

Utah ShakeOut 2012 Scenario



Updated Hazus Modeling and Loss Estimates-Salt Lake City Segment M 7.0

Jesse Rozelle

Austen Cutrell

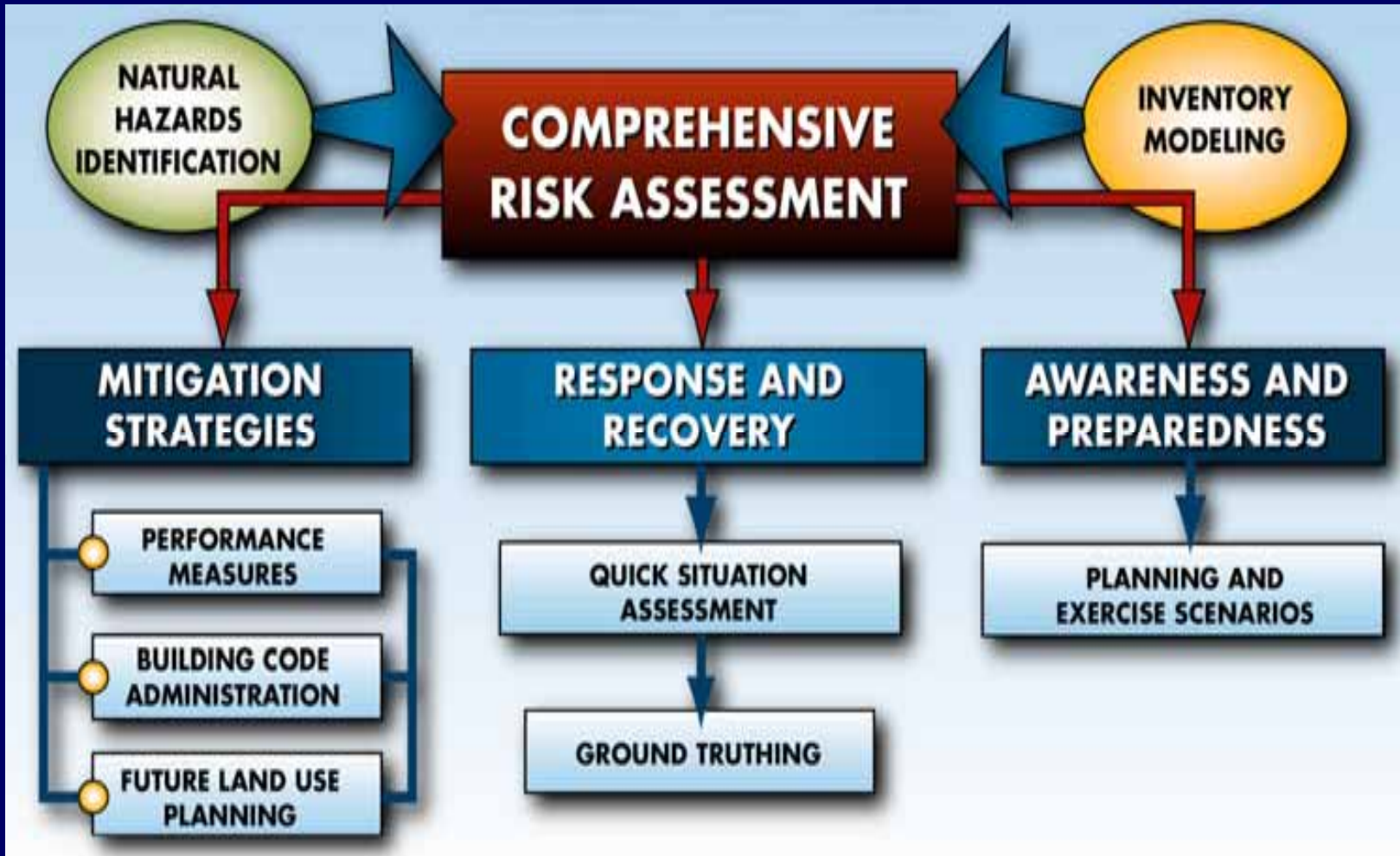
FEMA Region 8 Risk Analysis GIS

ESRI International Users Conference 2012

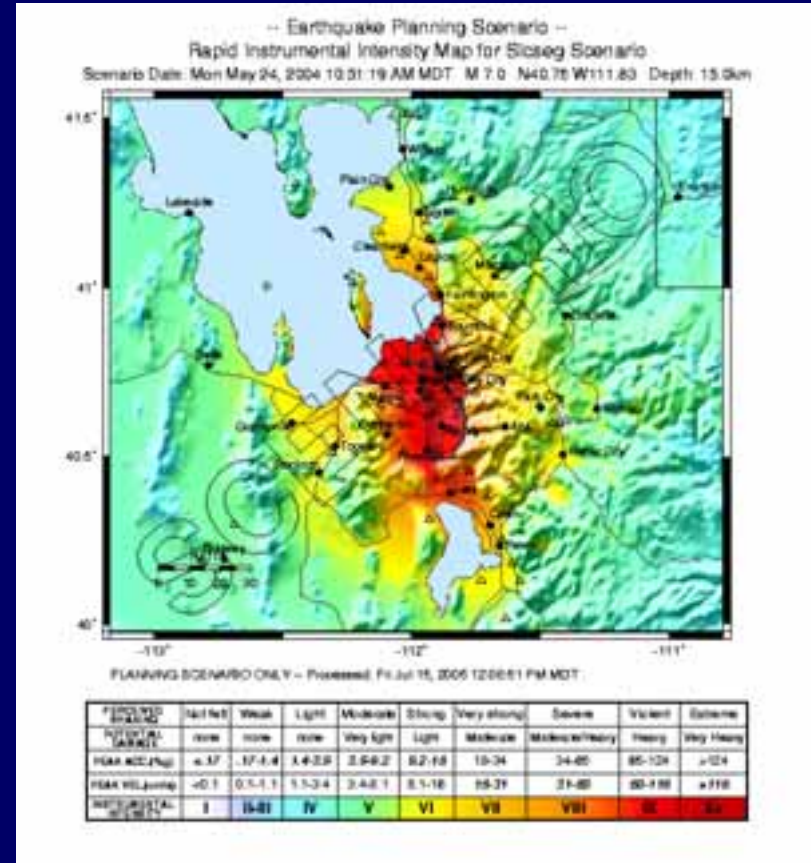
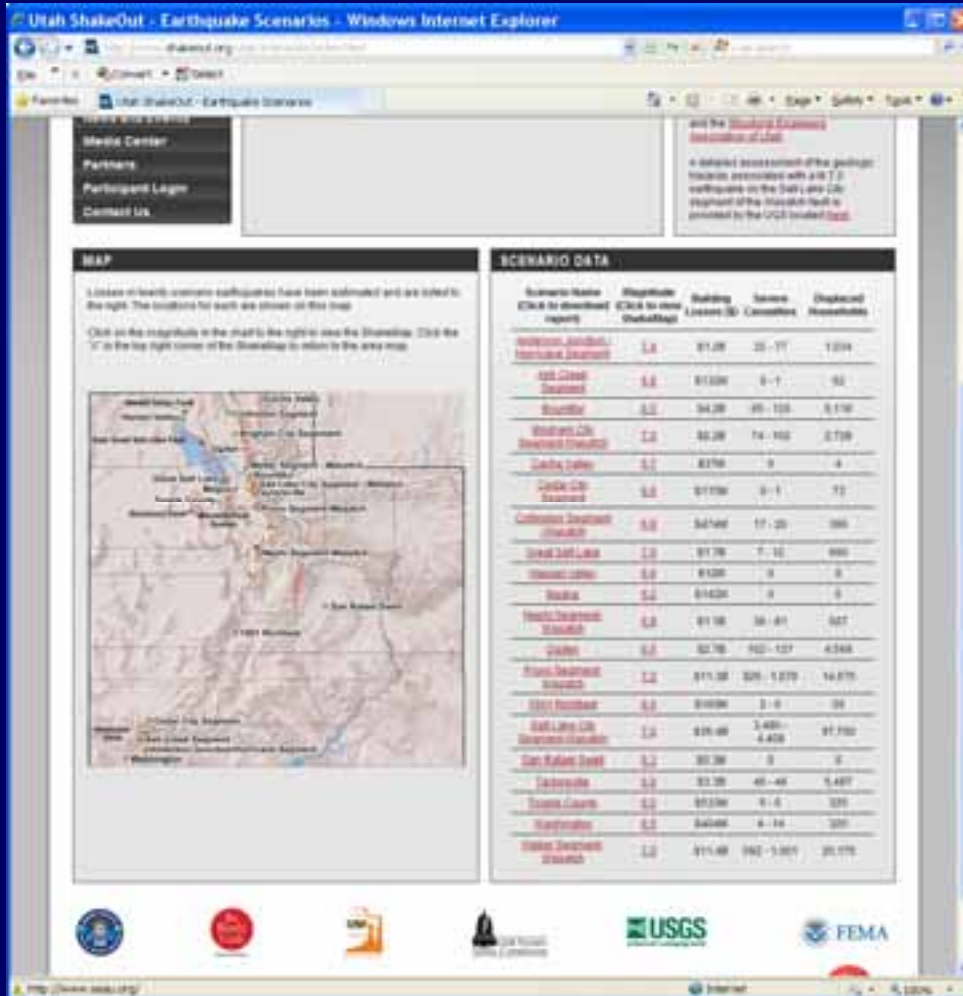
HAZUS Model Update

- **2010 Census:** Population increase of 100K in Salt Lake County. Updated university daytime population based on a survey of Utah college populations.
- **2011 URM Inventory:** A field screening of Salt Lake's largest 3,000 URMs resulted in collecting detailed information, including a FEMA 154 RVS score, but also reassigned approximately 500 of these to less vulnerable building types. The estimated 10% reduction in severe casualties is likely a result of this change.
- **UofU Buildings:** The detailed survey of UofU building types, design levels, areas, occupancy loads and valuations from their PDM planning effort were included into the building stock updates.
- **2011 Salt Lake County Assessor Data:** New assessor building descriptions, number of stories, occupancy types, building area and valuations were used to update the building stock information.
- **2011 Hospital Survey:** Hospital building types and design levels were updated based on a survey performed by Utah Homeland Security. The survey resulted in an increase in the number of hospitals, and included information on bed surge capacity.

HAZUS Applications

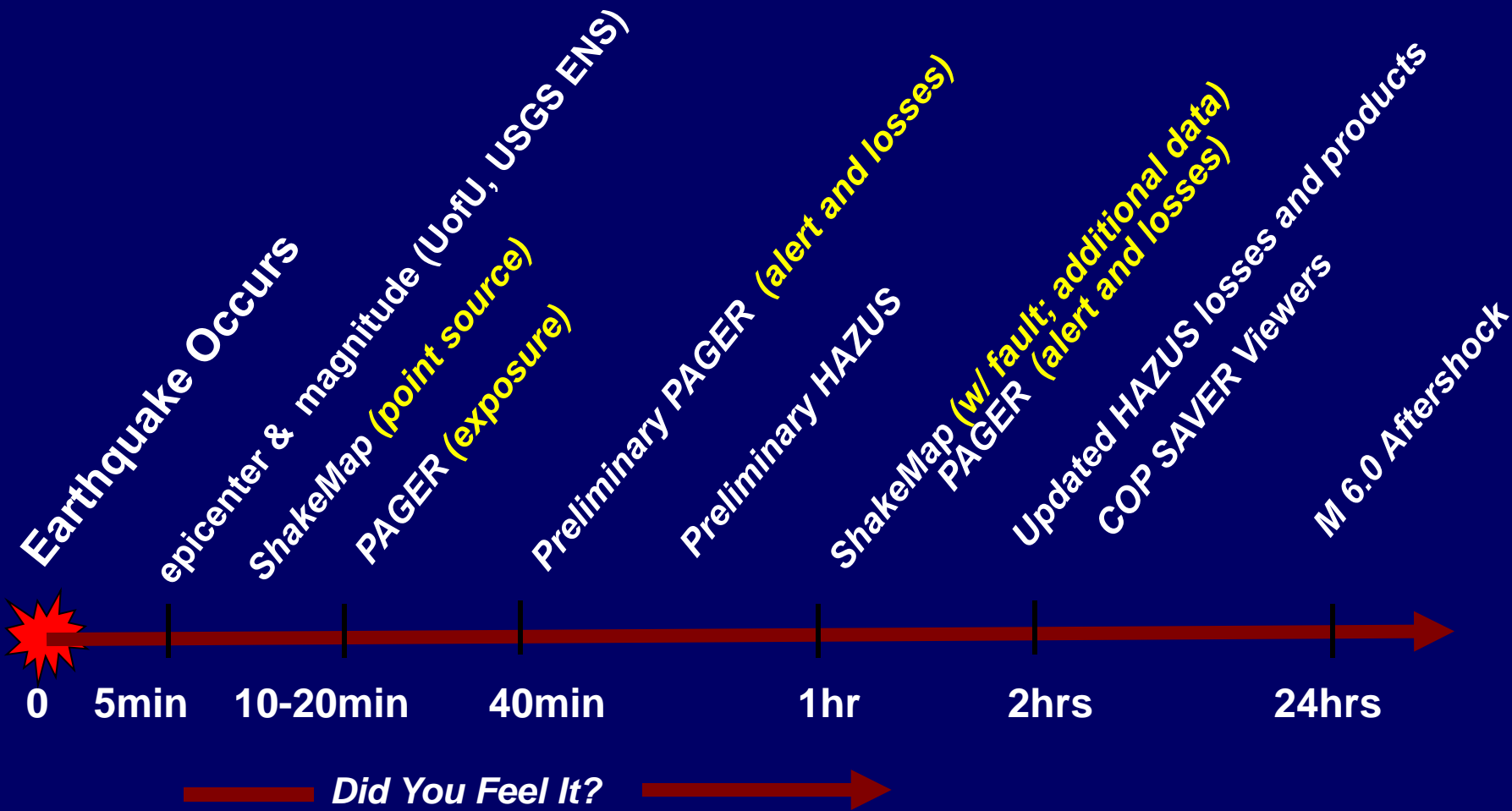


HAZUS/ShakeMap in Utah



We have analyzed 20 UofU ShakeMap Scenarios throughout Utah—
Significant hazard and inventory improvements

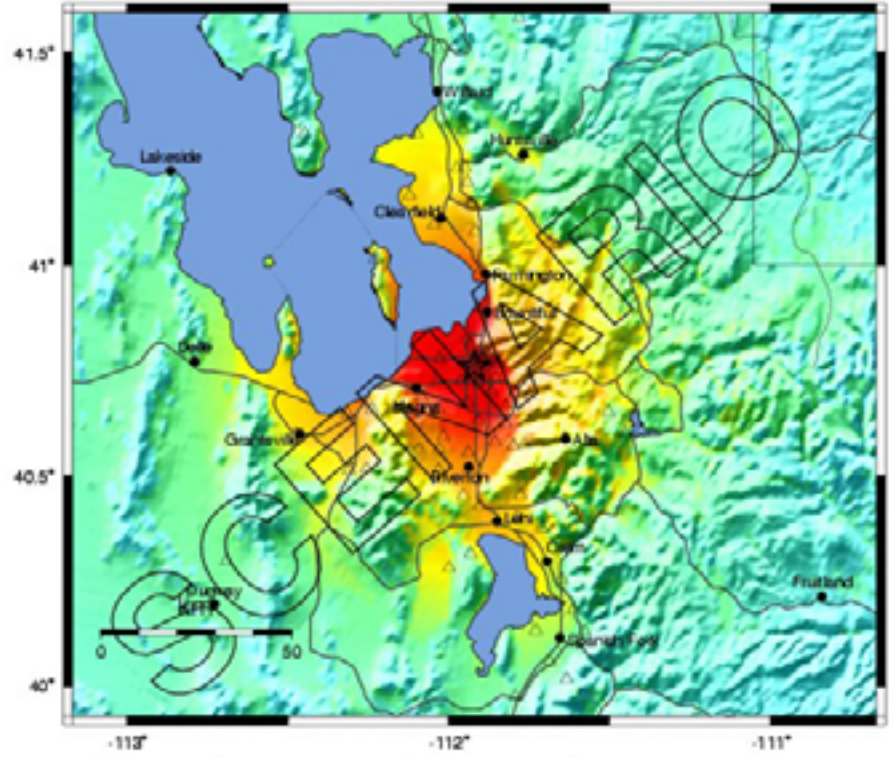
Earthquake Information Timeline (Utah ShakeOut 2012)



M7.0 Salt Lake City Segment Mainshock ShakeMap

- Point Source
- Initial Loss Estimates
- ~0+8minutes

-- Earthquake Planning Scenario --
 ShakeMap for Esfmainpt Scenario
 Scenario Date: Thu Apr 22, 2010 08:00:00 PM MDT M 7.0 N40.76 W111.92 Depth: 12.0km



PLANNING SCENARIO ONLY -- Map Version 2 Processed Wed Apr 7, 2010 01:42:41 PM MDT

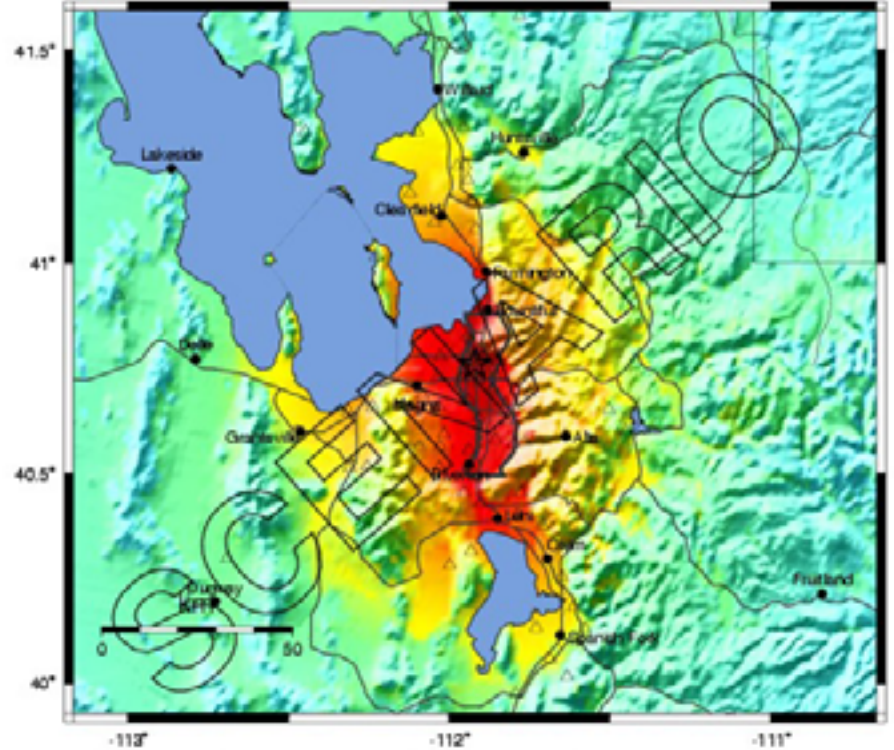
PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Moderate/Heavy	Heavy	Very Heavy
PEAK ACC (%g)	<.17	.17-1.1	1.1-3.9	3.9-9.2	9.2-18	18-34	34-65	65-124	>124
PEAK VEL (cm/s)	<0.1	0.1-1.1	1.1-3.4	3.4-8.1	8.1-16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

http://earthquake.usgs.gov/earthquakes/shakemap/ut/shake/ESFmainPT_se/

M7.0 Salt Lake City Segment Mainshock ShakeMap

- Fault Source
- Updated Loss Estimates
- ~0+1hour

-- Earthquake Planning Scenario --
 ShakeMap for Esfmainff Scenario
 Scenario Date: Thu Apr 22, 2010 08:00:00 PM MDT M 7.0 N40.76 W111.92 Depth: 12.0km



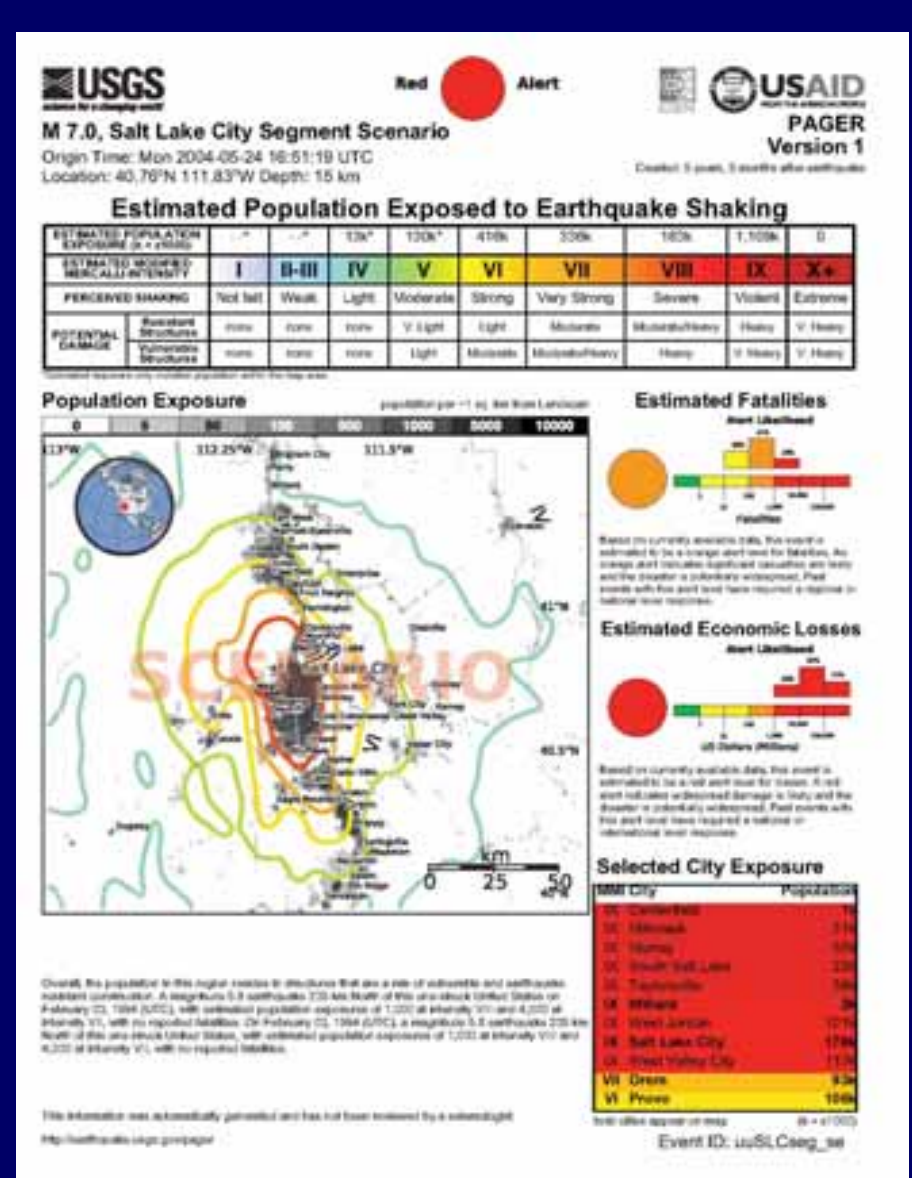
PLANNING SCENARIO ONLY -- Map Version 2 Processed Wed Apr 7, 2010 03:00:19 PM MDT

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

http://earthquake.usgs.gov/earthquakes/shakemap/ut/shake/ESFmainFF_se/

M7.0 Salt Lake City Segment Mainshock PAGER

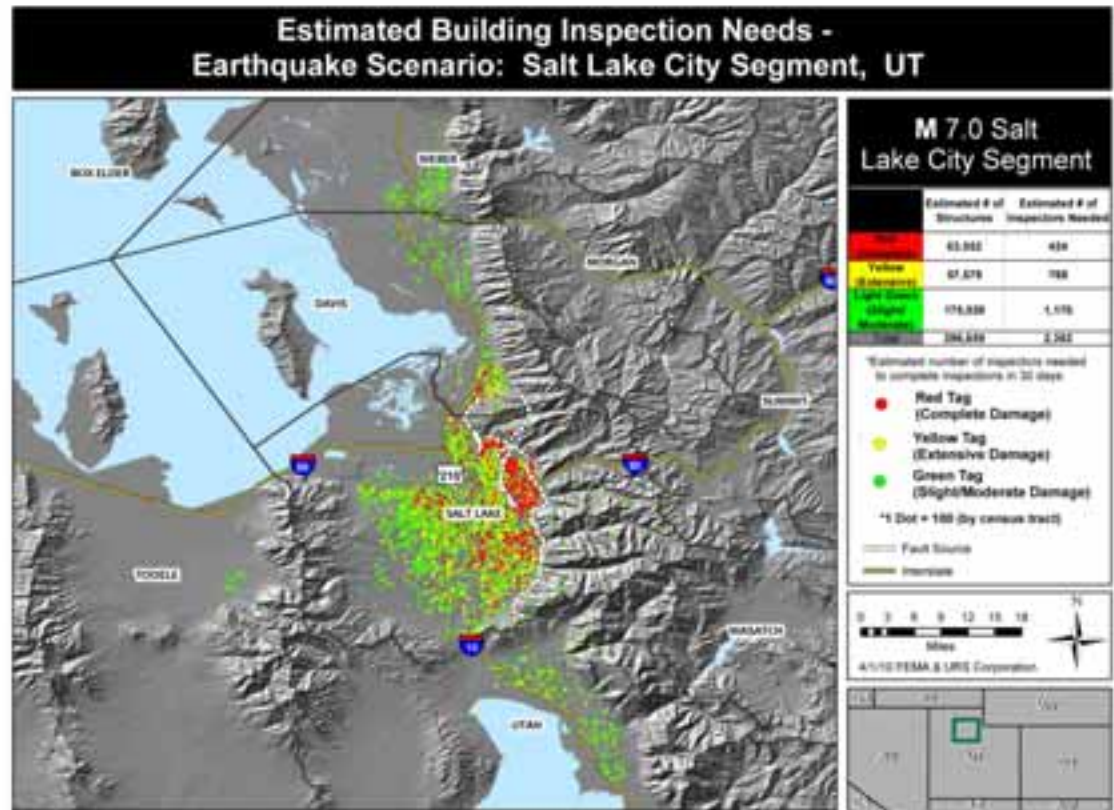
- Establishes Red Alert Level
- ~0+40min and 1hour



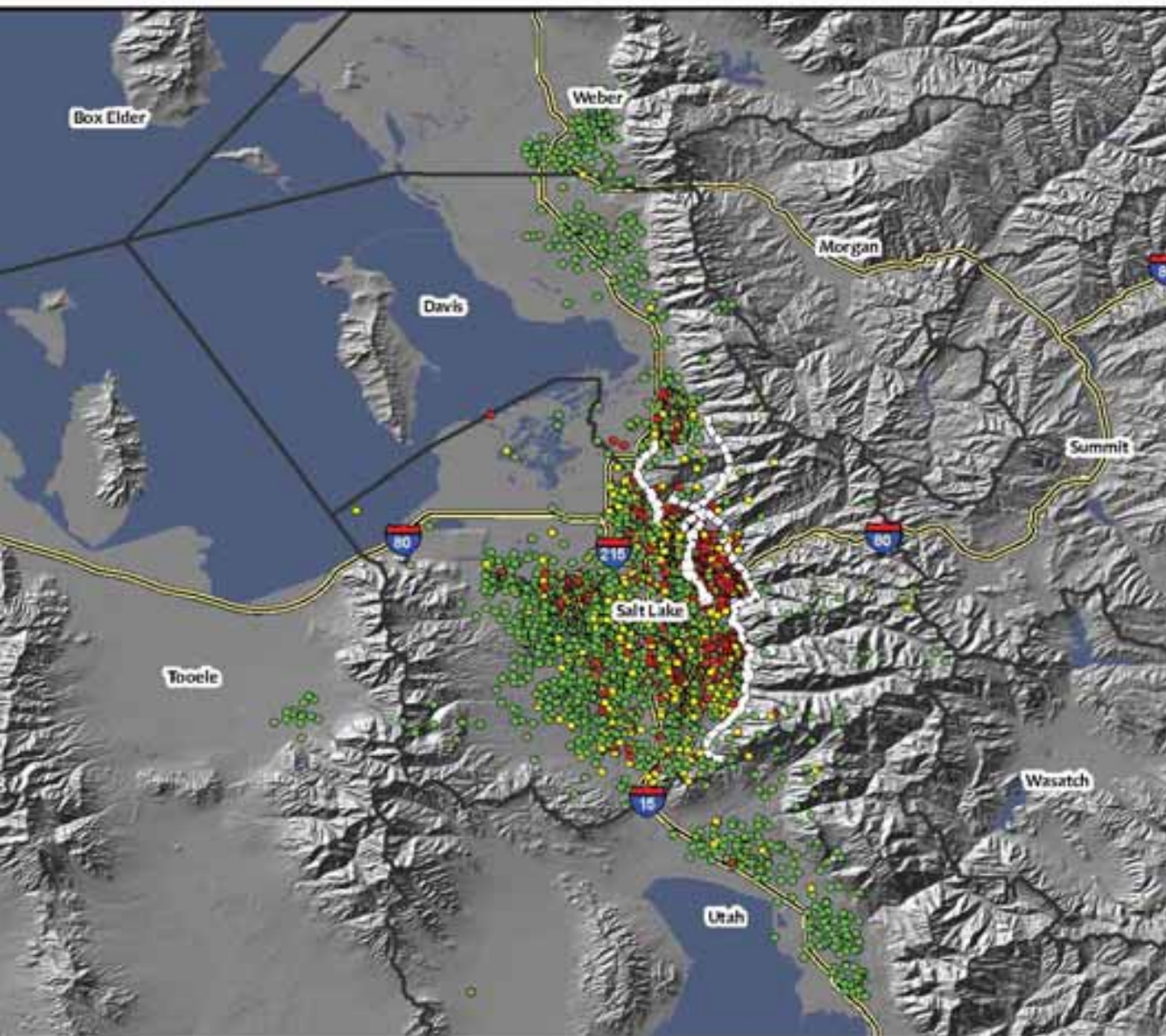
http://earthquake.usgs.gov/earthquakes/shakemap/ut/shake/ESFmainPT_se/

Hazus Loss Estimation Products

- ~0+1 hours
- FEMA, State, local modeling coordination call



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	376
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)**

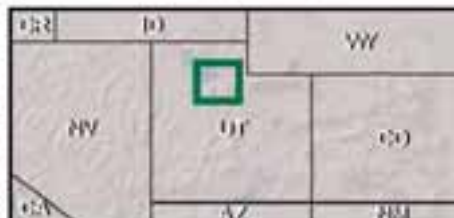
*1 Dot = 100 (by census tract)

TTTTT Fault Source

— Interstate



1/23/2012 FEMA Region 8 Mtigation



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

	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

M 7.0 Salt Lake City Segment

Liquefaction Susceptibility

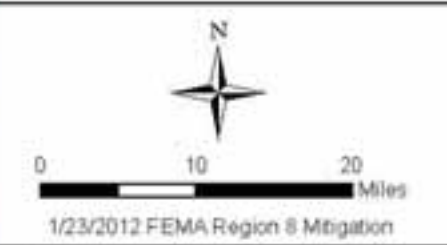
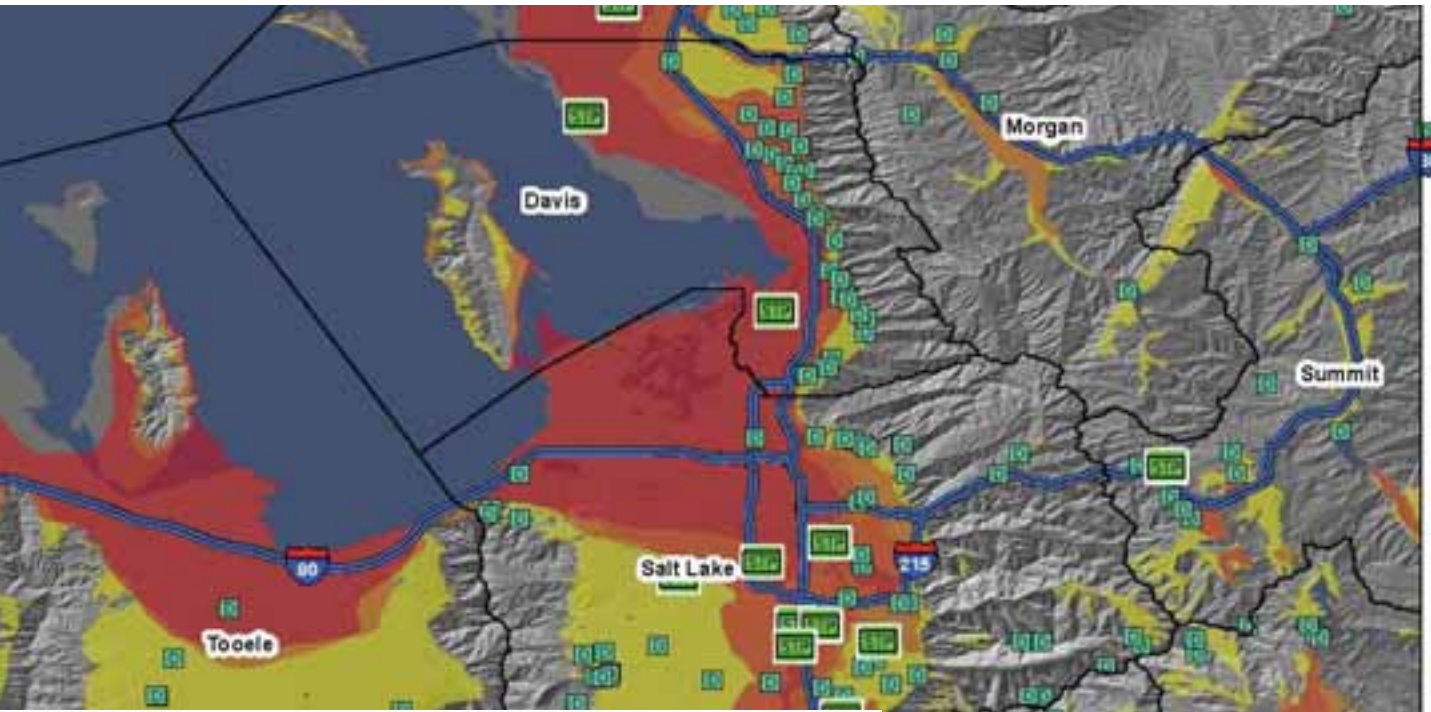


Sewage Treatment Facilities

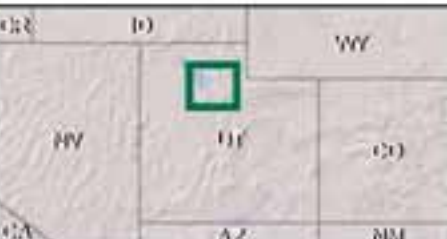
Dams

County	# Households without Potable Water (at Day 1)	Daily Potable Water Needs Per Person (Gallons/day)	Number of Truckloads needed Daily
Davis	53,745	181,235	34
Salt Lake	323,845	971,535	204
Utah	1,500	4,590	1
Total	379,120	1,137,360	239

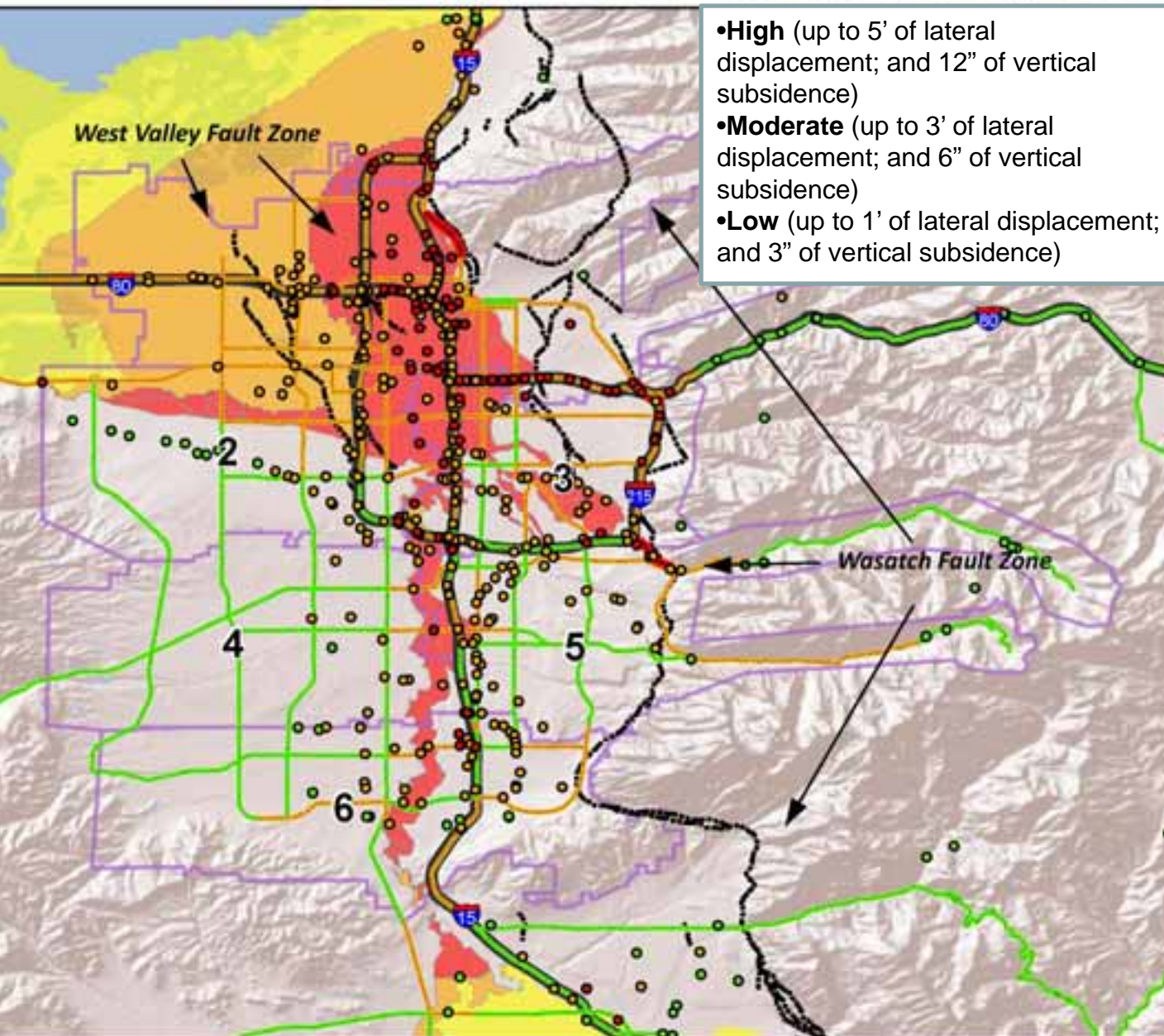
* Based on U.S. Army Corps of Engineers Guidebook.
 (Daily water is based on an assumed 3 people per household.
 One truck can transport an estimated 5000 gallons of water.)



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	2,058	38	81
Oil	976	22	38



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



- **High** (up to 5' of lateral displacement; and 12" of vertical subsidence)
- **Moderate** (up to 3' of lateral displacement; and 6" of vertical subsidence)
- **Low** (up to 1' of lateral displacement; and 3" of vertical subsidence)

M 7.0 Salt Lake City Segment

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

Impassable Areas Based on Potential Ground Deformation

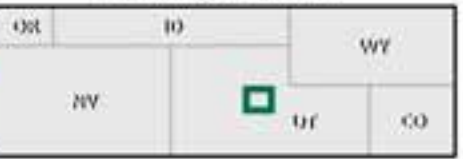
Local variation is likely. Impassable areas may include significant liquefaction, debris and flooding

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
Fault Lines

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



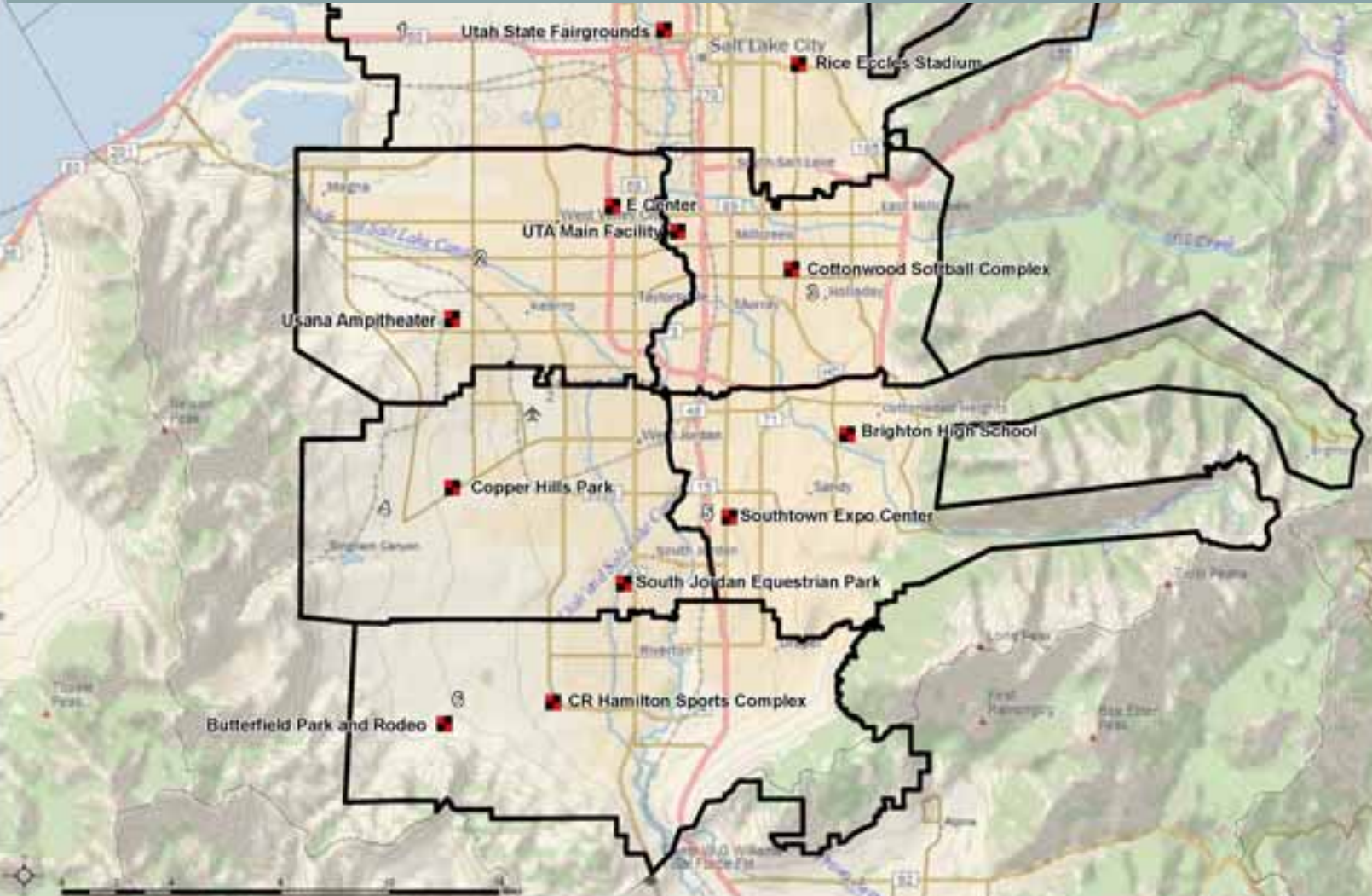


Salt Lake City

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, Airports, 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.

Site Specific Evaluations

URM Inventory & Assessor Data



ROVER: Rapid Observation of Vulnerability & Estimation of Risk

- Implements FEMA 154 (rapid building screening) on Smartphone & tablet PC
- ROVER is funded by FEMA
- Objective: rapidly (10-20 min/building) create an inventory buildings exposed to risk; ID those warranting detailed examination
- Improves FEMA 154 efficiency, accuracy & data handling:
 - Integrated database, GPS, photos, sketches
 - Site automated USGS soil & hazard lookup
 - **Integrated with HAZUS & USGS ShakeCast**



Site Specific Evaluations


URM Inventory, Collapse Hazard Scoring



ROVER: Rapid Observation of Vulnerability and Estimation of Risk

ROVER Server:

- Take in building inventory for ShakeCast/HAZUS in pre-event screening.
- Displays ShakeCast estimated damage likelihoods (tagging) post event.

 **ROVER Server - List sites** [Home](#) [New Site](#) [Logout](#)

Site Listing: Click ID to Edit

ID	Name	Address	City	State	Zip	Stories	Area	Year built	Evaluation	Posting	Barriers?	Further Eval?	Other Actions?
45	test1	addr1	city1	NY	12866	1	1001	2001	Edit Rapid Edit Detailed	Unsafe	Needed	Recommended	Yes
46	tim's house	rr 1	saratoga springs	NY	12866	1	1001	2001	Edit Rapid Edit Detailed	Inspected	Needed	Recommended	Yes
47	scott's house	addr1	saratoga springs	NY	12866	1	1001	2001	Edit Rapid Edit Detailed	Unsafe	Needed	Recommended	Yes
48	isti	77 van dam	saratoga springs	NY	12866	1	20000	1901	Edit Rapid Edit Detailed	Unsafe	Needed	Recommended	Yes
50	mom	jjj	ci	si	11111	0	None	2005	Edit Rapid Edit Detailed	None	Not needed	Not recommended	Yes
51	mom	jjj	ci	si	11111	0	None	2005	Edit Rapid Edit Detailed	Unsafe	Not needed	Not recommended	Yes
52	isti	77 van dam	saratoga springs	NY	12866	4	20000	None	Edit Rapid Edit Detailed	Restricted	Not needed	Not recommended	Yes

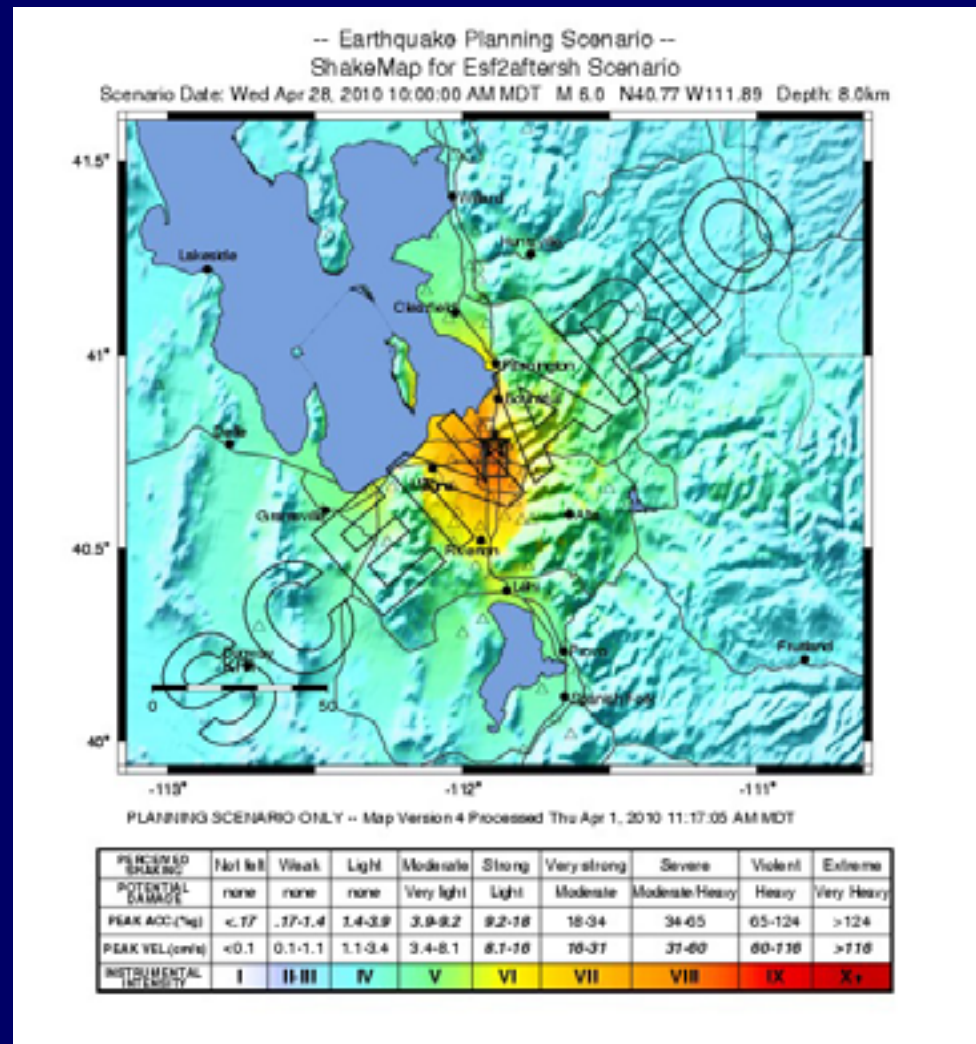


M 6.0 Aftershock

- ~0+24 hours

Resets progress

- Building/Infrastructure Inspection
- Opening Shelters
- Impassable Areas



Summary

URM inventory and data improvements allow for site-specific evaluations to support neighborhood needs assessments

Mobility issues especially during life saving response period

Building inspection gap can be closed by expediting with enhanced pre-event building data

