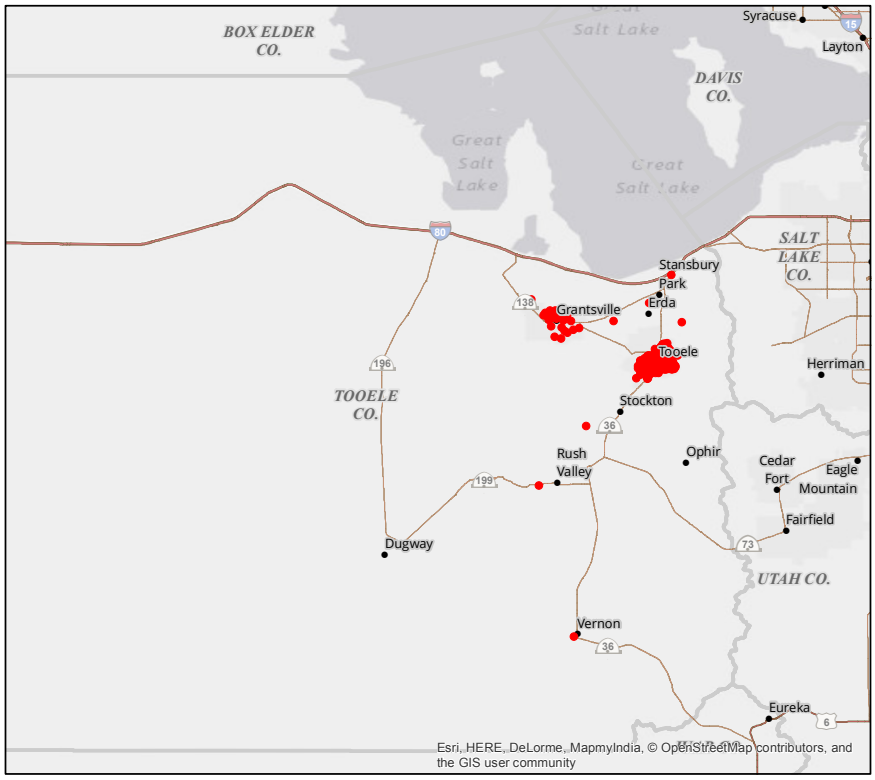
APPENDIX L - TOOELE COUNTY M6.5 HAZUS EQ SCENARIO

Courtesy of Josh Groeneveld with the Utah Division of Emergency Management

Direct Building Economic Loss



M 6.5 Tooele Earthquake

● 1 Dot = $1,000,000

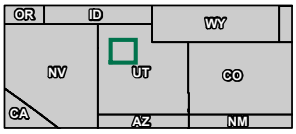
County	Cost Structural Damage	Cost Non-Structural Damage	Total Loss (Including Contents)
Tooele	$30,297	$92,449	$196,926
Total	**$30,297**	**$92,449**	**$196,926**

All values are in thousands of dollars
* Total loss = structural, nonstructural, contents, and inventory damage, as well as income losses resulted form relocation, capital related losses, wage loss, and rental income loss

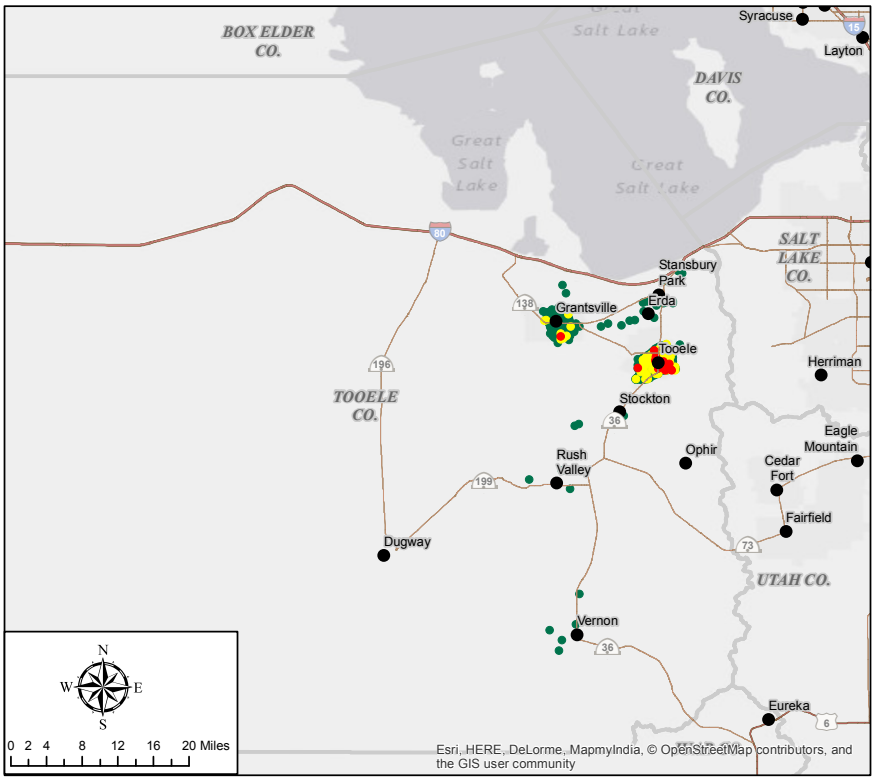
N W E S

0 2 4 8 12 16 20 Miles

Loss Estimation Data: HAZUS-MH 2.1
Reference Data: Utah Automated Geographic Reference Center
Basemap Data: ESRI
Analysis Performed By: Utah Division of Emergency Management



Estimated Building Inspection Needs



M 6.5 Tooele Earthquake

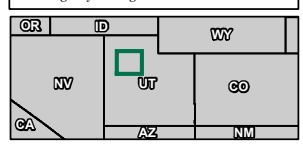
	Estimated # of Structures	Estimated # of Inspectors Needed
Red (Complete)	147	1
Yellow (Extensive)	764	10
Light Green (Slight/ Moderate)	6,547	44
Total	7,458	55

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

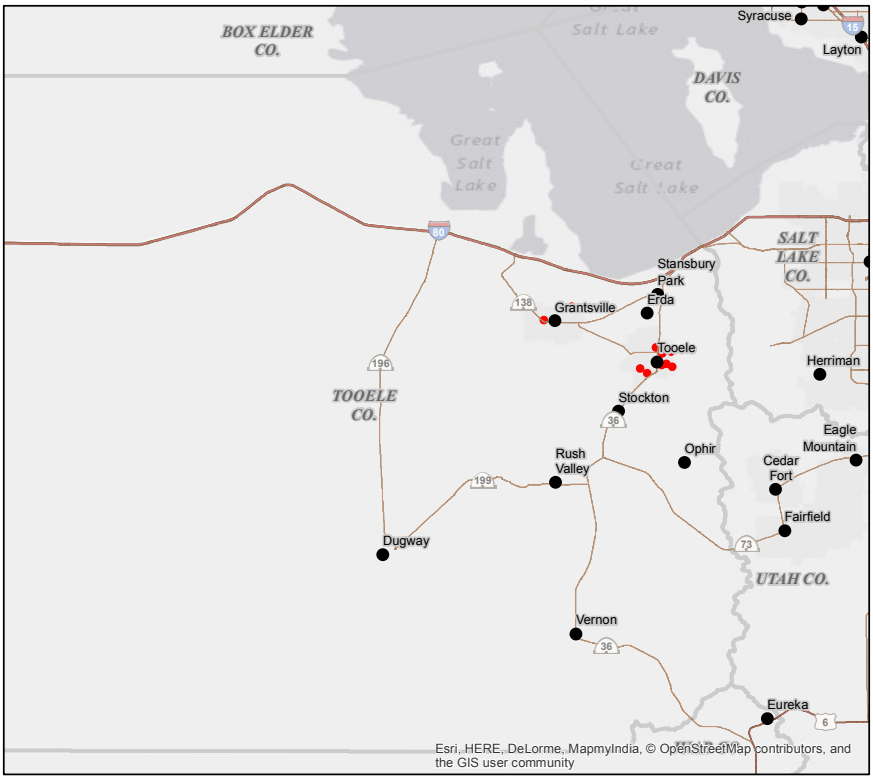
1 Dot = 10 Buildings (by census tract)

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

Loss Estimation Data: HAZUS-MH 2.1
Reference Data: Utah Automated Geographic Reference Center
Basemap Data: ESRI
Analysis Performed By: Utah Division of Emergency Management



Estimated Concrete and Steel Debris



M 6.5 Tooele Earthquake

● 1 Dot = 5 thousand tons of Concrete and Steel Debris (by census tract)

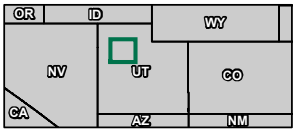
County	Brick and Wood (tons)	Concrete and Steel (tons)	Estimated Truck Loads*
Tooele	46,000	53,000	3,960
Total	**46,000**	**53,000**	**3,960**

* Truck loads estimated at 25 tons per truck

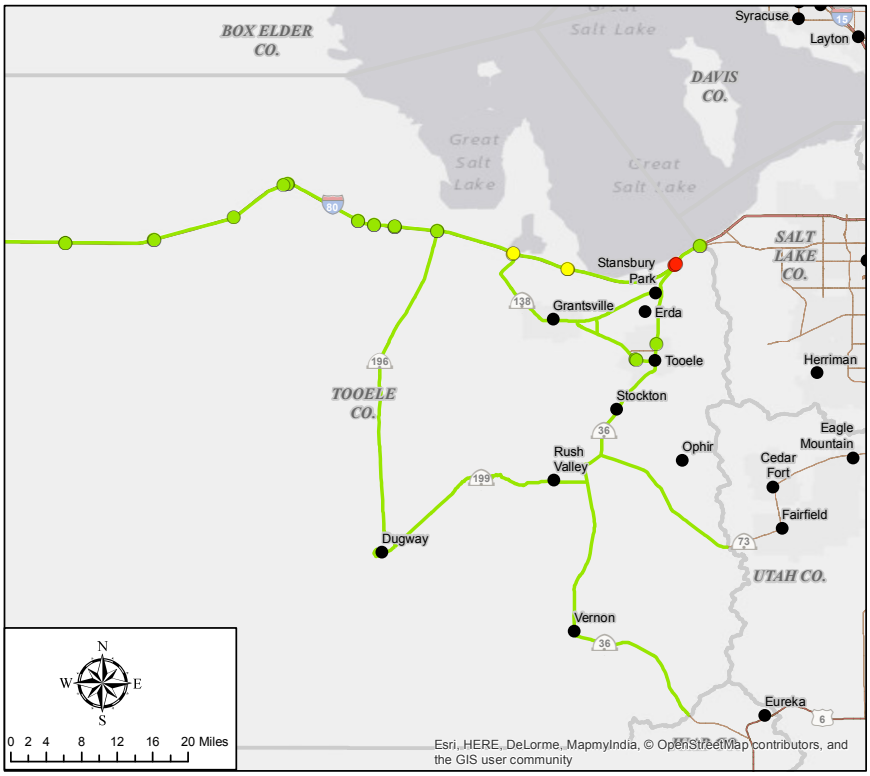
N W E S

0 2 4 8 12 16 20 Miles

Loss Estimation Data: HAZUS-MH 2.1
Reference Data: Utah Automated Geographic Reference Center
Basemap Data: ESRI
Analysis Performed By: Utah Division of Emergency Management



Highway Infrastructure Damage



M 6.5 Tooele Earthquake

Highway Impacts (at least moderate)

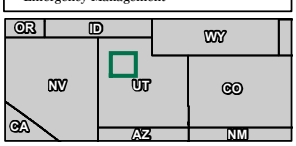
Major Roadway Bridge	Highway Segment
● High	— High
● Moderate	— Moderate
● Low	— Low

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

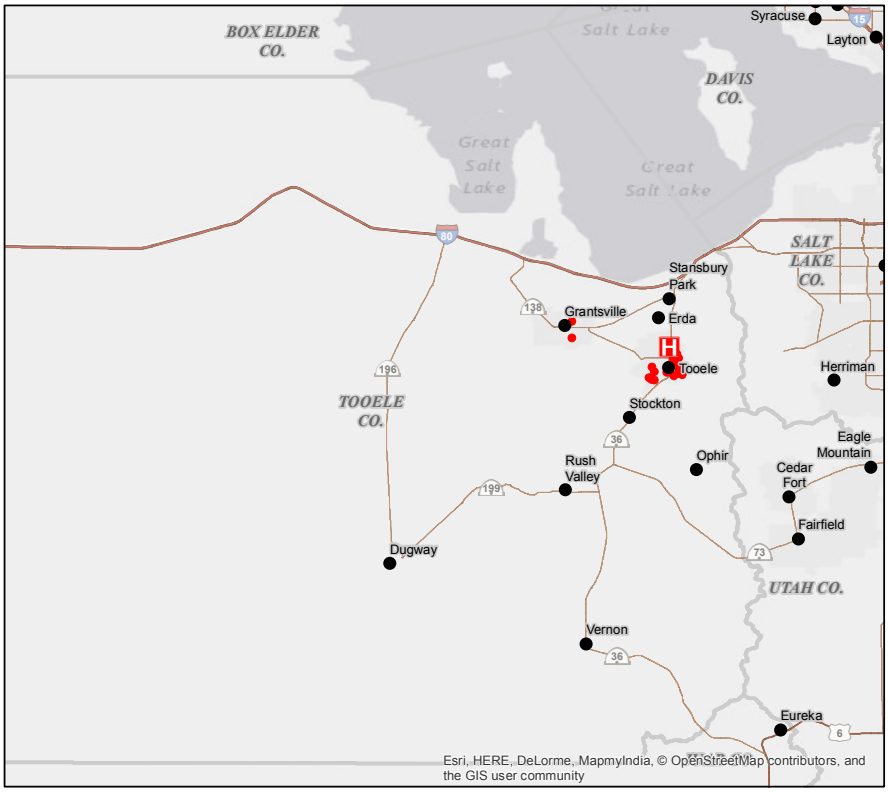
County	Total # of Bridges	# of Bridges Needing Priority Inspection	# of Bridge Engineers Needed*
Tooele	35	5	1
Total	**35**	**5**	**1**

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

Loss Estimation Data: HAZUS-MH 2.1
Reference Data: Utah Automated Geographic Reference Center
Basemap Data: ESRI
Analysis Performed By: Utah Division of Emergency Management



Life Threatening Injuries



M 6.5 Tooele Earthquake

1 Dot = 1 Life Threatening Injury (Severity Level 2 and 3 delineated by Census Tract)

Impaired Hospitals (Day 1)

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

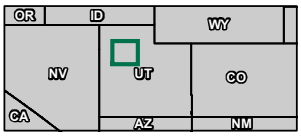
- High
- Moderate
- Low

County	Total # Hospital Beds	Hospital Beds Available	Injuries Requiring Hospital Treatment 2pm
Tooele	43	5	31
Total	**43**	**5**	**31**

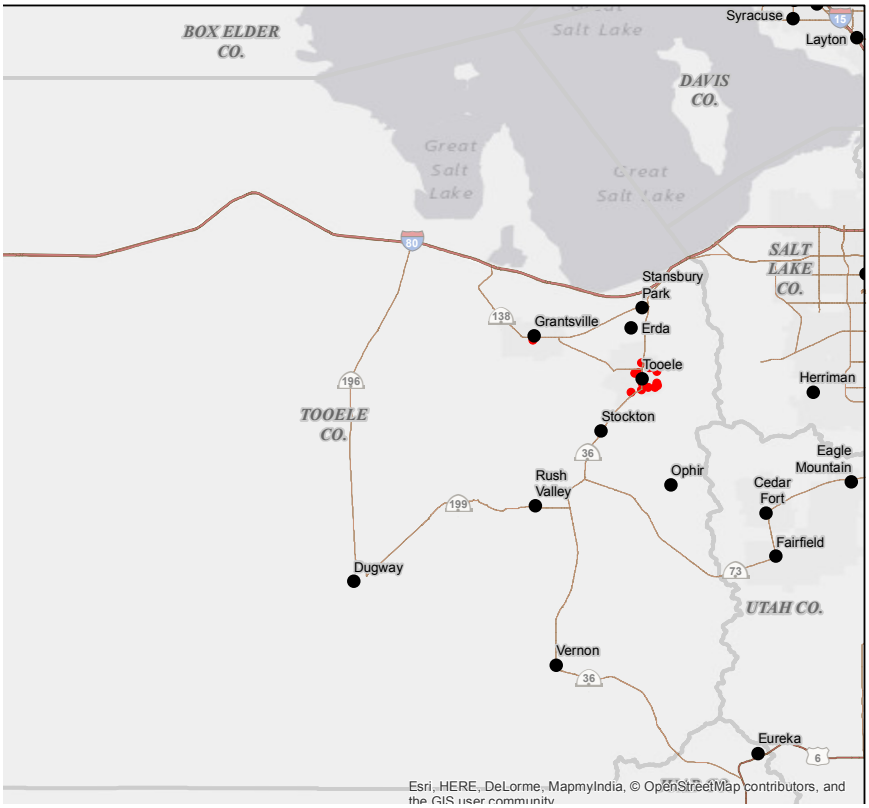
N W E S

0 2 4 8 12 16 20 Miles

Loss Estimation Data: HAZUS-MH 2.1
Reference Data: Utah Automated Geographic Reference Center
Basemap Data: ESRI
Analysis Performed By: Utah Division of Emergency Management



Potential Search and Rescue Needs



M 6.5 Tooele Earthquake

Structure Type	Red (Complete)	Collapse Rates for Complete Damage	Total Collapse
Wood	1	3%	0
Steel	10	6%	1
Concrete	3	10%	0
Precast	3	13%	0
Reinforced Masonry	2	10%	0
Unreinforced Masonry	70	15%	11
Manufactured Housing	57	3%	2
Total	146		14

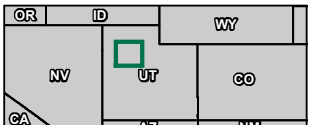
1 Dot = 10 Buildings (by Census Tract)

Red Tag (Complete Damage)

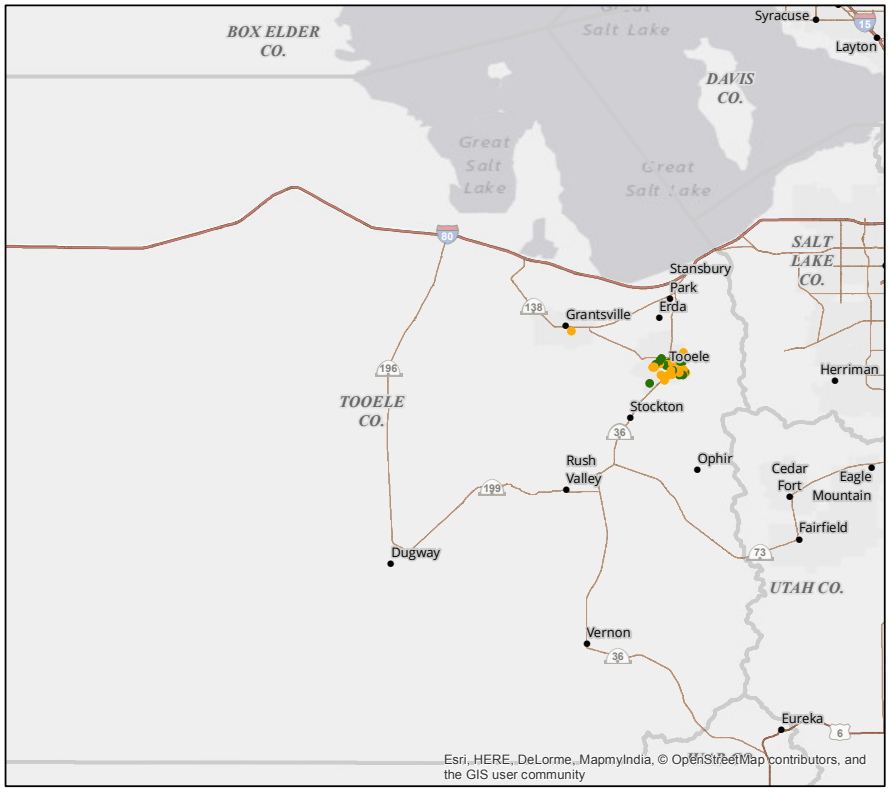
N W E S

0 2 4 8 12 16 20 Miles

Loss Estimation Data: HAZUS-MH 2.1
Reference Data: Utah Automated Geographic Reference Center
Basemap Data: ESRI
Analysis Performed By: Utah Division of Emergency Management



Displaced Households and Shelter Needs



M 6.5 Tooele Earthquake

	Total #
Public Shelter Needs (Individuals)	78
Displaced Households	119

1 Dot = 5 Displaced Households*

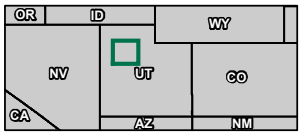
1 Dot = 5 Public Shelter Needs (Individuals)*

* delineated by census tract

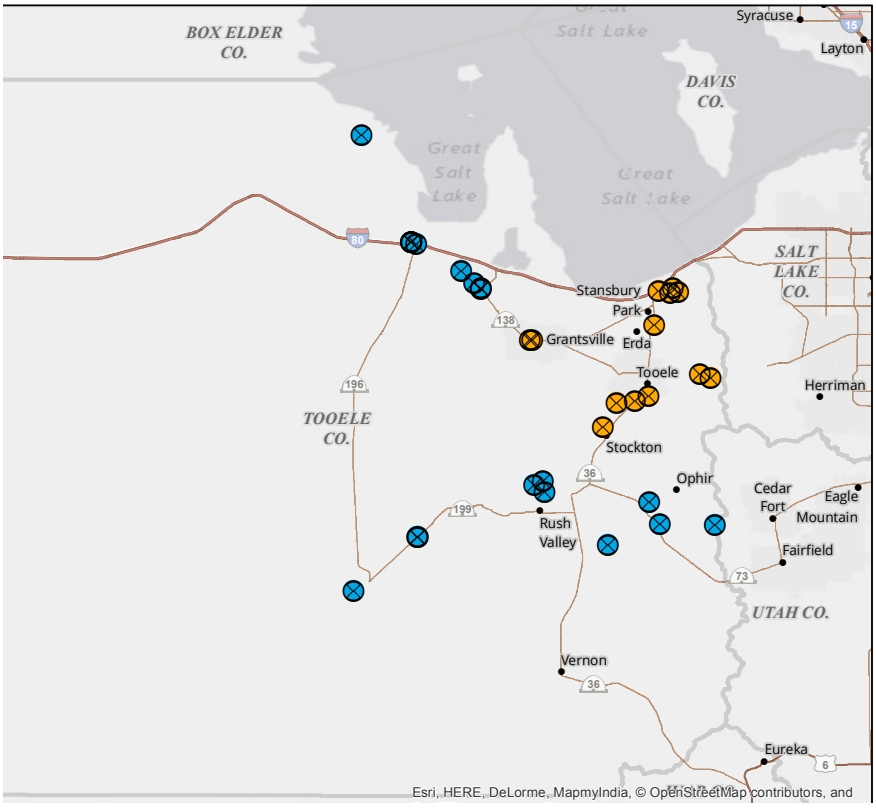
N W E S

0 2 4 8 12 16 20 Miles

Loss Estimation Data: HAZUS-MH 2.1
Reference Data: Utah Automated Geographic Reference Center
Basemap Data: ESRI
Analysis Performed By: Utah Division of Emergency Management



Utility Infrastructure Damage



M 6.5 Tooele Earthquake

Utility Damage (at least moderate)

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

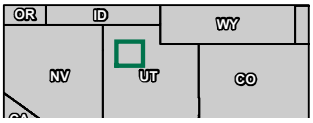
Electric Power Facility

- High
- Moderate
- Low

N W E S

0 2 4 8 12 16 20 Miles

Loss Estimation Data: HAZUS-MH 2.1
Reference Data: Utah Automated Geographic Reference Center
Basemap Data: ESRI
Analysis Performed By: Utah Division of Emergency Management



Using HAZUS to Model an M 6.5 Earthquake in Tooele County

Josh Groeneveld
GIS Coordinator
Utah Division of Emergency Management
10 November 2015

What HAZUS Can Analyze

- Earthquakes
- Floods (both riverine and coastal)
- Hurricane Winds
- Flood and Hurricane can be combined for a storm surge model

What HAZUS Can't Analyze

- Wind storms in areas outside of the hurricane states
- Wildfires
- Tornadoes
- Volcanoes

HAZUS Analysis Levels

- Level 1: Out of the box data and settings
- **Level 2: Combination of local and default hazard, building and damage data**
- Level 3: Use local building and damage data, as well as hazard specific damage functions (this usually requires engineering expertise)

HAZUS Model Inputs

- Census Data
  - **HAZUS relies heavily on Census data for population and demographics**
  - As of HAZUS 2.2, the 2010 Census geometries are available by default

HAZUS Model Inputs

- Inventory Data
  - Essential Facilities (hospitals, EOC's, police stations, fire stations, schools)
  - Transportation (bridges, highways, railroads, light rail, etc.)
  - High Potential Loss Facilities (dams, nuclear power, military installations, etc.)
  - Utilities (natural gas, electric, potable water and waste water)

HAZUS Key Points

- A HAZUS analysis occurs in a Study Region, which can consist of a state, county, Census Tract, Census Block, Community or Watershed
- Loss estimates are only for what is within the study region -- **if the disaster extends past the study region boundaries, those losses won't be captured**

HAZUS Key Points: Building Damage Guidelines

Damage State	Range of Possible Loss Ratios	Probability of Long-Term Building Closure	Probability of Partial or Full Collapse	Immediate Post Earthquake Inspection
Slight	0% - 5%	P = 0	P = 0	Green Tag
Moderate	5% - 25%	P = 0	P = 0	Green Tag
Extensive	25% - 100%	P ≅ 0.5	P ≅ 0	Yellow Tag
Complete	100%	P ≅ 1.0	P > 0	Red Tag

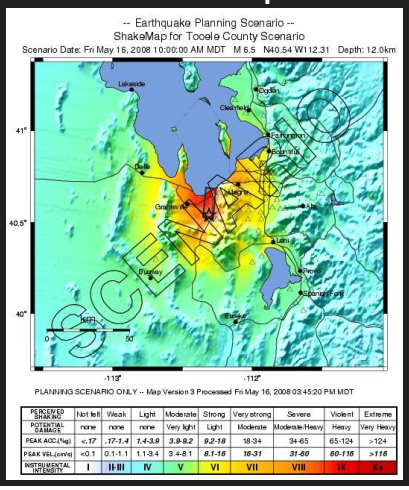
HAZUS Key Points

- You can download HAZUS here:
  - https://msc.fema.gov/portal/resources/hazus
- **HAZUS is free to download and use; but it requires ArcGIS 10.2.2**
- Useful info here:
  - http://www.fema.gov/hazus

Tooele County M 6.5 Earthquake Scenario

- M 6.5 represents a credible event in the Tooele Valley
- The University of Utah Seismograph Stations generated a scenario ShakeMap that we input into HAZUS
- Also included in this HAZUS analysis are geologic data layers:
  - Liquefaction potential
  - Landslide susceptibility
  - Soil type
  - Water depth

Tooele County M 6.5 Earthquake Scenario



Tooele County M 6.5 Earthquake Scenario

- Tooele County was the only county in this study region
- Total Economic Loss: $254,470,000
- Total Building-Related Economic Loss: $196,920,000
- ~3,000 buildings at least moderately damaged
- ~150 buildings damaged beyond repair

Tooele County M 6.5 Earthquake Scenario

- ~120 households displaced
- ~80 people seeking public shelter
- Depending on time of day:
  - 50 - 100 people with minor injuries
  - 15 - 30 people with life threatening injuries
  - 3 - 6 fatalities
- ~7,000 households without power on the first day

Other Earthquake Scenarios Covering Tooele

- **M 6.5 Tooele County: $196,920,000 in building-related economic losses**
- M 7.0 Salt Lake City Segment of Wasatch Fault: $34,969,000
- M 7.0 East Great Salt Lake Fault: $46,060,000
- M 7.2 Provo Segment of Wasatch Fault: $12,964,000
- M 7.0 Weber Segment of Wasatch Fault: $4,469,000

Questions?

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jgroeneveld@utah.gov
(801) 538-9791

Hazus-MH: Earthquake Event Report

Region Name: Tooele_County_M65_Peak_PGV_Sept_2014

Earthquake Scenario: Tooele_County_M65_Peak_Ground_Motions

Print Date: September 22, 2014

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 1 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 7,275.67 square miles and contains 7 census tracts. There are over 17 thousand households in the region which has a total population of 58,218 people (2002 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 19 thousand buildings in the region with a total building replacement value (excluding contents) of 3,611 (millions of dollars). Approximately 94.00 % of the buildings (and 79.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 3,418 and 238 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 19 thousand buildings in the region which have an aggregate total replacement value of 3,611 (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 39% 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 1 hospitals in the region with a total bed capacity of 43 beds. There are 32 schools, 17 fire stations, 8 police stations and 1 emergency operation facilities. With respect to high potential loss facilities (HPL), there are 9 dams identified within the region. Of these, 2 of the dams are classified as 'high hazard'. The inventory also includes 94 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 3,656.00 (millions of dollars). This inventory includes over 487 kilometers of highways, 35 bridges, 17,380 kilometers of pipes.

Table 1: Transportation System Lifeline Inventory

System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	35	74.70
	Segments	39	2,790.00
	Tunnels	0	0.00
		Subtotal	**2,864.70**
Railways	Bridges	1	0.00
	Facilities	0	0.00
	Segments	254	418.50
	Tunnels	0	0.00
		Subtotal	**418.50**
Light Rail	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
		Subtotal	**0.00**
Bus	Facilities	0	0.00
		Subtotal	**0.00**
Ferry	Facilities	0	0.00
		Subtotal	**0.00**
Port	Facilities	0	0.00
		Subtotal	**0.00**
Airport	Facilities	2	21.30
	Runways	3	113.90
		Subtotal	**135.20**
		Total	**3,418.50**

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	216.20
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**216.20**
Waste Water	Distribution Lines	NA	129.70
	Facilities	3	195.80
	Pipelines	0	0.00
		Subtotal	**325.50**
Natural Gas	Distribution Lines	NA	86.50
	Facilities	0	0.00
	Pipelines	3	42.30
		Subtotal	**128.80**
Oil Systems	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**0.00**
Electrical Power	Facilities	33	0.00
		Subtotal	**0.00**
Communication	Facilities	4	0.40
		Subtotal	**0.40**
		Total	**670.80**

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	Tooele_County_M65_Peak_Ground_Motions
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	6.50
Depth (Km)	NA
Rupture Length (Km)	NA
Rupture Orientation (degrees)	NA
Attenuation Function	NA

Building Damage

Building Damage

Hazus estimates that about 2,993 buildings will be at least moderately damaged. This is over 15.00 % of the buildings in the region. There are an estimated 146 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	43	0.34	10	0.23	9	0.42	7	0.96	1	0.90
Commercial	417	3.33	168	3.76	94	4.54	32	4.17	5	3.29
Education	17	0.13	4	0.09	6	0.29	4	0.57	1	0.42
Government	38	0.31	7	0.15	4	0.20	3	0.41	1	0.42
Industrial	99	0.79	29	0.66	57	2.71	41	5.36	8	5.32
Other Residential	1,403	11.19	656	14.70	493	23.65	352	46.03	67	45.81
Religion	18	0.14	8	0.17	9	0.42	5	0.70	1	0.47
Single Family	10,502	83.76	3,582	80.23	1,412	67.78	319	41.80	64	43.38
Total	**12,537**		**4,464**		**2,083**		**764**		**147**	

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

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	5,068	40.43	2423	54.28	362	17.36	8	1.05	1	0.37
Steel	91	0.73	23	0.52	40	1.92	39	5.10	10	6.69
Concrete	104	0.83	36	0.81	53	2.53	30	3.90	3	2.13
Precast	26	0.21	5	0.12	14	0.67	18	2.34	3	2.32
RM	5,874	46.85	1525	34.15	711	34.14	49	6.40	2	1.37
URM	1,081	8.62	353	7.91	593	28.48	321	41.98	70	48.03
MH	294	2.34	98	2.20	310	14.90	300	39.23	57	39.08
Total	**12,537**		**4,464**		**2,083**		**764**		**147**	

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

Essential Facility Damage

Before the earthquake, the region had 43 hospital beds available for use. On the day of the earthquake, the model estimates that only 4 hospital beds (11.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 41.00% of the beds will be back in service. By 30 days, 92.00% 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	1	1	0	0
Schools	32	0	0	8
EOCs	1	0	0	0
PoliceStations	8	0	0	4
FireStations	17	0	0	10

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	39	0	0	39	39
	Bridges	35	4	0	31	33
	Tunnels	0	0	0	0	0
Railways	Segments	254	0	0	254	254
	Bridges	1	0	0	1	1
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Light Rail	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Bus	Facilities	0	0	0	0	0
Ferry	Facilities	0	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	2	0	0	2	2
	Runways	3	0	0	3	3

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	0	0	0	0	0
Waste Water	3	2	0	0	3
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	33	6	0	20	33
Communication	4	0	0	4	4

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

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	10,808	196	50
Waste Water	6,485	98	25
Natural Gas	88	18	9
Oil	0	0	0

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	17,971	0	0	0	0	0
Electric Power		6,915	2,601	566	76	18

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 0 ignitions that will burn about 0.00 sq. mi 0.00 % of the region's total area.) The model also estimates that the fires will displace about 0 people and burn about 0 (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 0.10 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 3,920 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 119 households to be displaced due to the earthquake. Of these, 78 people (out of a total population of 58,218) 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	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	1	0	0	0
	Other-Residential	15	3	0	0
	Single Family	55	11	1	3
	Total	**72**	**14**	**2**	**3**
2 PM	Commercial	14	3	0	1
	Commuting	0	0	0	0
	Educational	68	15	2	4
	Hotels	0	0	0	0
	Industrial	10	2	0	1
	Other-Residential	3	1	0	0
	Single Family	13	3	0	1
	Total	**110**	**24**	**4**	**6**
5 PM	Commercial	13	3	0	1
	Commuting	3	3	6	1
	Educational	6	1	0	0
	Hotels	0	0	0	0
	Industrial	6	1	0	0
	Other-Residential	6	1	0	0
	Single Family	22	5	1	1
	Total	**56**	**14**	**7**	**4**

Economic Loss

The total economic loss estimated for the earthquake is 254.47 (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 196.92 (millions of dollars); 20 % 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 59 % 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	0.59	3.43	0.23	2.52	6.77
	Capital-Related	0.00	0.25	2.16	0.13	0.75	3.29
	Rental	2.46	1.42	1.31	0.06	0.53	5.78
	Relocation	9.10	2.19	2.04	0.40	9.10	22.83
	Subtotal	**11.56**	**4.44**	**8.94**	**0.82**	**12.89**	**38.67**
Capital Stock Losses							
	Structural	15.00	3.03	2.26	1.22	8.79	30.30
	Non_Structural	49.18	11.85	8.04	2.97	20.40	92.45
	Content	18.05	2.58	4.60	1.72	7.99	34.95
	Inventory	0.00	0.00	0.12	0.42	0.03	0.57
	Subtotal	**82.24**	**17.46**	**15.03**	**6.32**	**37.22**	**158.26**
	Total	**93.80**	**21.90**	**23.97**	**7.14**	**50.11**	**196.92**

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	2,790.04	$14.48	0.52
	Bridges	74.71	$2.31	3.09
	Tunnels	0.00	$0.00	0.00
	Subtotal	**2864.70**	**16.80**	
Railways	Segments	418.50	$0.32	0.08
	Bridges	0.04	$0.00	0.00
	Tunnels	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Subtotal	**418.50**	**0.30**	
Light Rail	Segments	0.00	$0.00	0.00
	Bridges	0.00	$0.00	0.00
	Tunnels	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**0.00**	
Bus	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**0.00**	
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	21.30	$3.11	14.59
	Runways	113.89	$0.83	0.73
	Subtotal	**135.20**	**3.90**	
	Total	**3418.50**	**21.00**	

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	0.00	$0.00	0.00
	Distribution Lines	216.20	$0.89	0.41
	Subtotal	**216.16**	**$0.89**	
Waste Water	Pipelines	0.00	$0.00	0.00
	Facilities	195.80	$34.85	17.80
	Distribution Lines	129.70	$0.45	0.34
	Subtotal	**325.50**	**$35.30**	
Natural Gas	Pipelines	42.30	$0.16	0.38
	Facilities	0.00	$0.00	0.00
	Distribution Lines	86.50	$0.15	0.18
	Subtotal	**128.79**	**$0.31**	
Oil Systems	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**$0.00**	
Electrical Power	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**$0.00**	
Communication	Facilities	0.40	$0.01	3.34
	Subtotal	**0.39**	**$0.01**	
	Total	**670.84**	**$36.51**	

Table 14. Indirect Economic Impact with outside aid

(Employment as # of people and Income in millions of $)

LOSS		Total	%

Appendix A: County Listing for the Region

Tooele,UT

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Utah					
	Tooele	58,218	2,862	748	3,611
Total State		**58,218**	**2,862**	**748**	**3,611**
Total Region		**58,218**	**2,862**	**748**	**3,611**