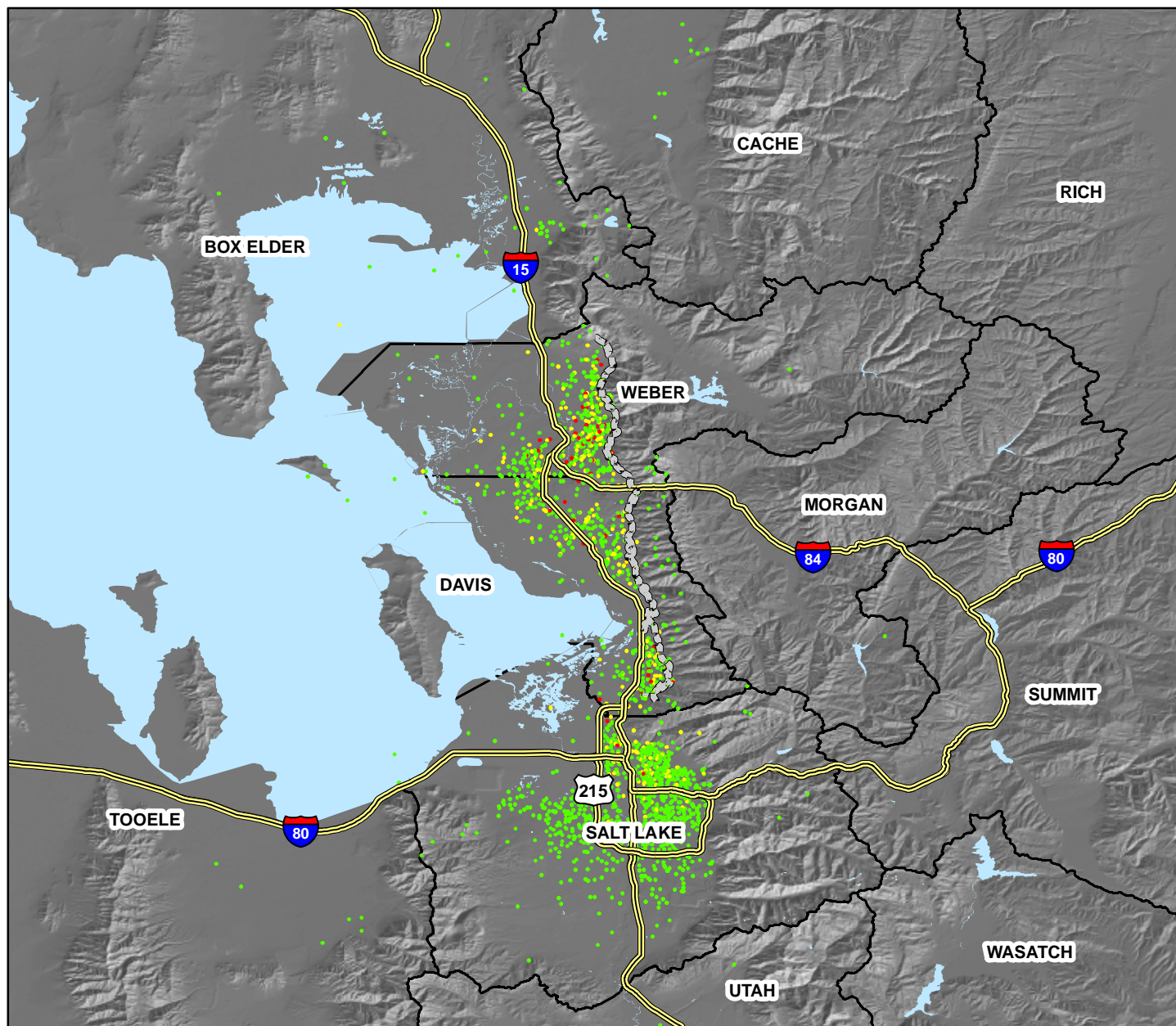
- Low
- Moderate
- High



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Estimated Building Inspection Needs - Earthquake Scenario: Weber, UT



M 7.0 Weber Segment Eq.

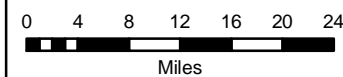
	Estimated # of Structures	Estimated # of Inspectors Needed
Red (Complete)	7,308	49
Yellow (Extensive)	29,313	391
Light Green (Slight/Moderate)	152,420	1,016
Total	189,041	1,456

*Estimated number of inspectors needed to complete inspections in 30 days.

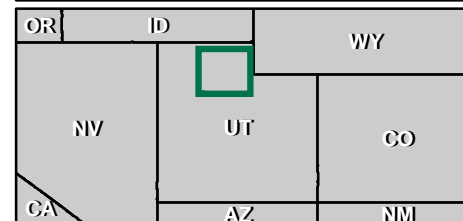
- Red Tag (Complete Damage)
- Yellow Tag (Extensive Damage)
- Green Tag (Slight/Moderate Damage)

*1 Dot = 100 (by census tract)

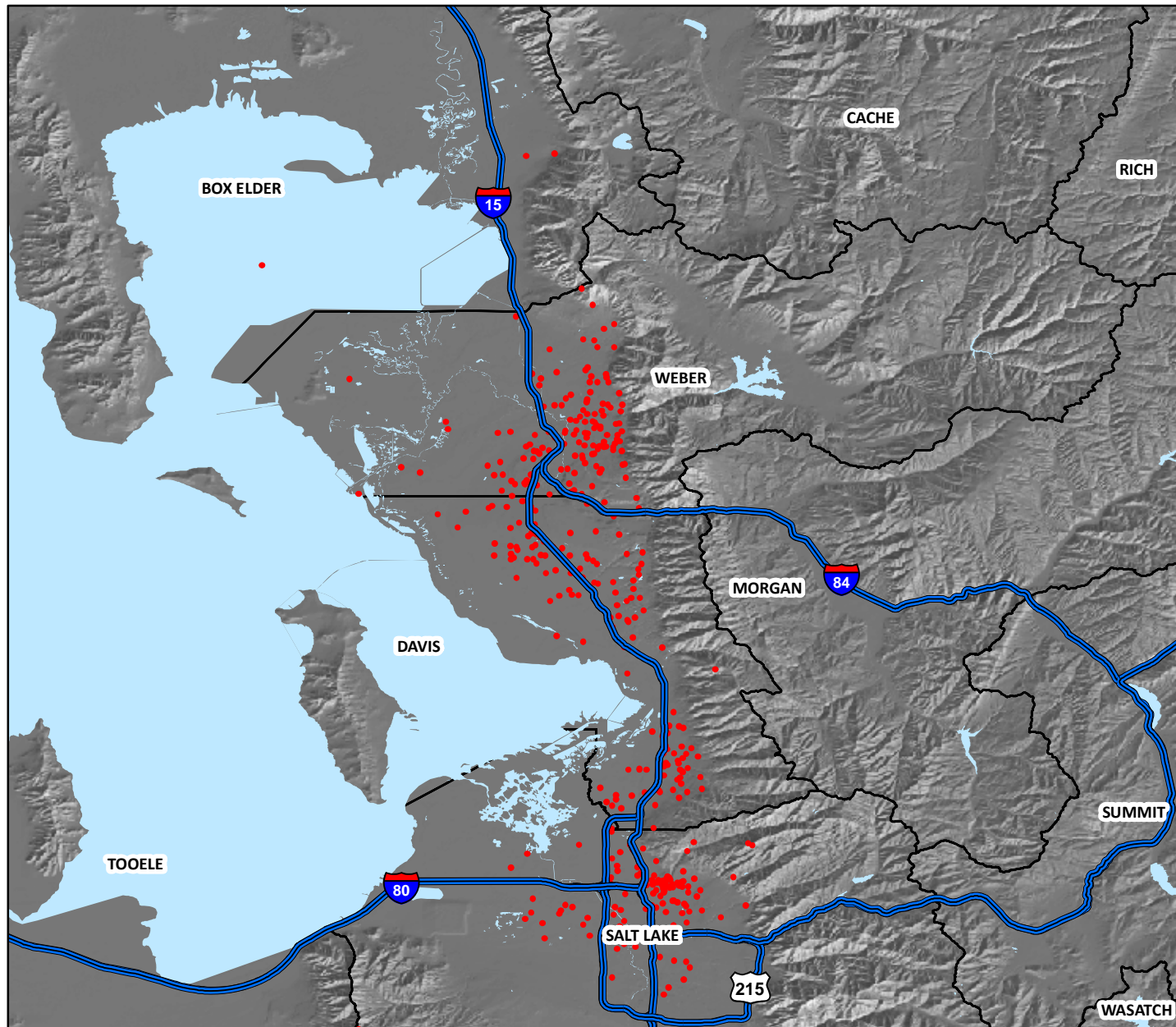
Counties
 Fault Source
 Utah_Interstates



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Estimated Concrete, Steel Debris and Highway Damage - Earthquake Scenario: Weber, UT



M 7.0 Weber Segment Eq.

Highway Damage

Damage is expressed as the probability that a given bridge or highway segment will realize at least moderate damage.

Highway Segment Impact

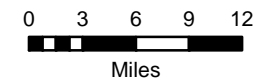
- Low
- Moderate
- High

□ Fault Source Interstate Counties

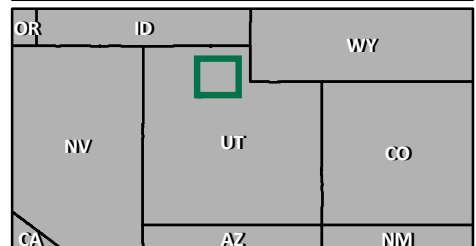
1 Dot = 10 thousand tons of
Concrete and Steel Debris
(by census tract)

County	Brick and Wood (tons)	Concrete and Steel (tons)	Estimated Truck Loads*
Box Elder	30	30	2
Cache	7	2	0
Davis	758	1,474	89
Morgan	1	0	0
Salt Lake	1,948	1,305	130
Tooele	2	0	0
Utah	4	2	0
Weber	975	1,397	95
Total	3,725	4,210	317

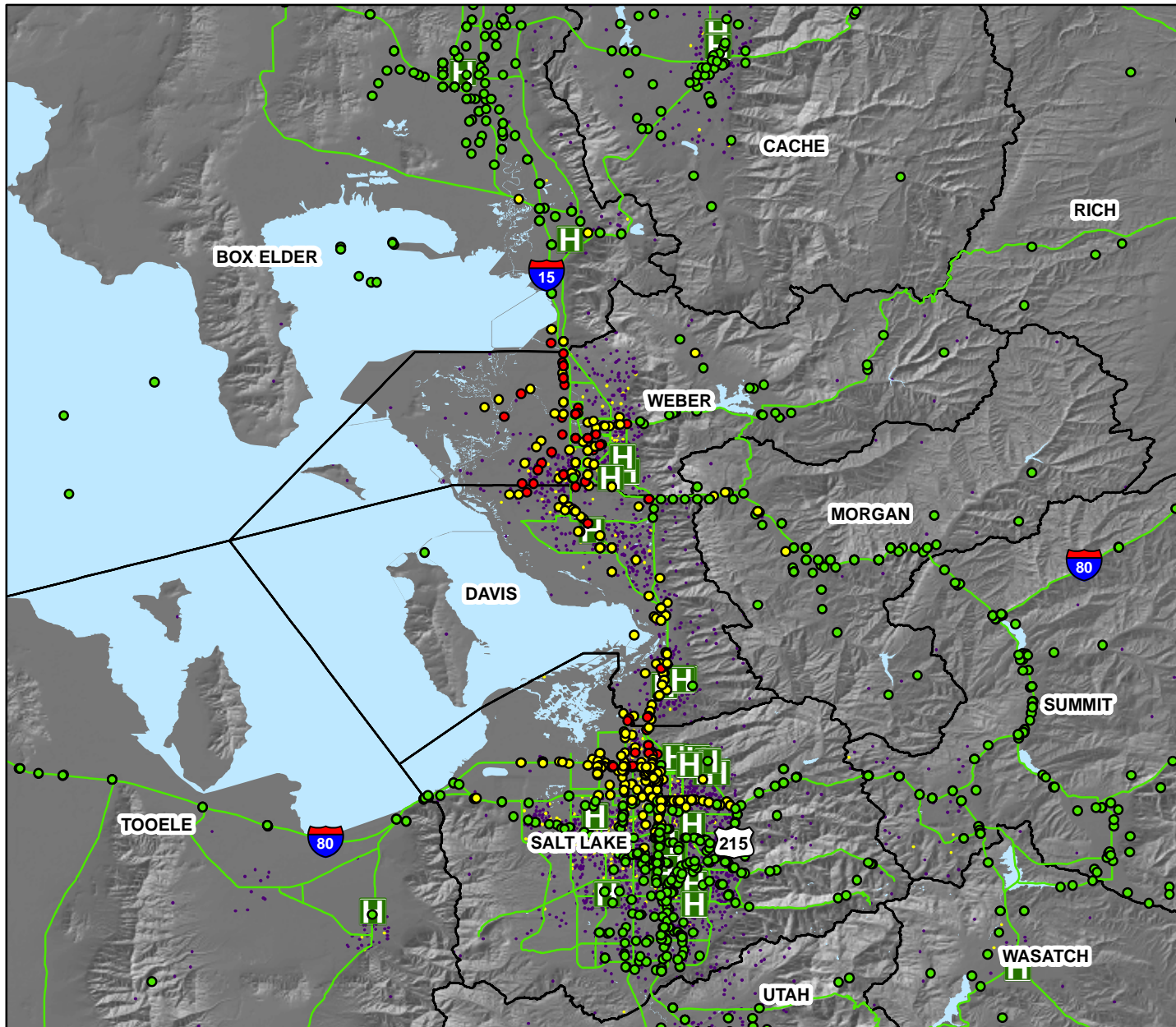
* Truck loads estimated at 25 tons per truck



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Demographic Distribution and Highway Functionality - Earthquake Scenario: Weber, UT



M 7.0 Weber Segment Eq.

Highway Damage

Damage is expressed as the probability that a given bridge or highway segment will realize at least moderate damage.

Major Roadway Bridge Impact

- Low
- Moderate
- High

Highway Segment Impact

- Low
- Moderate
- High

Demographics

1 Dot = 500 People (by census tract)

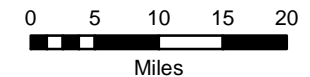
• English Speaking

• Potentially Non-English Speaking

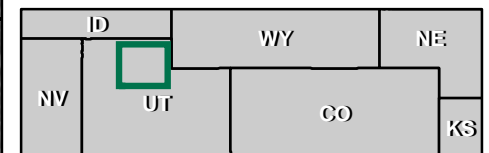
Impaired Hospitals (Day 1)

Damage is expressed as the probability that a given hospital will be at least moderately damaged.

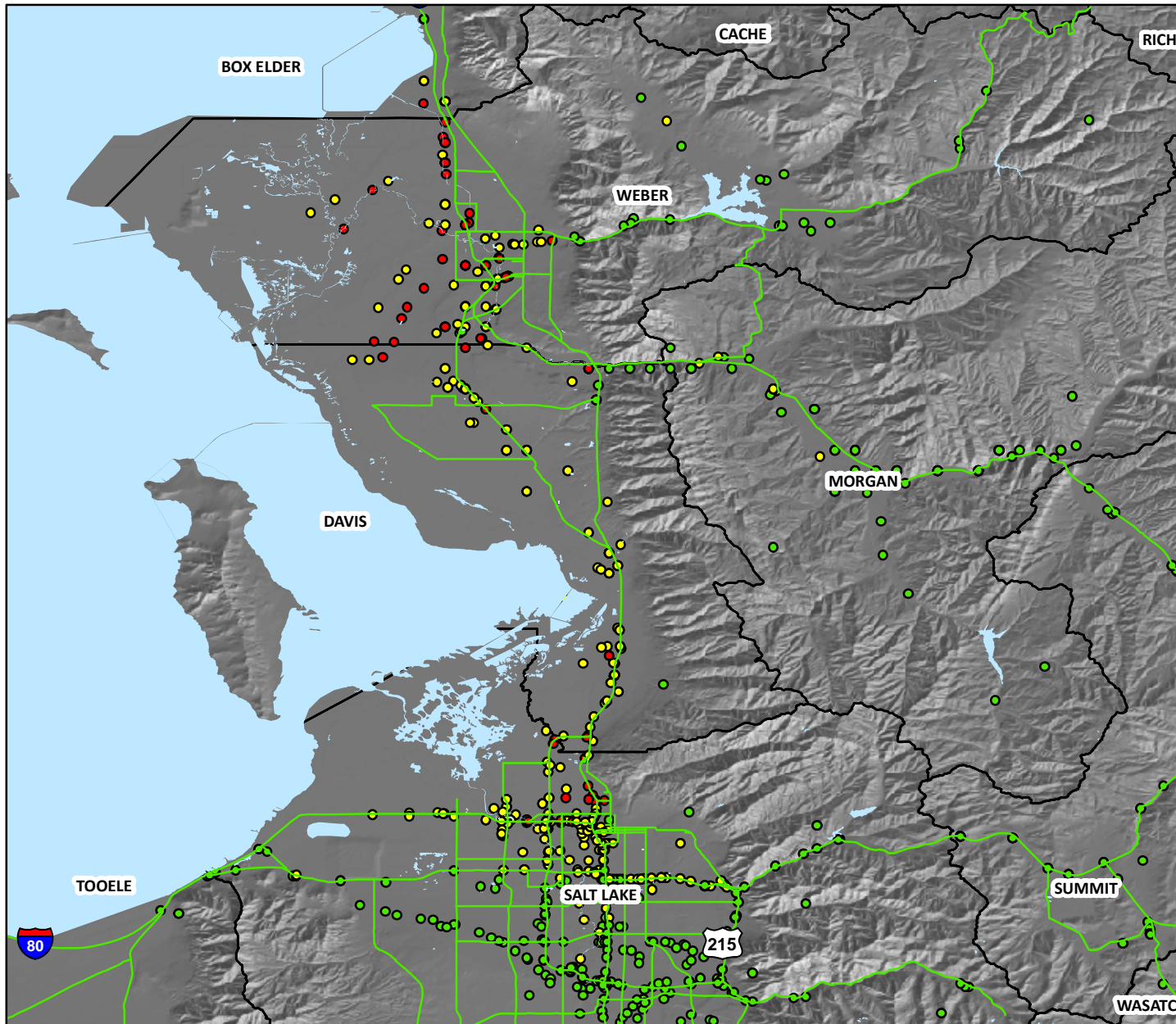
- H Low
- H Moderate
- H High



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Estimated Highway Infrastructure Damage - Earthquake Scenario: Weber, UT



M 7.0 Weber Segment Eq.

Highway Damage

Damage is expressed as the probability that a given bridge or highway segment will realize at least moderate damage.

Major Roadway Bridge Impact

- Low
- Moderate
- High

Highway Segment Impact

- Low
- Moderate
- High

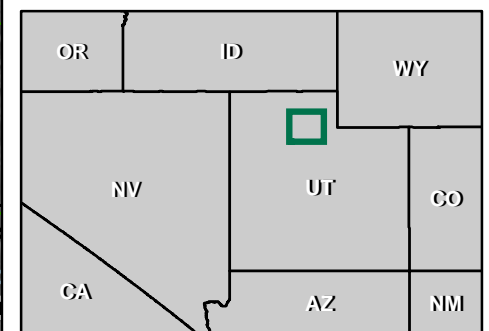
□ □ □ □ Fault Source — Major Roads

County	Total # of Bridges	# of Bridges Needing Priority Inspection	# of Bridge Engineers Needed*
Box Elder	230	12	2
Cache	62	0	0
Davis	130	63	8
Morgan	80	4	1
Rich	23	0	0
Salt Lake	608	134	18
Summit	156	0	0
Tooele	54	5	1
Wasatch	24	0	0
Weber	141	72	10
Total	1,508	290	39

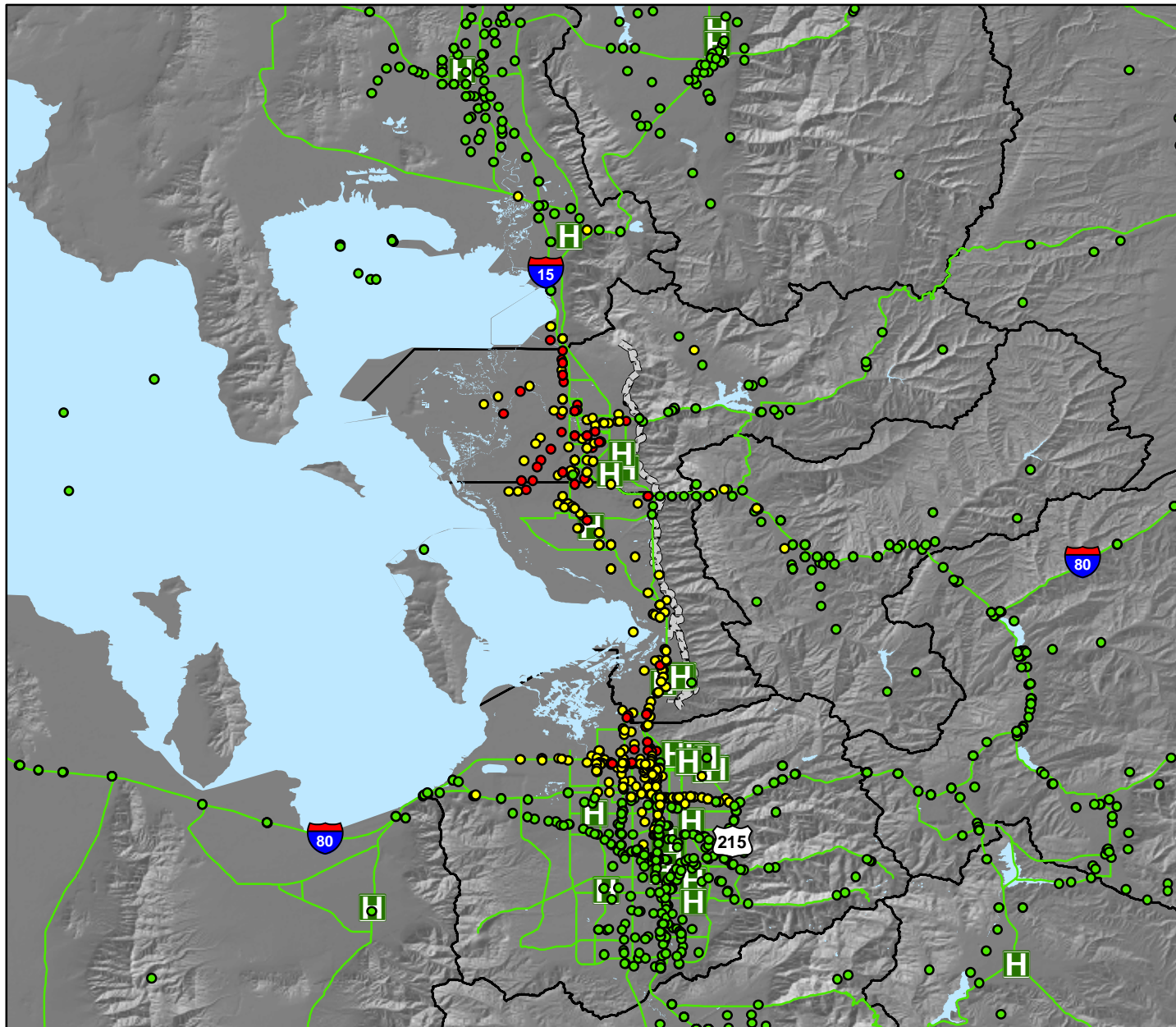
* Assuming that 2 engineers can inspect 5 bridges a day for 3 days



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Impaired Hospitals (Day 1), Hospital Bed Availability, & Highway Functionality - Earthquake Scenario: Weber, UT



M 7.0 Weber Segment Eq.

Highway Damage

Damage is expressed as the probability that a given bridge or highway segment will realize at least moderate damage.

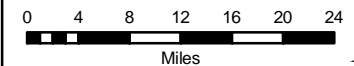
Major Roadway Bridge Impact	Highway Segment Impact
● Low	— Low
● Moderate	— Moderate
● High	— High

Impaired Hospitals (Day 1)

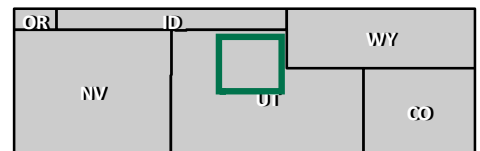
Damage is expressed as the probability that a given hospital will be at least moderately damaged.

	Low
	Moderate
	High

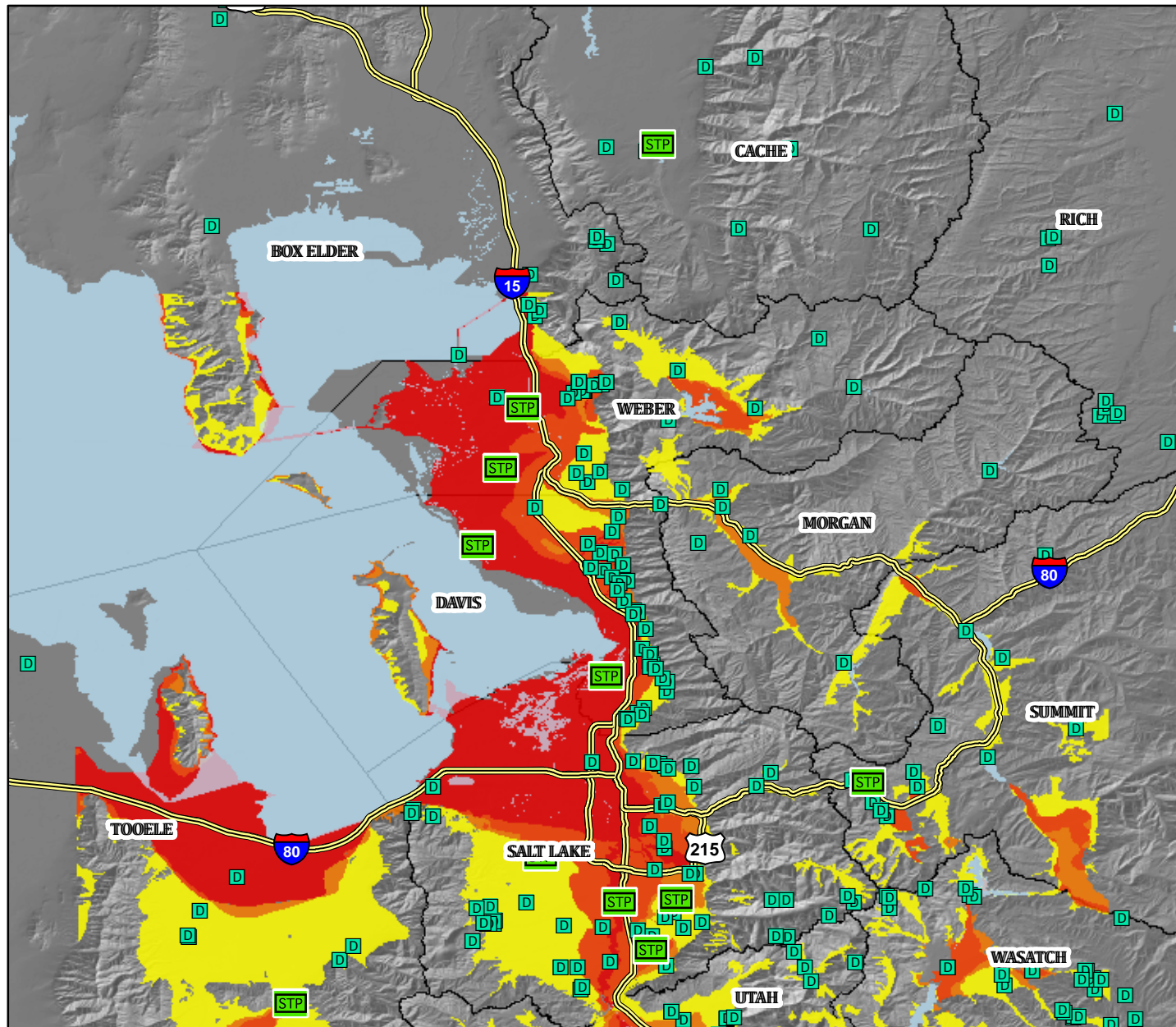
County	Total # Hospital Beds	Hospital Beds Available	Injuries Requiring Hospital Treatment 2pm
Box Elder	107	90	1
Cache	158	156	0
Davis	468	171	145
Salt Lake	3,440	2,627	54
Utah	1,013	1,010	0
Wasatch	20	20	0
Weber	655	211	148
Total	5,861	4,285	348



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Water Line, Sewage Treatment Facility Distribution and Liquefaction Susceptibility - Earthquake Scenario: Weber, UT



M 7.0 Weber Segment Eq.

Liquefaction Susceptibility

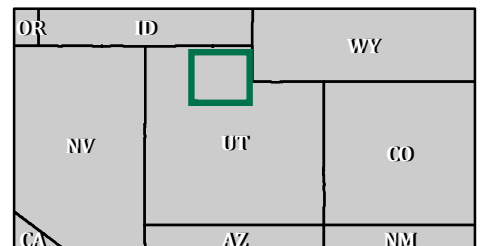
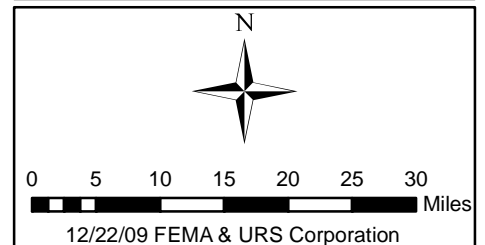


STP Sewage Treatment Facilities

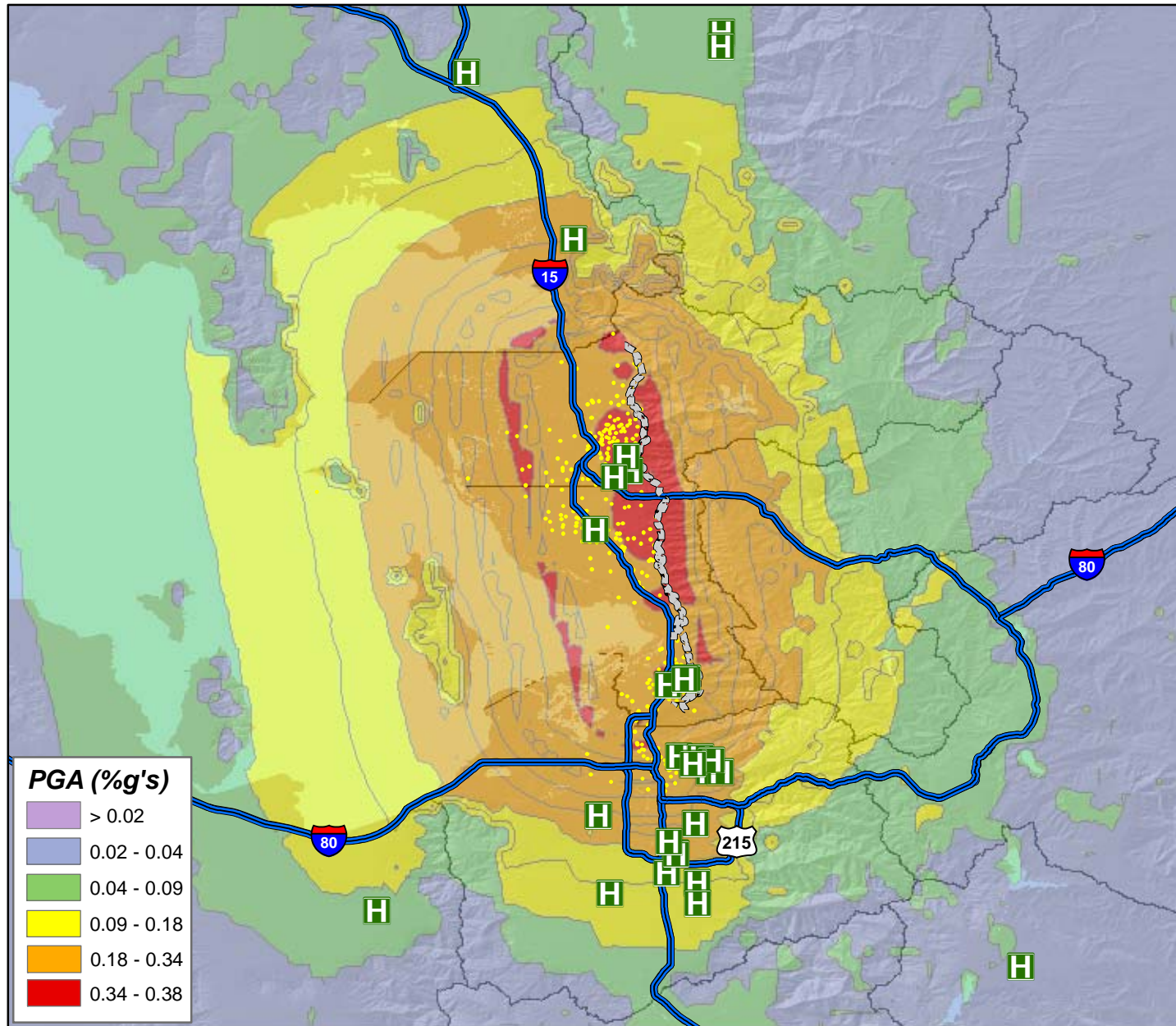
D Dams

County	# Households without Potable Water (at Day 1)	Daily Potable Water Needs Per Person (Gallons/day)	Number of Truckloads needed Daily
Davis	73,717	221,151	47
Salt Lake	146,528	439,584	92
Weber	58,914	176,742	1

* Based on U.S. Army Corp Mission Guidebook
(Daily water is based on an estimated 3 people per household. One truck can transport an estimated 5000 gallons of water.)



Potential Search and Rescue Needs - Earthquake Scenario: Weber, UT



M 7.0 Weber Segment Eq.

Impaired Hospitals (Day 1)

Damage is expressed as the probability that a given hospital will be at least moderately damaged.

H Low
H Moderate
H High

1 Dot = 1 Life Threatening Injury (Severity Level 3* - 2pm)

County	Requiring Hospital Treatment	Immediate Life Threatening Injuries
Box Elder	6	1
Cache	0	0
Davis	968	145
Salt Lake	436	54
Utah	0	0
Wasatch	0	0
Weber	1012	148
Total	2422	348

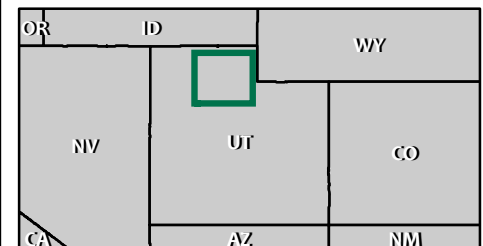
Structure Type	Red (Complete)	Collapse Rates for Complete Damage	Total Collapse
Wood	412	3%	12
Steel	405	6%	24
Concrete	302	10%	30
Precast	201	13%	26
Reinforced Masonry	486	10%	49
Unreinforced Masonry	4,975	15%	746
Manufactured Housing	527	3%	16
Total	7,308		904

*Severity Level 3 is defined as injuries that require hospitalization and can become life threatening if not promptly treated.

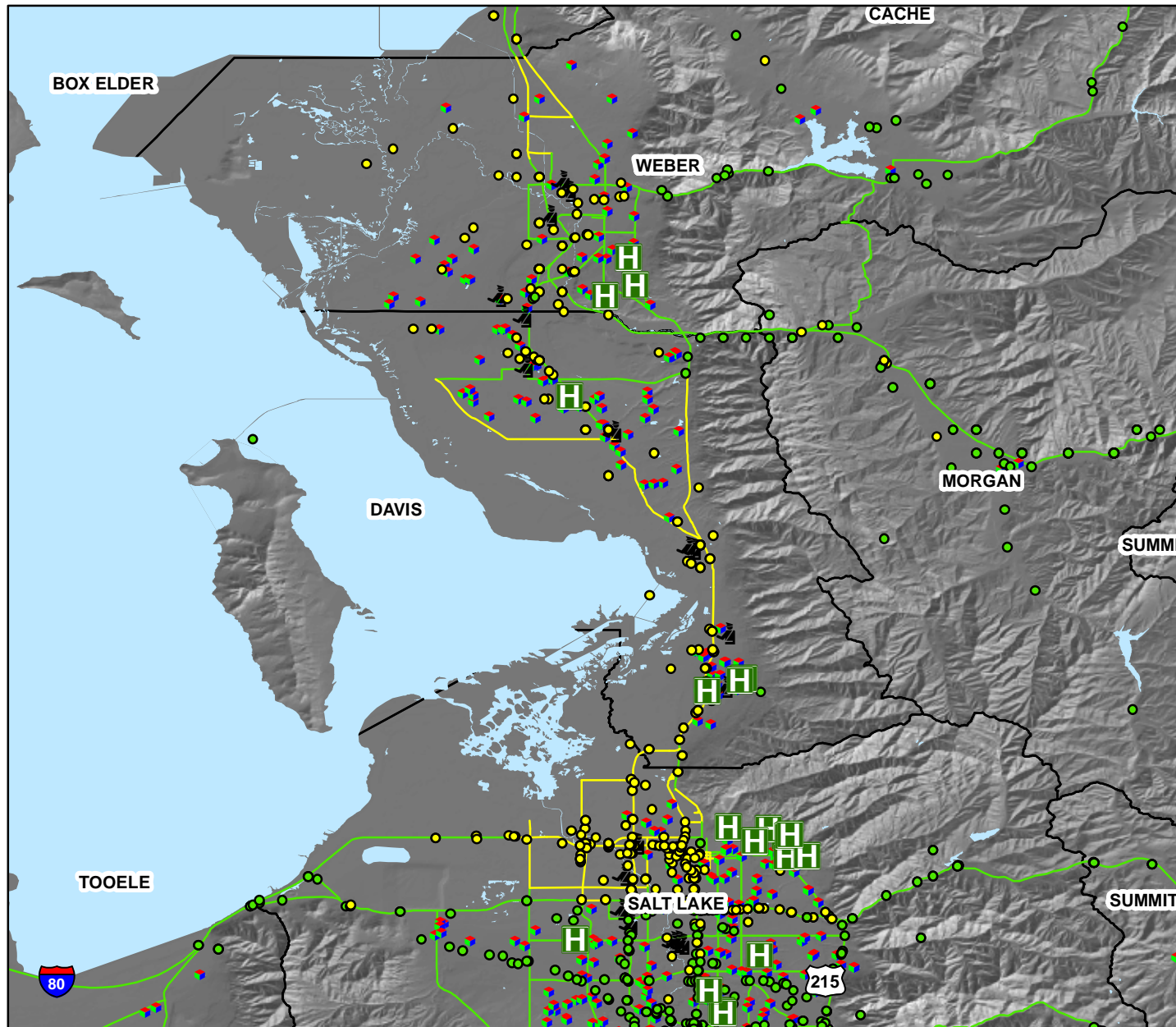
0 3 6 9 12 15 18 Miles



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Correctional and Daycare Facilities, Impaired Hospitals (Day 1), and Highway Functionality - Earthquake Scenario: Weber, UT



M7.0 Weber Segment Eq.

Highway Damage

Damage is expressed as the probability that a given bridge or highway segment will realize at least moderate damage.

Major Roadway Bridge Impact	Highway Segment Impact
● Low	— Low
● Moderate	— Moderate
● High	— High

Impaired Hospitals (Day 1)

Damage is expressed as the probability that a given hospital will be at least moderately damaged.

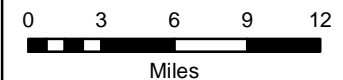
H	Low
H	Moderate
H	High



Correctional Facilities



Daycare Facilities



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