Hazus-MH: Earthquake Event Report

Region Name: SLC Segment M70 2012 ShakeOut

Earthquake Scenario: SLC Segment M70

Print Date: February 24, 2012

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 12 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 27,583.22 square miles and contains 422 census tracts. There are over 712 thousand households in the region which has a total population of 2,301,462 people (2010 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 630 thousand buildings in the region with a total building replacement value (excluding contents) of 129,617 (millions of dollars). Approximately 90.00 % 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 27,274 and 3,760 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 630 thousand buildings in the region which have an aggregate total replacement value of 129,617 (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 42% 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 facilities (HPL). 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 47 hospitals in the region with a total bed capacity of 6,630 beds. There are 953 schools, 208 fire stations, 104 police stations and 22 emergency operation facilities. With respect to high potential loss facilities (HPL), there are 272 dams identified within the region. Of these, 117 of the dams are classified as 'high hazard'. The inventory also includes 636 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 31,034.00 (millions of dollars). This inventory includes over 3,595 kilometers of highways, 1,902 bridges, 93,834 kilometers of pipes.

Table 1: Transportation System Lifeline Inventory

System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	1,902	2,646.60
	Segments	844	21,652.00
	Tunnels	2	1.80
		Subtotal	**24,300.30**
Railways	Bridges	31	3.80
	Facilities	10	26.60
	Segments	1,041	1,947.30
	Tunnels	0	0.00
		Subtotal	**1,977.70**
Light Rail	Bridges	0	0.00
	Facilities	24	63.90
	Segments	24	37.20
	Tunnels	0	0.00
		Subtotal	**101.10**
Bus	Facilities	8	8.50
		Subtotal	**8.50**
Ferry	Facilities	0	0.00
		Subtotal	**0.00**
Port	Facilities	0	0.00
		Subtotal	**0.00**
Airport	Facilities	12	127.80
	Runways	20	759.30
		Subtotal	**887.10**
		Total	**27,274.80**

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	1,135.00
	Facilities	1	32.60
	Pipelines	0	0.00
		Subtotal	**1,167.70**
Waste Water	Distribution Lines	NA	681.00
	Facilities	38	2,480.20
	Pipelines	0	0.00
		Subtotal	**3,161.20**
Natural Gas	Distribution Lines	NA	454.00
	Facilities	1	0.00
	Pipelines	372	968.90
		Subtotal	**1,422.90**
Oil Systems	Facilities	16	0.00
	Pipelines	228	270.10
		Subtotal	**270.10**
Electrical Power	Facilities	617	0.00
		Subtotal	**0.00**
Communication	Facilities	93	9.10
		Subtotal	**9.10**
		Total	**6,030.90**

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	SLC Segment M70
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 204,060 buildings will be at least moderately damaged. This is over 32.00 % of the buildings in the region. There are an estimated 56,241 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 below 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	1,526	0.47	155	0.15	128	0.15	60	0.10	25	0.05
Commercial	22,205	6.89	6,874	6.63	6,900	7.86	5,958	9.93	3,576	6.36
Education	462	0.14	93	0.09	115	0.13	179	0.30	139	0.25
Government	672	0.21	239	0.23	250	0.28	161	0.27	99	0.18
Industrial	6,114	1.90	1,736	1.68	1,884	2.14	1,154	1.92	617	1.10
Other Residential	51,125	15.86	14,119	13.62	10,810	12.31	6,395	10.66	4,730	8.41
Religion	946	0.29	225	0.22	246	0.28	143	0.24	88	0.16
Single Family	239,291	74.24	80,186	77.38	67,497	76.85	45,939	76.58	46,968	83.51
Total	**322,341**		**103,627**		**87,829**		**59,990**		**56,242**	

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

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	155,144	48.13	60299	58.19	34,630	39.43	12,858	21.43	3,520	6.26
Steel	4,720	1.46	1117	1.08	1,464	1.67	982	1.64	819	1.46
Concrete	3,927	1.22	1113	1.07	845	0.96	499	0.83	450	0.80
Precast	1,396	0.43	277	0.27	391	0.45	194	0.32	70	0.13
RM	115,543	35.84	26092	25.18	28,035	31.92	20,495	34.16	6,466	11.50
URM	31,837	9.88	12408	11.97	20,198	23.00	23,961	39.94	44,409	78.96
MH	9,775	3.03	2321	2.24	2,266	2.58	1,001	1.67	508	0.90
Total	**322,341**		**103,627**		**87,829**		**59,990**		**56,242**	

*Note:
RM Reinforced Masonry
URM Unreinforced Masonry
MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 6,630 hospital beds available for use. On the day of the earthquake, the model estimates that only 2,625 hospital beds (40.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 51.00% of the beds will be back in service. By 30 days, 69.00% will be operational.

Table 5: Expected Damage to Essential Facilities

		# Facilities		
Classification	**Total**	**At Least Moderate Damage > 50%**	**Complete Damage > 50%**	**With Functionality > 50% on day 1**
Hospitals	47	25	4	21
Schools	953	259	22	524
EOCs	22	5	0	15
PoliceStations	104	8	0	70
FireStations	208	18	0	147

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	844	0	0	844	844
	Bridges	1,902	469	140	1,438	1,556
	Tunnels	2	0	0	2	2
Railways	Segments	1,041	0	0	1,041	1,041
	Bridges	31	3	0	28	30
	Tunnels	0	0	0	0	0
	Facilities	10	6	0	6	10
Light Rail	Segments	24	0	0	24	24
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	24	23	0	7	15
Bus	Facilities	8	2	0	7	8
Ferry	Facilities	0	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	12	2	0	11	12
	Runways	20	0	0	20	20

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	1	0	0	1	1
Waste Water	38	5	0	30	37
Natural Gas	1	0	0	1	1
Oil Systems	16	10	0	6	15
Electrical Power	617	220	0	370	587
Communication	93	20	0	81	93

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

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	56,751	2067	4420
Waste Water	34,051	1038	2220
Natural Gas	2,056	38	81
Oil	976	22	38

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	712,097	379,120	369,186	344,930	319,419	286,960
Electric Power		381,793	229,013	109,050	30,369	713

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 11 ignitions that will burn about 0.04 sq. mi 0.00 % of the region's total area.) The model also estimates that the fires will displace about 417 people and burn about 17 (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 20.76 million tons of debris will be generated. Of the total amount, Brick/Wood comprises 40.00% 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 830,520 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 86,330 households to be displaced due to the earthquake. Of these, 53,861 people (out of a total population of 2,301,462) 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	174	52	9	17
	Commuting	1	2	3	1
	Educational	0	0	0	0
	Hotels	98	28	4	9
	Industrial	120	33	5	9
	Other-Residential	4,662	1,354	210	413
	Single Family	22,469	6,652	1,041	2,053
	Total	**27,524**	**8,122**	**1,272**	**2,502**
2 PM	Commercial	9,675	2,914	476	936
	Commuting	13	21	30	6
	Educational	2,508	744	124	241
	Hotels	19	5	1	2
	Industrial	887	245	36	70
	Other-Residential	755	221	35	66
	Single Family	3,702	1,118	180	340
	Total	**17,558**	**5,269**	**883**	**1,662**
5 PM	Commercial	6,908	2,077	341	662
	Commuting	554	815	1,283	253
	Educational	648	200	35	69
	Hotels	29	8	1	3
	Industrial	554	153	23	44
	Other-Residential	1,864	553	89	167
	Single Family	9,054	2,749	445	839
	Total	**19,612**	**6,556**	**2,217**	**2,037**

Economic Loss

The total economic loss estimated for the earthquake is 33,271.07 (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 32,050.78 (millions of dollars); 22 % 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 53 % 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	304.44	783.04	25.14	112.27	1,224.88
	Capital-Related	0.00	129.61	696.54	15.30	39.76	881.21
	Rental	464.05	484.87	636.34	14.90	61.48	1,661.64
	Relocation	1,590.95	218.63	1,002.88	60.72	514.33	3,387.51
	Subtotal	**2,055.00**	**1,137.56**	**3,118.79**	**116.06**	**727.83**	**7,155.24**
Capital Stock Losses							
	Structural	2,227.18	387.31	1,512.02	144.47	228.23	4,499.21
	Non_Structural	6,816.43	2,061.48	4,321.10	581.62	997.89	14,778.52
	Content	1,749.73	479.07	2,358.42	432.45	418.02	5,437.70
	Inventory	0.00	0.00	103.58	75.95	0.58	180.11
	Subtotal	**10,793.35**	**2,927.86**	**8,295.13**	**1,234.49**	**1,644.72**	**24,895.54**
	Total	**12,848.35**	**4,065.42**	**11,413.92**	**1,350.55**	**2,372.55**	**32,050.78**

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	21,652.01	$397.83	1.84
	Bridges	2,646.56	$457.00	17.27
	Tunnels	1.76	$0.00	0.00
	Subtotal	**24300.30**	**854.80**	
Railways	Segments	1,947.31	$14.46	0.74
	Bridges	3.79	$0.33	8.71
	Tunnels	0.00	$0.00	0.00
	Facilities	26.63	$9.21	34.58
	Subtotal	**1977.70**	**24.00**	
Light Rail	Segments	37.15	$2.71	7.28
	Bridges	0.00	$0.00	0.00
	Tunnels	0.00	$0.00	0.00
	Facilities	63.91	$36.72	57.46
	Subtotal	**101.10**	**39.40**	
Bus	Facilities	8.55	$1.51	17.72
	Subtotal	**8.50**	**1.50**	
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	127.81	$18.01	14.09
	Runways	759.28	$13.43	1.77
	Subtotal	**887.10**	**31.40**	
	Total	**27274.80**	**951.20**	

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	32.60	$0.06	0.18
	Distribution Lines	1,135.00	$48.34	4.26
	Subtotal	**1,167.66**	**$48.40**	
Waste Water	Pipelines	0.00	$0.00	0.00
	Facilities	2,480.20	$186.02	7.50
	Distribution Lines	681.00	$24.28	3.57
	Subtotal	**3,161.20**	**$210.30**	
Natural Gas	Pipelines	968.90	$0.88	0.09
	Facilities	0.00	$0.00	0.00
	Distribution Lines	454.00	$8.32	1.83
	Subtotal	**1,422.88**	**$9.20**	
Oil Systems	Pipelines	270.10	$0.22	0.08
	Facilities	0.00	$0.00	0.00
	Subtotal	**270.07**	**$0.22**	
Electrical Power	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**$0.00**	
Communication	Facilities	9.10	$0.97	10.59
	Subtotal	**9.11**	**$0.97**	
	Total	**6,030.92**	**$269.08**	

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

LOSS		Total	%
First Year			
	Employment Impact	477,685	64.35
	Income Impact	962	3.54
Second Year			
	Employment Impact	210,187	28.32
	Income Impact	51	0.19
Third Year			
	Employment Impact	5,123	0.69
	Income Impact	(686)	-2.52
Fourth Year			
	Employment Impact	290	0.04
	Income Impact	(894)	-3.29
Fifth Year			
	Employment Impact	14	0.00
	Income Impact	(906)	-3.33
Years 6 to 15			
	Employment Impact	0	0.00
	Income Impact	(907)	-3.33

Appendix A: County Listing for the Region

Box Elder,UT

Cache,UT

Davis,UT

Juab,UT

Morgan,UT

Rich,UT

Salt Lake,UT

Summit,UT

Tooele,UT

Utah,UT

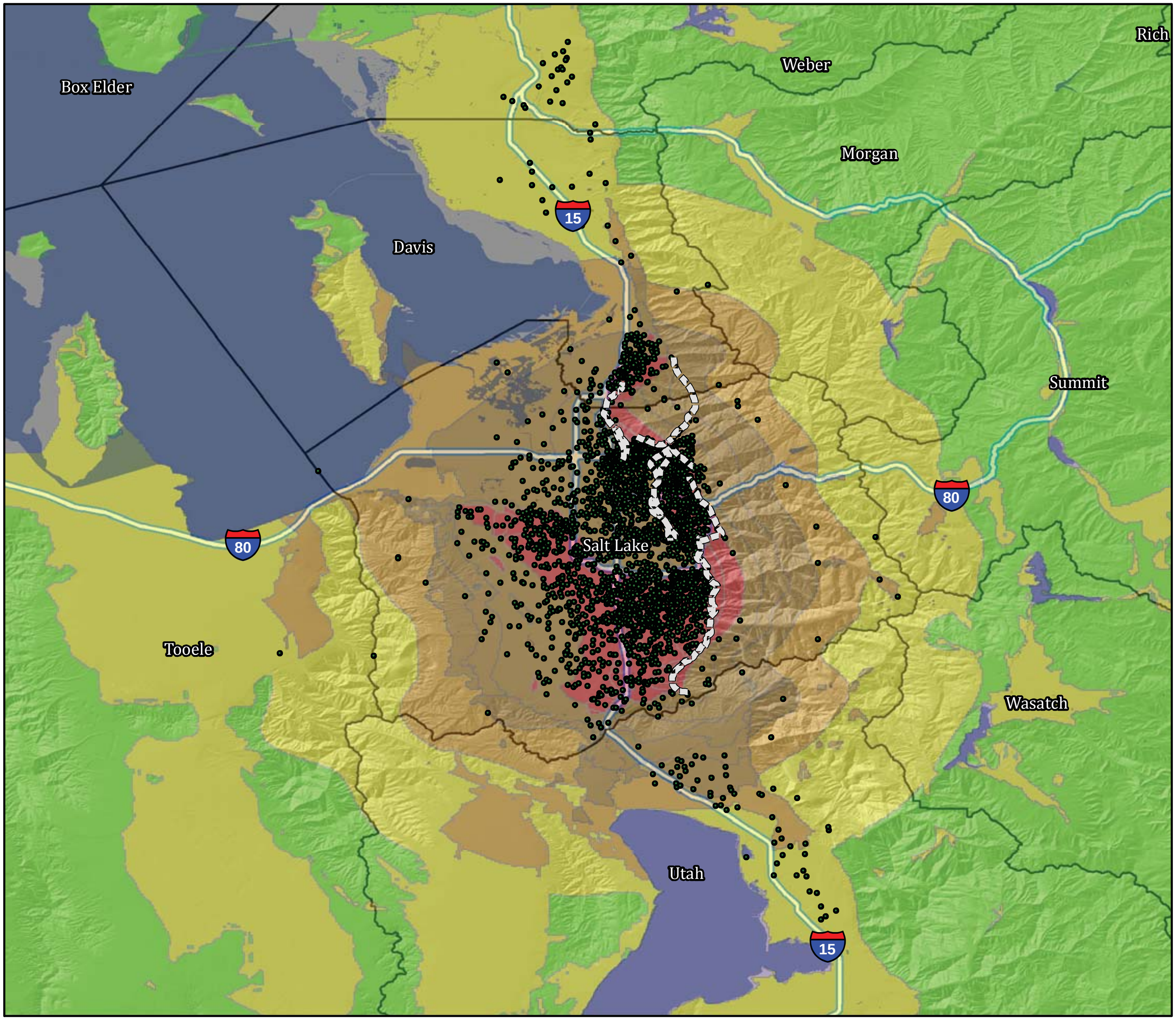
Wasatch,UT

Weber,UT

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Utah					
	Box Elder	47,897	1,653	889	2,543
	Cache	109,347	3,377	2,408	5,785
	Davis	286,502	10,226	4,513	14,739
	Juab	9,563	288	268	557
	Morgan	8,381	304	146	451
	Rich	2,067	248	41	290
	Salt Lake	1,000,299	35,742	28,197	63,940
	Summit	35,644	2,596	721	3,317
	Tooele	54,473	1,780	698	2,478
	Utah	504,990	13,046	8,765	21,812
	Wasatch	20,318	853	412	1,265
	Weber	221,981	8,458	3,976	12,435
Total State		**2,301,462**	**78,571**	**51,034**	**129,612**
Total Region		**2,301,462**	**78,571**	**51,034**	**129,612**

Direct Building Economic Loss -
Earthquake Scenario: Salt Lake City Segment, UT



M 7.0 Salt Lake City Segment

PGA (%g's)

- < 0.02
- 0.02 - 0.04
- 0.04 - 0.09
- 0.09 - 0.18
- 0.18 - 0.34
- 0.34 - 0.65
- 0.65 - 1.05
- 1 Dot = $10,000,000
- Fault Source

Total Direct Economic Loss: $32.1B

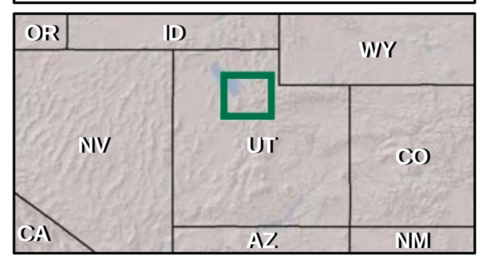
County	Cost Structural Damage	Cost Non-Structural Damage	Total Loss (Including Contents)
Utah	$80,299	$290,752	$648,875
Wasatch	$93	$1,573	$3,073
Box Elder	$10	$72	$132
Tooele	$1,895	$8,356	$17,217
Salt Lake	$4,121,057	$13,480,283	$29,277,229
Weber	$30,863	$83,179	$213,836
Summit	$446	$4,846	$8,763
Morgan	$41	$314	$594
Davis	$264,508	$909,139	$1,881,045
Total	**$4,499,212**	**$14,778,514**	**$32,050,764**

* All values are thousands of dollars

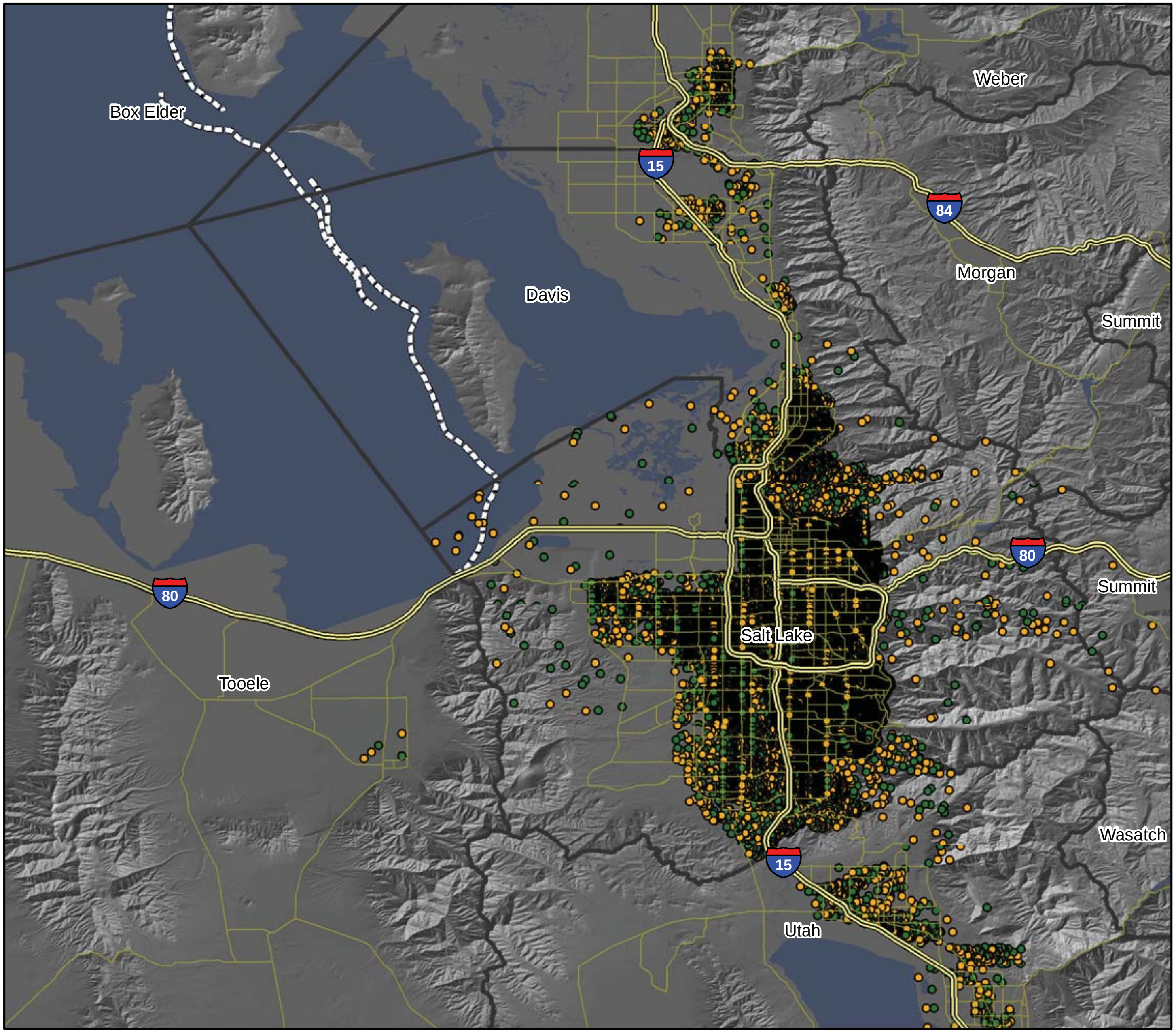
0 3 6 9 12 15 18
Miles

N

1/23/2012 FEMA Region 8 Mitigation



Estimated Displaced Households & Short Term Public Shelter Needs - Earthquake Scenario: Great Salt Lake Segment, UT



M 7.0
Salt Lake City Segment

	Total #
Public Shelter Needs (Individuals)	**53,862**
Displaced Households	**86,330**

1 Dot = 1 Public Shelter Need (Individuals)*

1 Dot = 1 Displaced Household*

** delineated by census tract*

Great Salt Lake Fault

Counties

Interstate

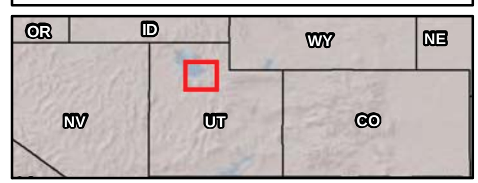
Major Roads

City Boundaries

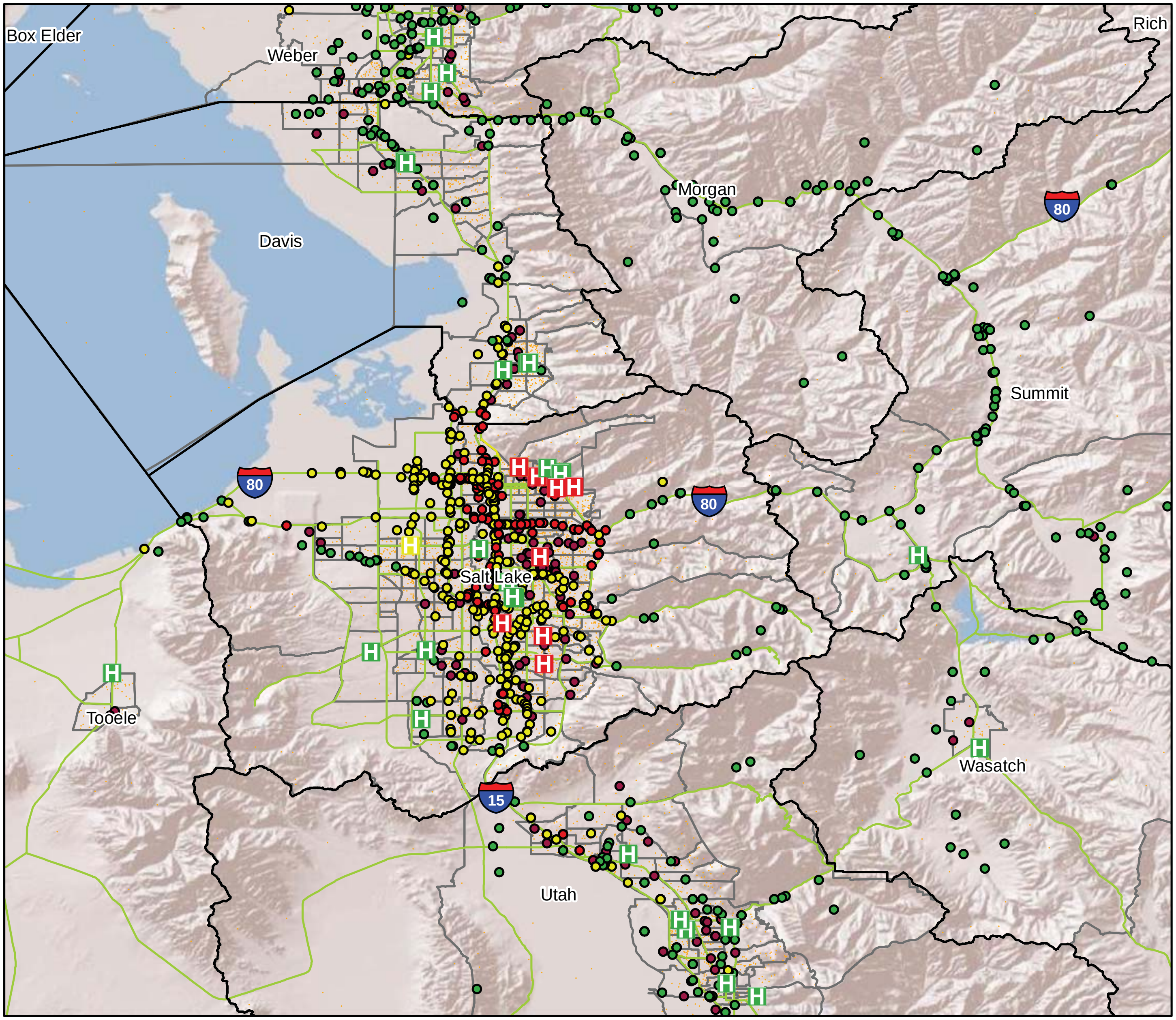
0 2.5 5 7.5 10 12.5 15
Miles

N

1-23-2012 FEMA Region 8 Mitigation



Distribution of Elderly, Impaired Hospitals (Day 1), & Hospital Bed Availability - Earthquake Scenario: Salt Lake City Segment, UT



M 7.0 Salt Lake City Segment

Highway Damage

Damage is expressd 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

Impaired Hospitals (Day 1)

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

- **Low**
- **Moderate**
- **High**

1 Dot = 30 People over 65

Nursing Home

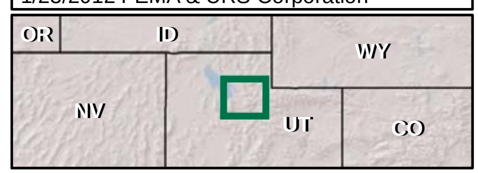
County	Total # of Hospital Beds	Day 1 Beds Available	Injuries Requiring Hospital Treatment
Box Elder	72	72	0
Cache	233	233	0
Davis	632	260	158
Juab	25	25	0
Salt Lake	3929	498	4,598
Tootle	43	31	0
Utah	1094	754	26
Wasatch	20	20	0
Summit	26	26	0
Weber	556	350	0
Total	**6630**	**2269**	**4782**

0 3 6 9 12

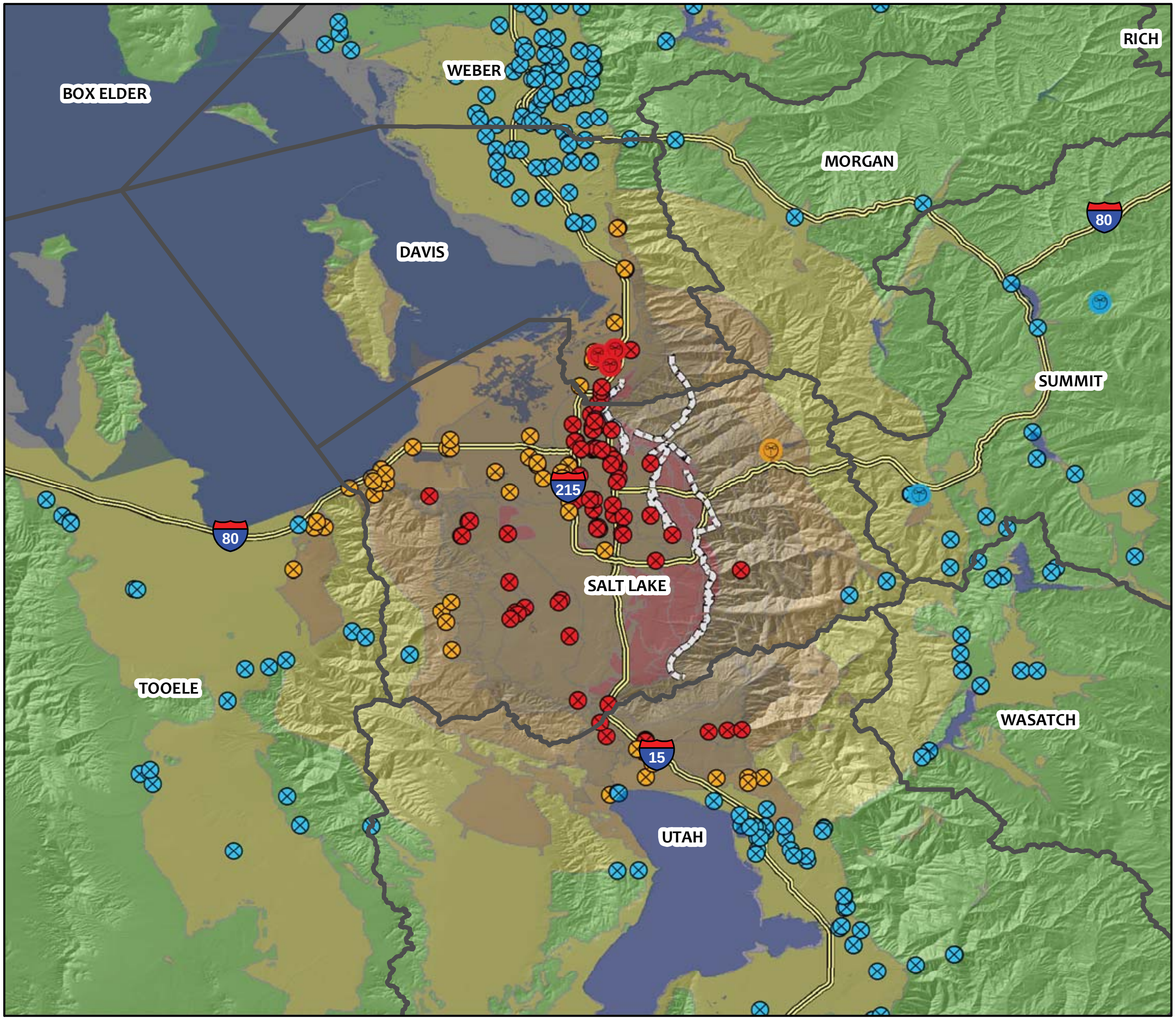
Miles

N

1/23/2012 FEMA & URS Corporation



Electrical, Natural Gas, and Oil Facility Damage - Earthquake Scenario: Salt Lake City Segment, UT



M 7.0 Salt Lake City Segment

Utility Damage (at least moderate)

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

PGA (%g's)

- < 0.02
- 0.02 - 0.04
- 0.04 - 0.09
- 0.09 - 0.18
- 0.18 - 0.34
- 0.34 - 0.65
- 0.65 - 1.05

Counties
Fault Source
Interstate

Oil Facility

- **Low**
- **Moderate**
- **High**

Electric Power Facility

- **Low**
- **Moderate**
- **High**

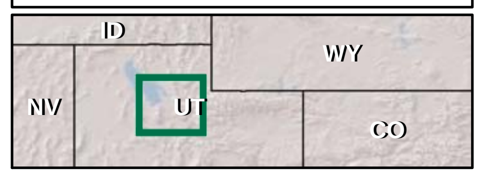
Natural Gas Facility

- **Low**
- **Moderate**
- **High**

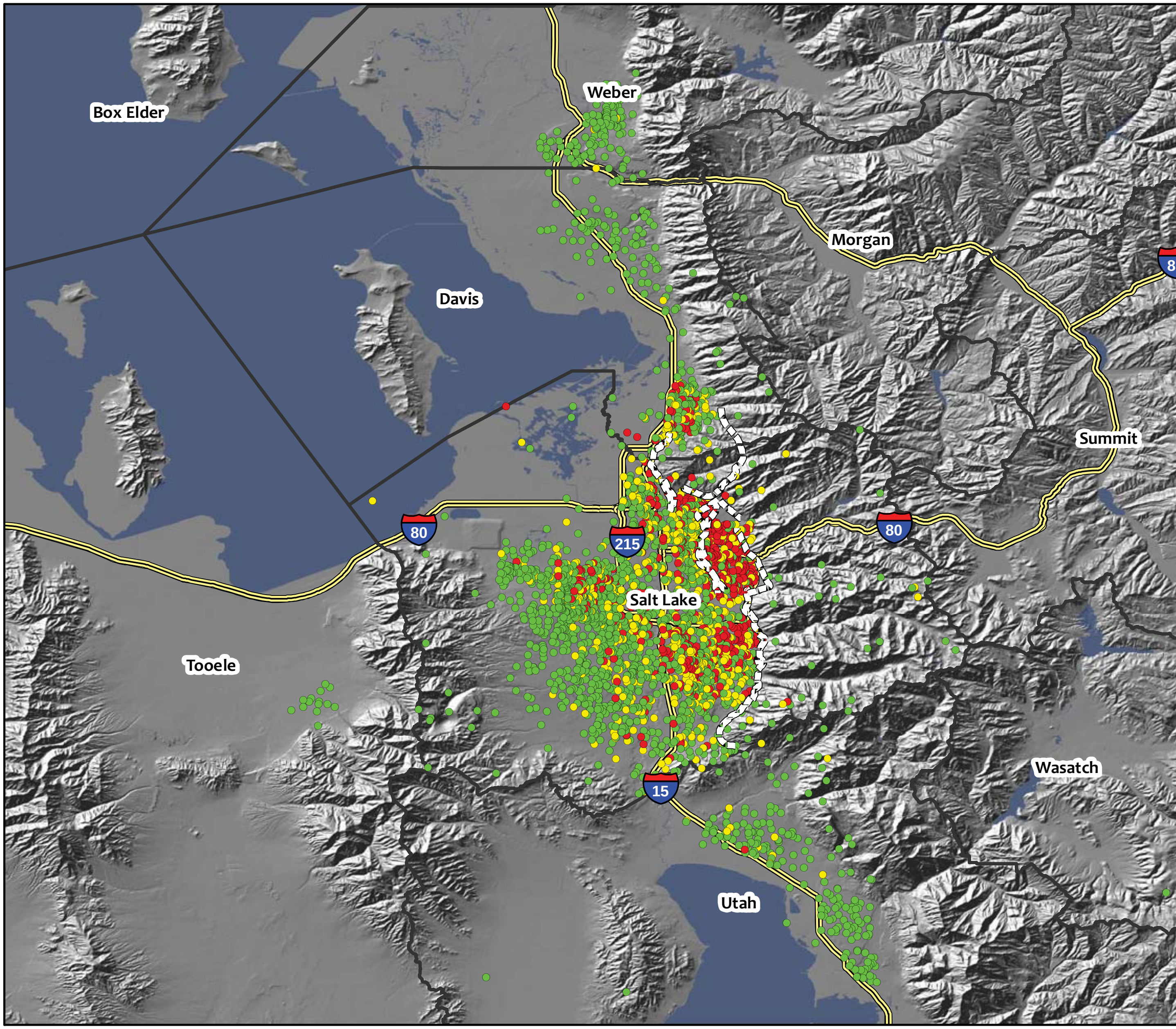
0 3 6 9 12 15 18
Miles

N

1/23/2012 FEMA Region 8 Mitigation



Estimated Building Inspection Needs - Earthquake Scenario: Salt Lake City Segment, UT



M 7.0 Salt Lake City Segment

	Estimated # of Structures	Estimated # of Inspectors Needed
Red (Complete)	56,242	375
Yellow (Extensive)	59,990	800
Light Green (Slight/ Moderate)	191,456	1,276
Total	307,688	2,451

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

Red Tag (Complete Damage)

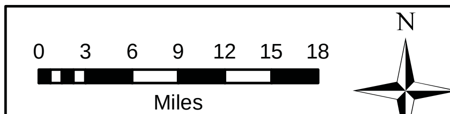
Yellow Tag (Extensive Damage)

Green Tag (Slight/Moderate Damage)

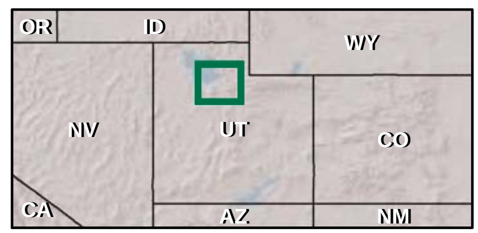
***1 Dot = 100 (by census tract)**

Fault Source

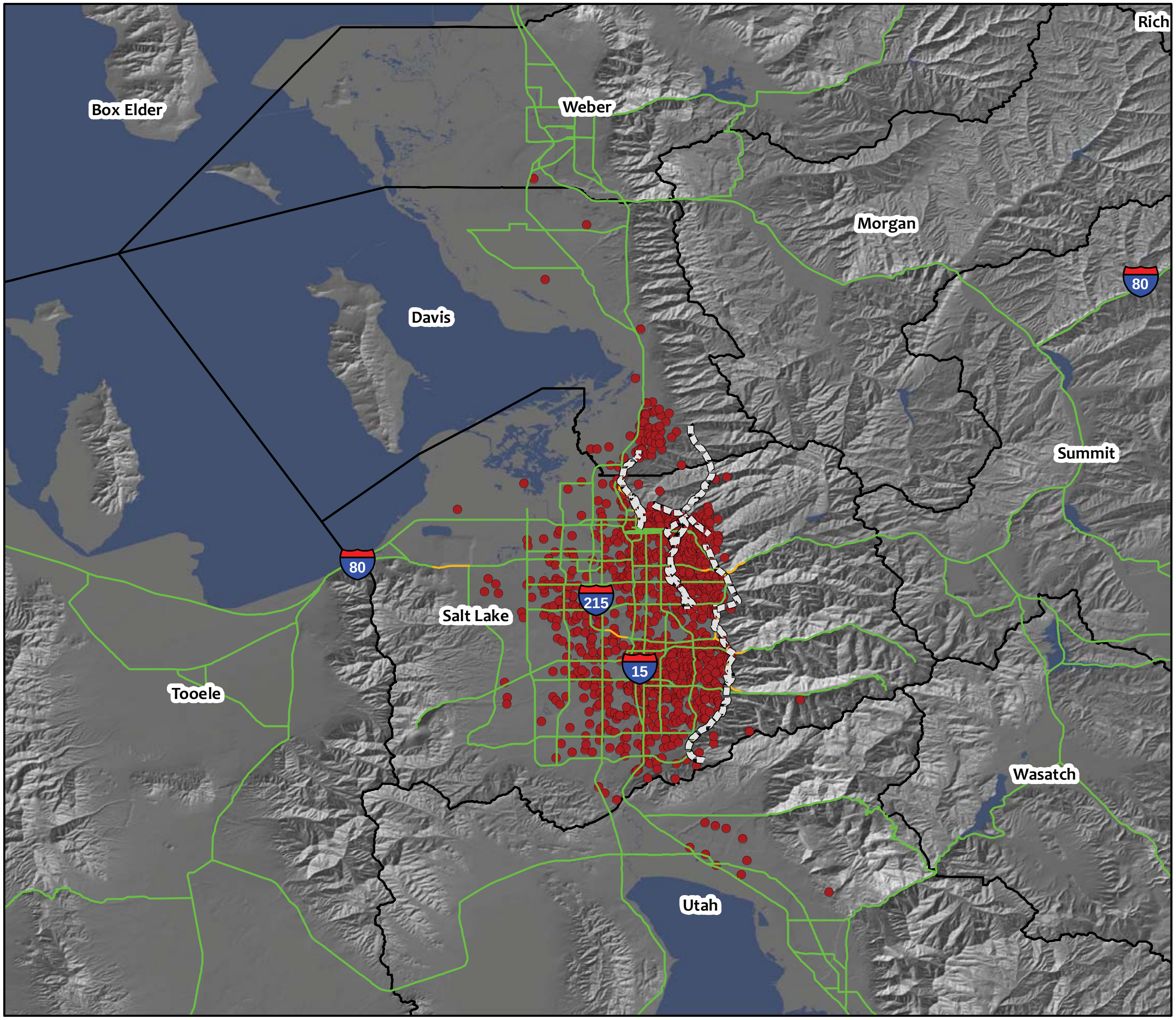
Interstate



1/23/2012 FEMA Region 8 Mitigation



Estimated Concrete, Steel Debris and Highway Damage - Earthquake Scenario: Salt Lake City Segment, UT



M 7.0 Salt Lake City Segment

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

Highway Damage

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

Highway Segment Impact

Low
Moderate
High

Fault Source
Counties

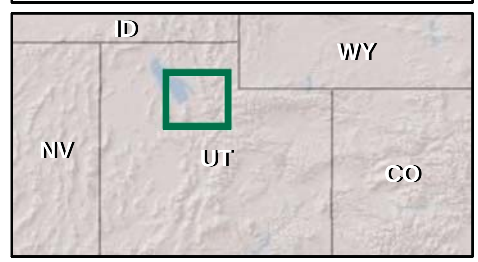
County	Brick and Wood (tons)	Concrete and Steel (tons)	Estimated Truck Loads*
Davis	439,000	642,000	43,240
Salt Lake	7,688,000	11,570,000	770,320
Summit	1,000	1,000	80
Tooele	4,000	2,000	240
Utah	127,000	154,000	11,240
Weber	98,000	37,000	5,400
Total	**8,357,000**	**12,406,000**	**830,520**

* Truck loads estimated at 25 tons per truck

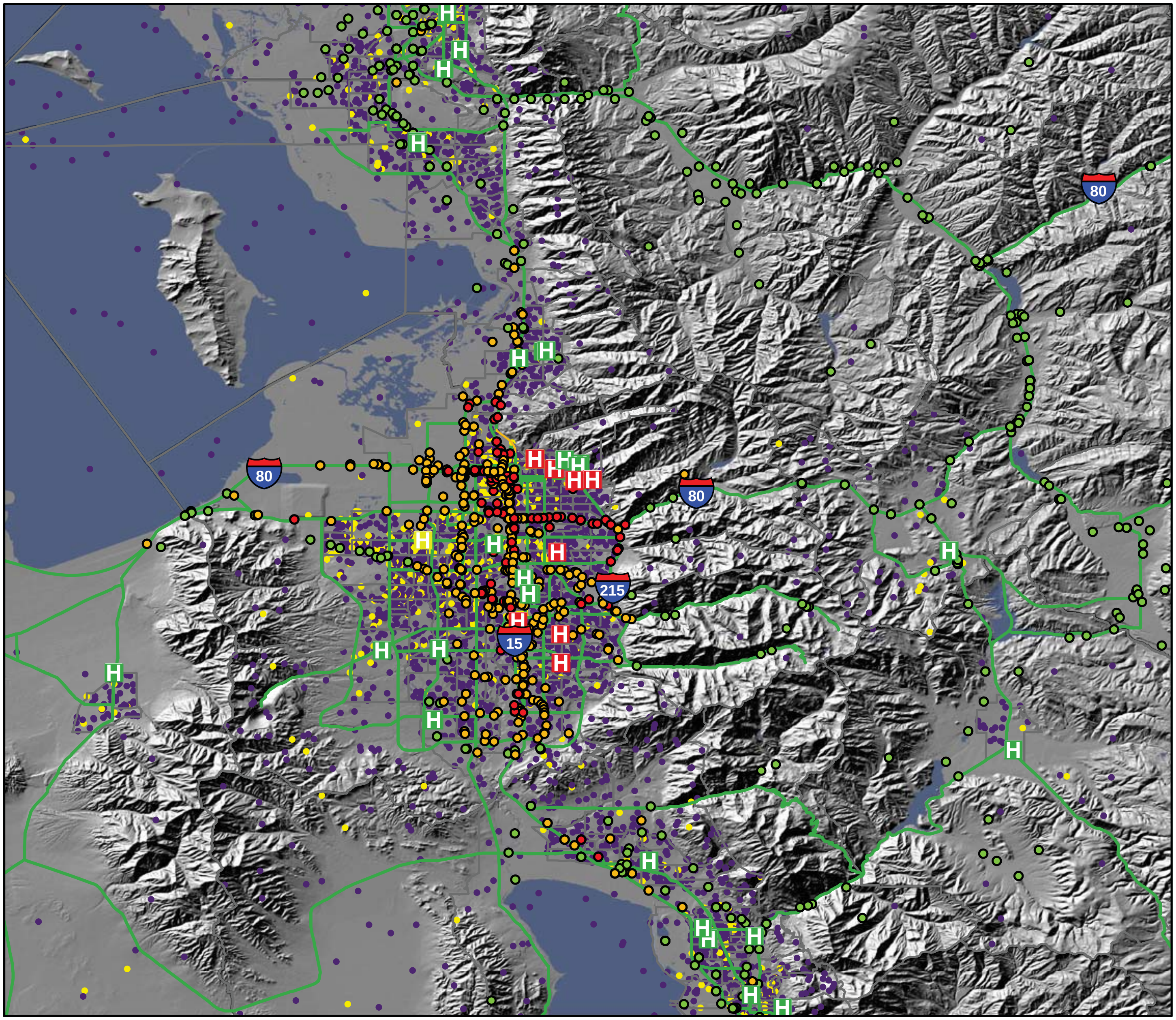
0 3 6 9 12 15 18
Miles

N

1/23/2012 FEMA Region 8 Mitigation



Demographic Distribution and Highway Functionality
Earthquake Scenario: Salt Lake City Segment, UT



M 7.0 Salt Lake City Segment

Highway Damage

Damage is expressd 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

Demographics

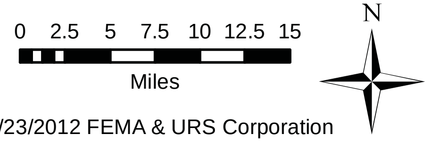
1 Dot = 500 People (by census tract)

- English Speaking
- Potentially Non-English Speaking

Impaired Hospitals (Day 1)

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

- Low
- Moderate
- High



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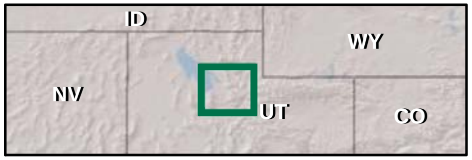
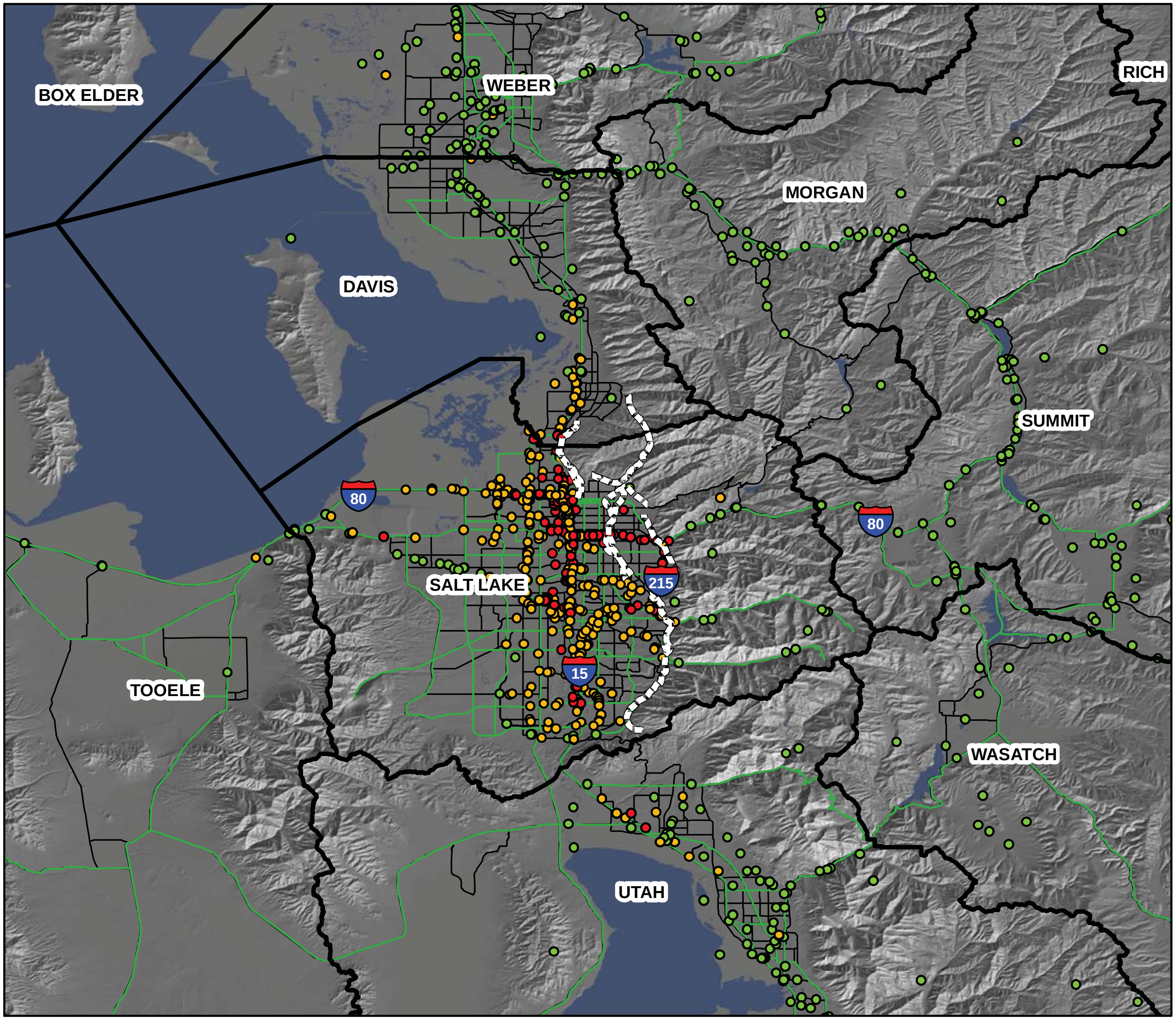


Estimated Highway Infrastructure Damage - Earthquake Scenario: Salt Lake City Segment, UT



M 7.0 Salt Lake City Segment

Highway Damage

Damage is expressd 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

County	Total # of Bridges	# of Bridges Needing Priority Inspection	# of Bridge Engineers Needed*
Salt Lake	608	420	56
Juab	80	0	0
Weber	141	0	0
Tooele	54	0	0
Cache	62	0	0
Rich	23	0	0
Morgan	80	0	0
Summit	156	0	0
Wasatch	24	0	0
Box Elder	230	0	0
Utah	314	75	10
Davis	130	36	5
Total	**1,902**	**531**	**71**

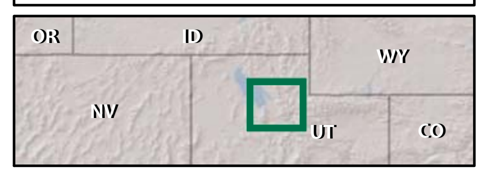
* For Priority Inspections only, assuming that 2 engineers can inspect 5 bridges a day for 3 days

Fault Source — Major Roads

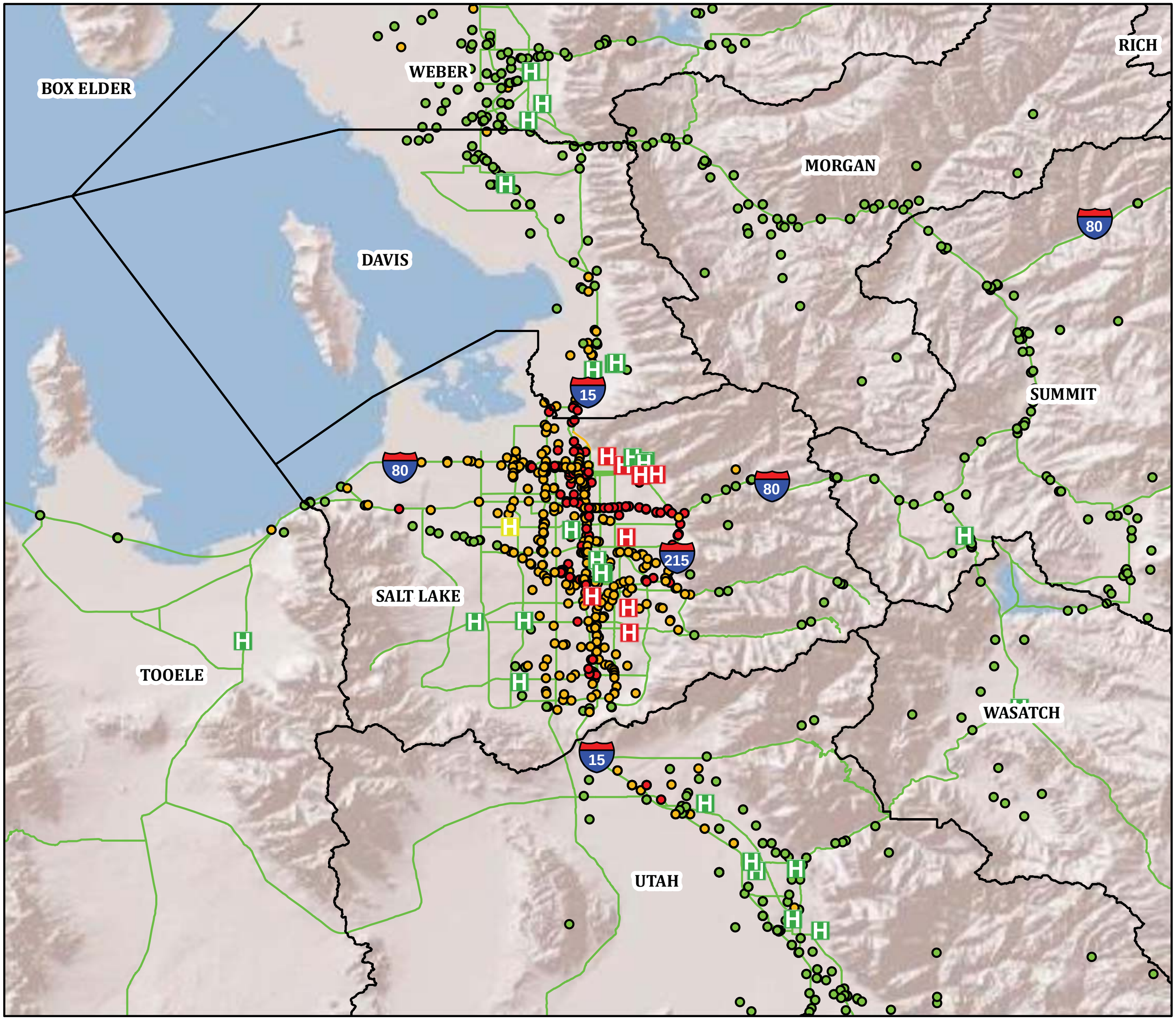
0 5 10 15 20
Miles

N

1/23/2012 FEMA Region 8 Mitigation



Impaired Hospitals (Day 1), Hospital Bed Availability, & Highway Functionality - Earthquake Scenario: Salt Lake City Segment, UT



M 7.0 Salt Lake City Segment

Highway Damage

Damage is expressd 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

Impaired Hospitals (Day 1)

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

- **Low**
- **Moderate**
- **High**

County	Total # of Hospital Beds	Day 1 Beds Available	Injuries Requiring Hospital Treatment
Box Elder	72	72	0
Cache	233	233	0
Davis	632	260	158
Juab	25	25	0
Salt Lake	3929	498	4,598
Tootle	43	31	0
Utah	1094	754	26
Wasatch	20	20	0
Summit	26	26	0
Weber	556	350	0
Total	**6630**	**2269**	**4782**

0 3 6 9 12 15 18
Miles

N

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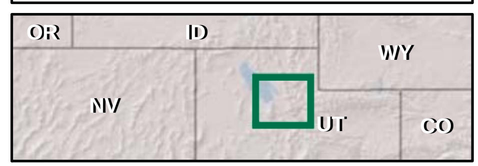
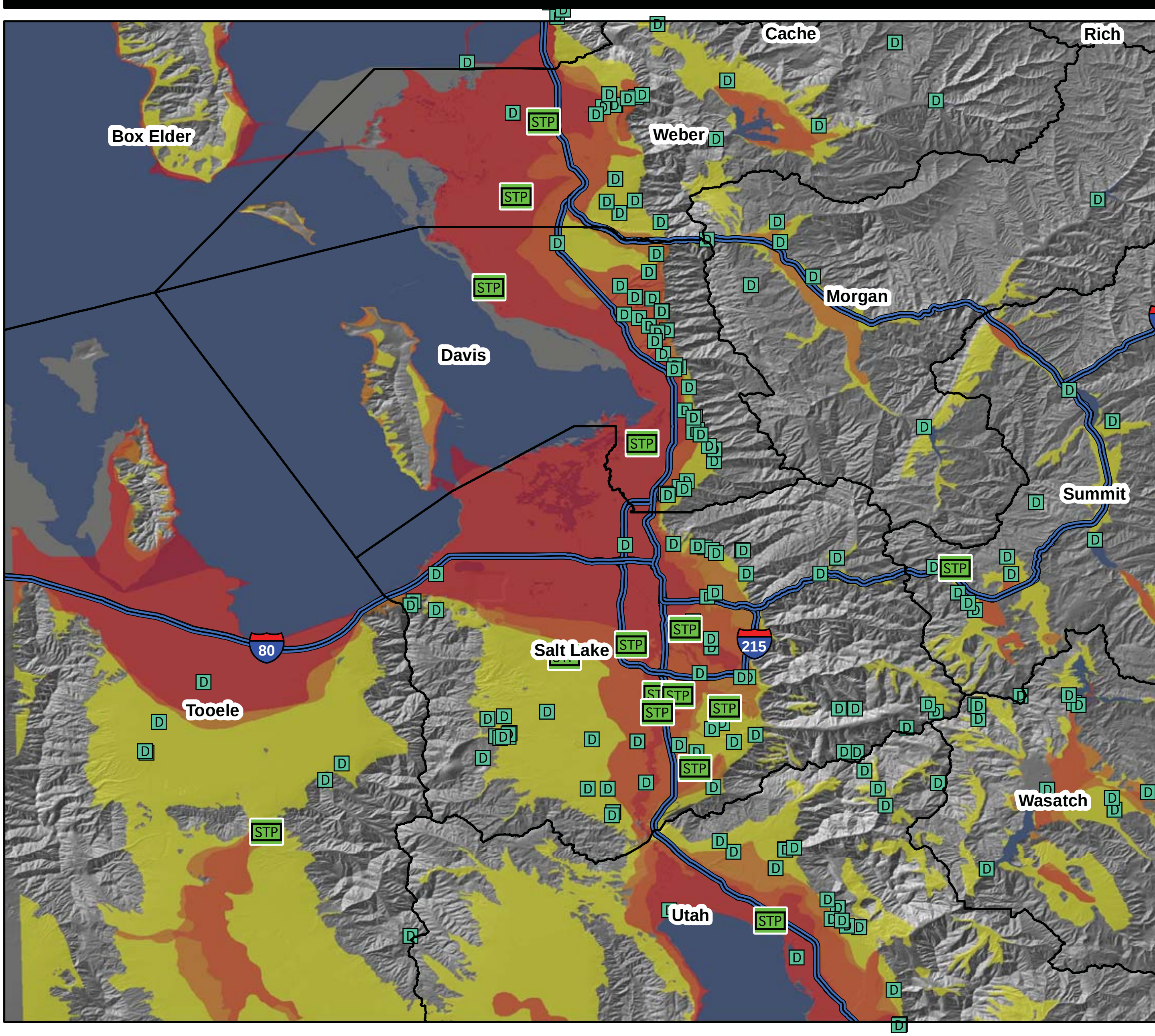


Water Line, Sewage Treatment Facility Distribution and Liquefaction Susceptibility - Earthquake Scenario: Salt Lake City Segment, UT



M 7.0 Salt Lake City Segment

Liquefaction Susceptibility

Low
High
Medium
Very High

STP Sewage Treatment Facilities

D Dams

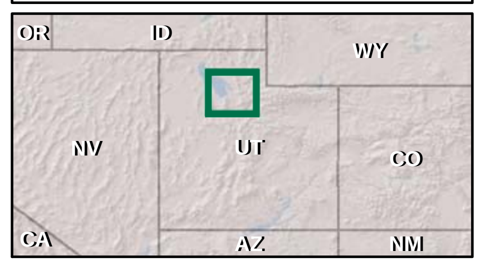
County	# Households without Potable Water (at Day 1)	Daily Potable Water Needs Per Person (Gallons/day)	Number of Truckloads needed Daily
Davis	53,745	161,235	34
Salt Lake	323,845	971,535	204
Utah	1,530	4,590	1
Total	**379,120**	**1,137,360**	**239**

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

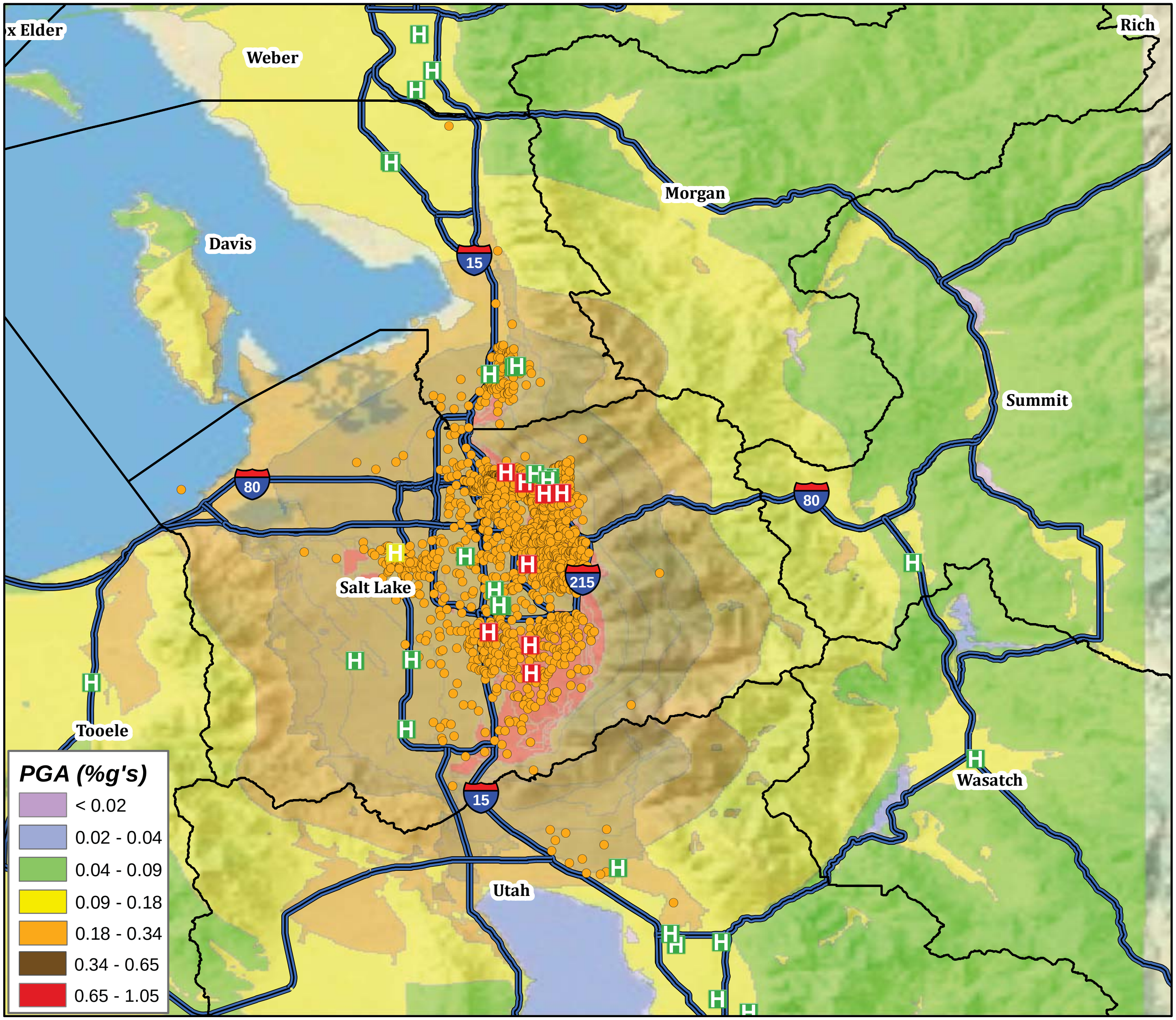
N

0 10 20 Miles

1/23/2012 FEMA Region 8 Mitigation



Life Threatening Injuries Assessment - Earthquake Scenario: Salt Lake City Segment, UT



M 7.0 Salt Lake City Segment

Impaired Hospitals (Day 1)

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

- Low
- Moderate
- High

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

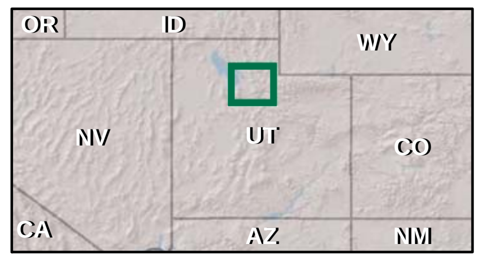
Structure Type	Red (Complete)	Collapse Rates for Complete Damage	Total Collapse
Wood	3,520	3%	106
Steel	819	6%	49
Concrete	450	10%	45
Precast	70	13%	9
Reinforced Masonry	6,466	10%	647
Unreinforced Masonry	44,409	15%	6,661
Manufactured Housing	508	3%	15
Total	56,242		7,532

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

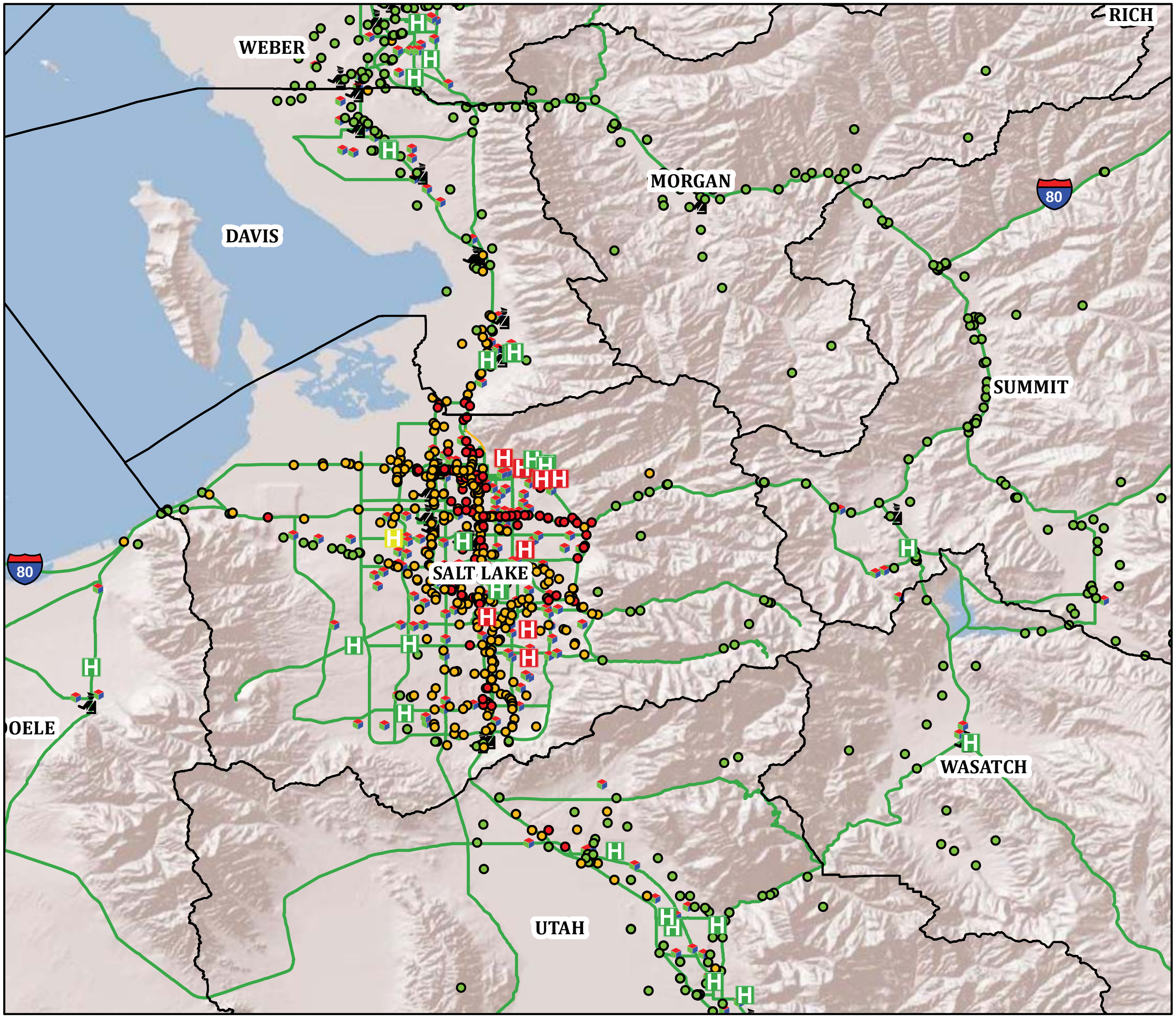
0 8 16 Miles

N

1/23/2012 FEMA & URS Corporation



Correctional and Daycare Facilities, Impaired Hospitals (Day 1), and Highway Functionality - Earthquake Scenario: Salt Lake City Segment, UT



M 7.0 Salt Lake City Segment

Highway Damage

Damage is expressd 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 extensively damaged.

- **Low**
- **Moderate**
- **High**

Correctional Facilities

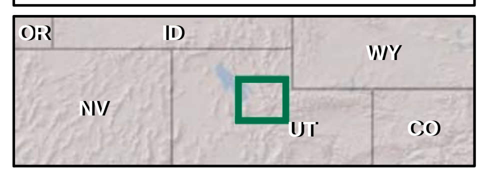
Daycare Facilities

0 2 4 6 8 10 12

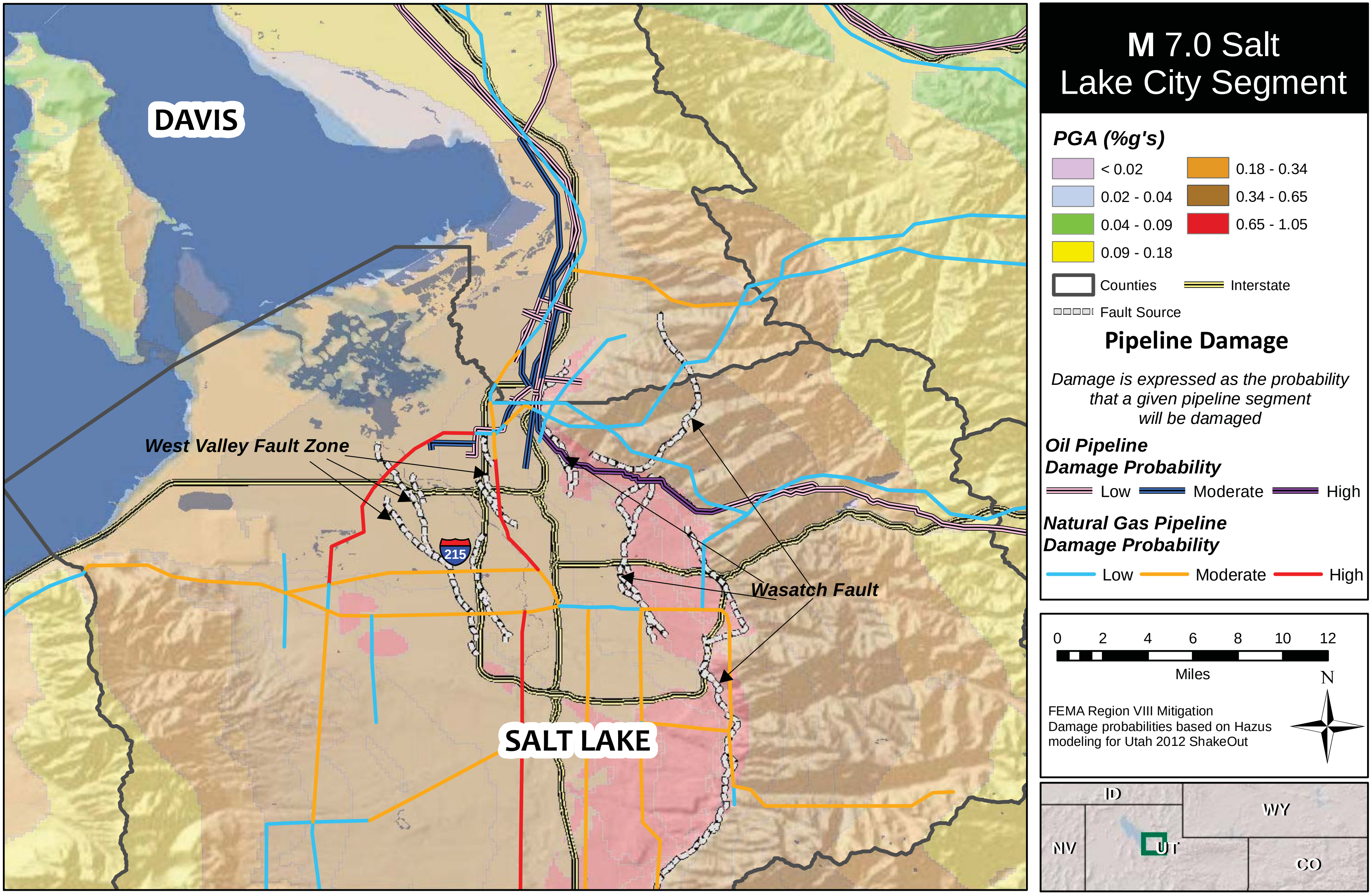
Miles

N

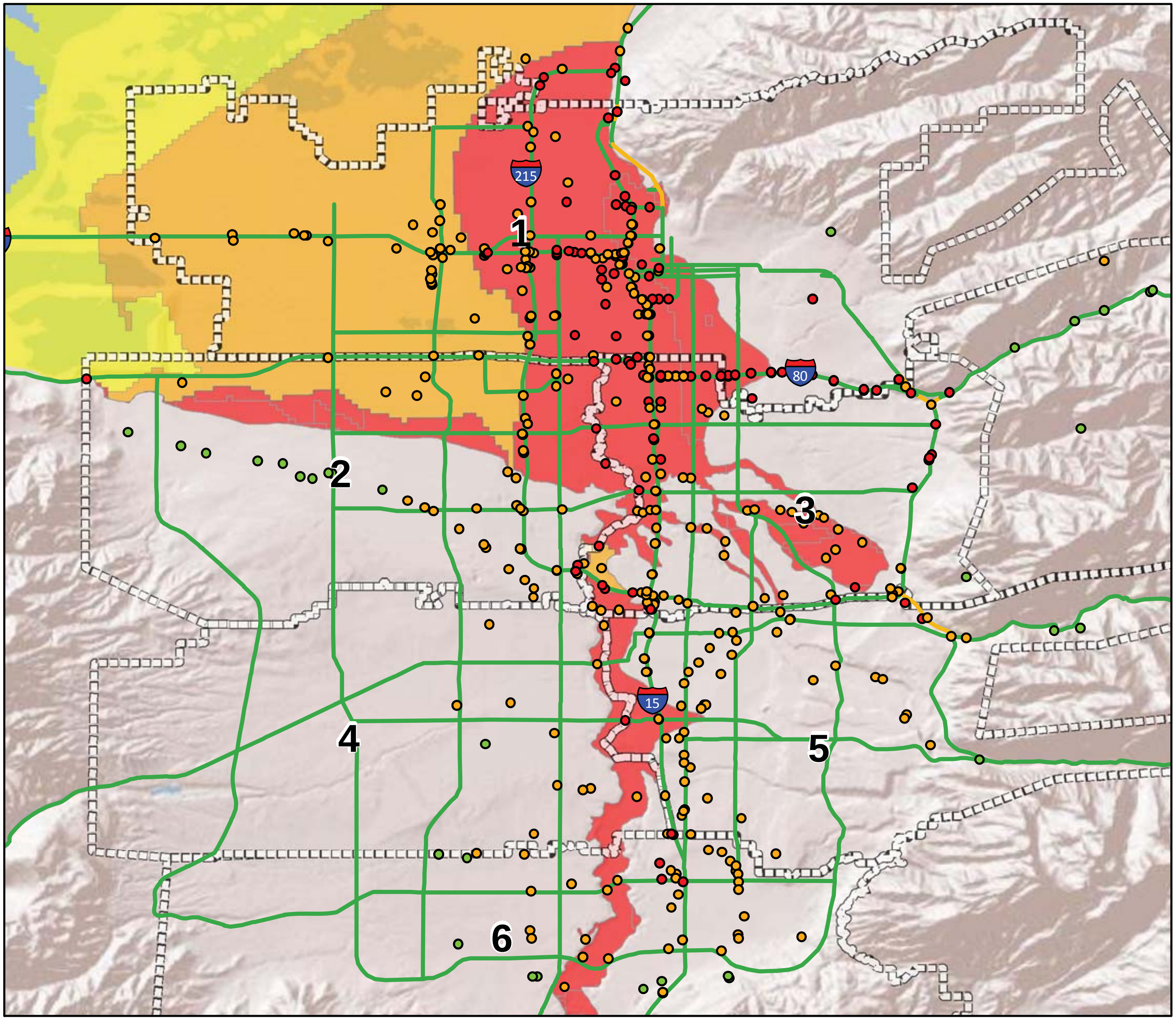
1/23/2012 FEMA & URS Corporation



Oil and Natural Gas Pipeline Probability of Damage
Salt Lake City Segment, UT



Day 1: Estimated Impassable Areas-
Earthquake Scenario: Salt Lake City Segment, UT



M 7.0 Salt Lake City Segment

Highway Damage

Damage is expressd 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

Impassable Areas Based on Potential Ground Deformation

Local Variation is Very Likely, Impassable Areas may Include Significant Liquefaction Debris and Flooding

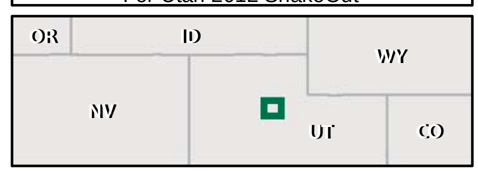
High Moderate Low

Response Area	Potential Debris on Major Roadways (Tons)
1	1,504,930
2	572,819
3	791,815
4	52,027
5	155,918
6	54,241
Total	**3,131,750**

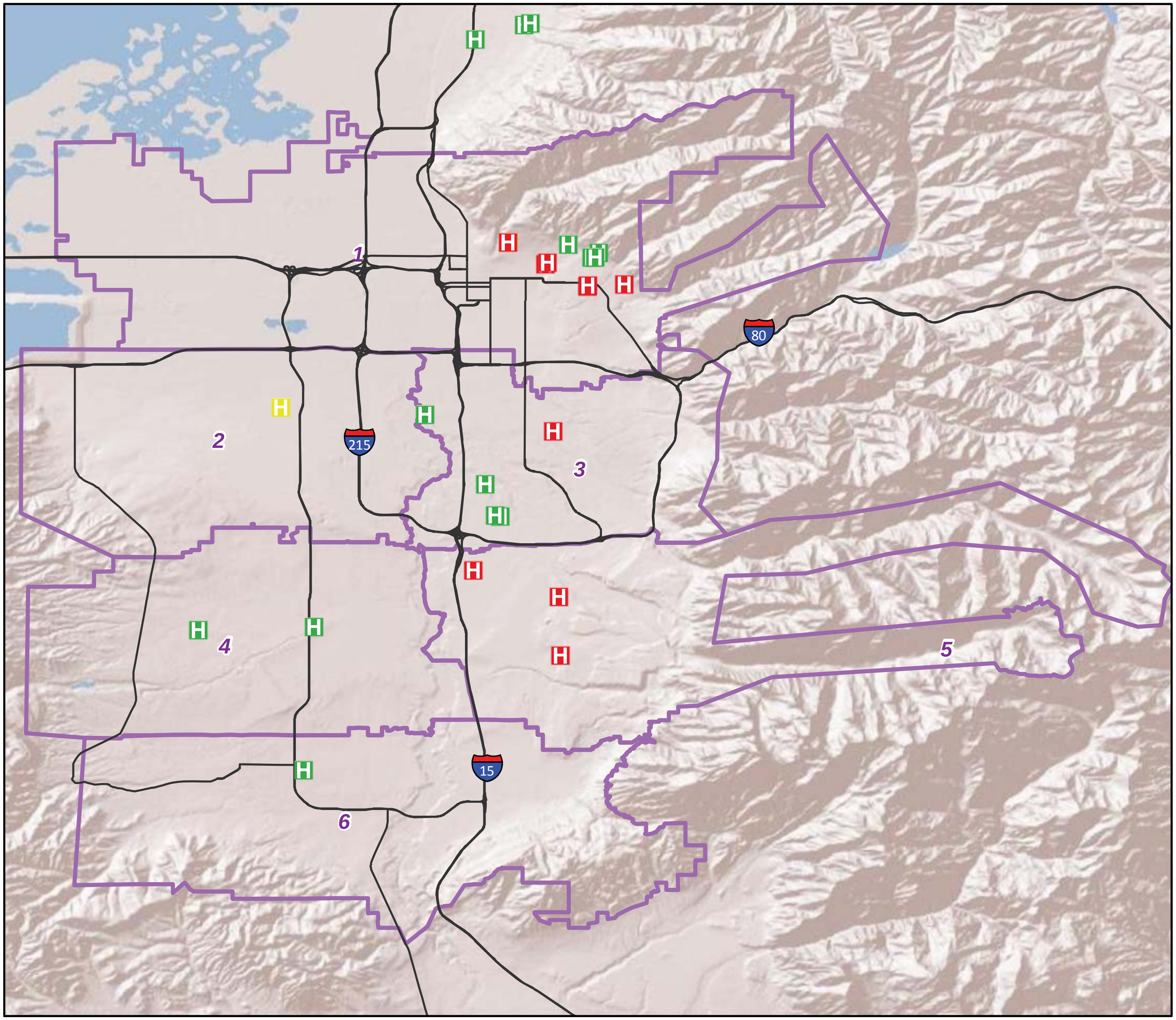
Response Divisions

0 2 4 6
Miles
N

FEMA Region VIII Mitigation GIS
Loss estimation based on Hazus modeling
For Utah 2012 ShakeOut



Impaired Hospitals (Day 1), Potential Damage and Bed Availability ~ Earthquake Scenario: Salt Lake City Segment, UT



M 7.0 Salt Lake City Segment

Impaired Hospitals (Day 1)

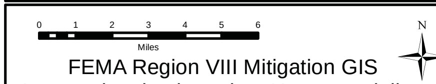
Damage is expressed as the probability that a given hospital will be at least extensively damaged.

- **Low**
- **Moderate**
- **High**

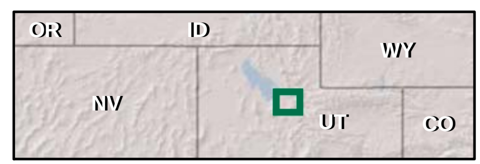
Response Area Divisions

Response Division	Total # of Hospital Beds	# of Surge Capacity Beds	Day 1 Beds Available	Injuries requiring hospital treatment @ 2pm
1	2244	1143	13	1273
2	139	169	0	175
3	931	482	456	435
4	329	213	27	37
5	198	128	0	387
6	88	106	3	45

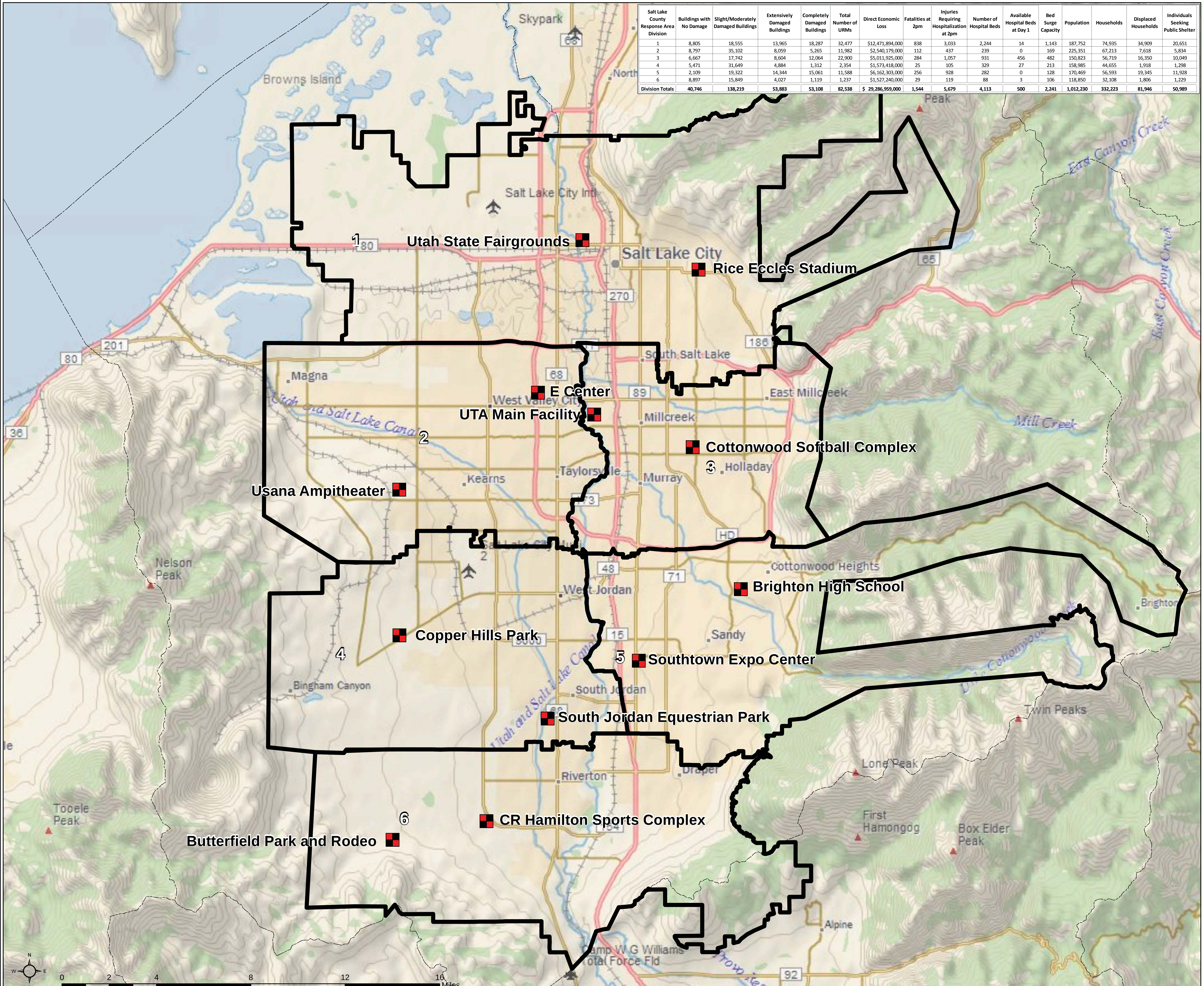
County	Total # of Hospital Beds	Day 1 Beds Available	# of Surge Capacity Beds	Injuries Requiring Hospital Treatment @ 2pm
Box Elder	72	72	254	0
Cache	233	233	175	0
Davis	632	260	378	158
Juab	25	25	na	0
Salt Lake	3929	498	2241	4,598
Tootle	43	31	22	0
Utah	1094	754	643	26
Wasatch	20	20	24	0
Summit	26	26	41	0
Weber	556	350	460	0
Total	6630	2269	4238	4782



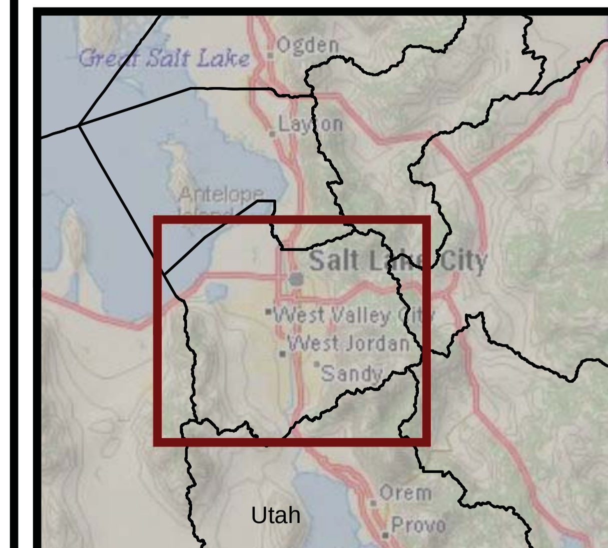
FEMA Region VIII Mitigation GIS
Loss estimation based on Hazus modeling
For Utah 2012 ShakeOut



Salt Lake City, Utah: *Staging Areas and Response Divisions*



Salt Lake County Response Area Division	Buildings with No Damage	Slight/Moderately Damaged Buildings	Extensively Damaged Buildings	Completely Damaged Buildings	Total Number of URMs	Direct Economic Loss	Fatalities at 2pm	Injuries Requiring Hospitalization at 2pm	Number of Hospital Beds	Available Hospital Beds at Day 1	Bed Surge Capacity	Population	Households	Displaced Households	Individuals Seeking Public Shelter
1	8,805	18,555	13,965	18,287	32,477	$12,471,894,000	838	3,033	2,244	14	1,143	187,752	74,935	34,909	20,651
2	8,797	35,102	8,059	5,265	11,982	$2,540,179,000	112	437	239	0	169	225,351	67,213	7,618	5,834
3	6,667	17,742	8,604	12,064	22,900	$5,011,925,000	284	1,057	931	456	482	150,823	56,719	16,350	10,049
4	5,471	31,649	4,884	1,312	2,354	$1,573,418,000	25	105	329	27	213	158,985	44,655	1,918	1,298
5	2,109	19,322	14,344	15,061	11,588	$6,162,303,000	256	928	282	0	128	170,469	56,593	19,345	11,928
6	8,897	15,849	4,027	1,119	1,237	$1,527,240,000	29	119	88	3	106	118,850	32,108	1,806	1,229
Division Totals	**40,746**	**138,219**	**53,883**	**53,108**	**82,538**	**$ 29,286,959,000**	**1,544**	**5,679**	**4,113**	**500**	**2,241**	**1,012,230**	**332,223**	**81,946**	**50,989**



Data Layer/ Map Description(s):

Provide general aerial extent of the area with points of interest such as major highways, roads, streets, rivers, bodies of water and city boundaries highlighted. Due to the aerial extent of the map not all points of interest listed in the legend will be visible at scale.

Map Legend:

- Staging Areas
- Response Divisions
- Major Highway
- Major Route
- Street
- County Boundary
- River / Stream
- City / Town
- City Boundary
- Bodies of Water
- Railroads

Data Sources:
Streets, Major Highways, Interstates, Imagery and Roads Provided by DeLorme Base Maps and Rivers Provided by DeLorme Base Maps. Staging Areas Response Divisions Provided by The State of Utah.