



Salt Lake City

Emergency Management





Emergency Management Program

- Director
 - Training & Exercise Specialist
 - Community Preparedness Coordinator
 - Critical Infrastructure Liaison / Grant coordinator
 - Multi-language Media Outreach Coordinator



Threats and Hazards

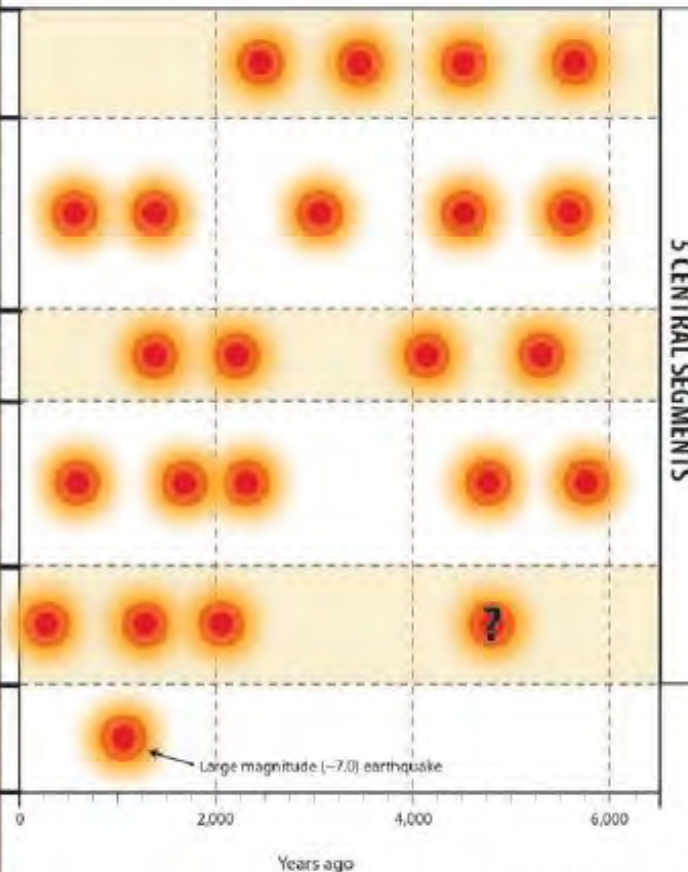
Natural	Technological	Human-caused
<ul style="list-style-type: none">▪ Avalanche▪ Animal disease outbreak▪ Drought▪ Earthquake▪ Epidemic▪ Flood▪ Hurricane▪ Landslide▪ Pandemic▪ Tornado▪ Tsunami▪ Volcanic eruption▪ Wildfire▪ Winter storm	<ul style="list-style-type: none">▪ Airplane crash▪ Dam failure▪ Levee failure▪ Mine accident▪ Hazardous materials release▪ Power failure▪ Radiological release▪ Train derailment▪ Urban conflagration	<ul style="list-style-type: none">▪ Biological attack▪ Chemical attack▪ Cyber incident▪ Explosives attack▪ Radiological attack▪ Sabotage▪ School and workplace violence



Map showing the Wasatch fault (red line) and other faults (black lines) in Utah that may be the sources of large earthquakes. Source: Utah Geological Survey



At least 23 large (magnitude ~7) surface-faulting earthquakes have occurred on the central segments of the Wasatch fault zone in the past 6500 years, which is an average of an earthquake every 300 years. The most recent large earthquake on the Wasatch fault took place about 300 years ago on the Nephi segment. In the Salt Lake City area, the Wasatch fault (Salt Lake City segment) has an average recurrence time between large earthquakes of about 1300 years; however, the last major earthquake occurred about 1400 years ago. Enough energy has accumulated on the Salt Lake City segment to produce a magnitude 7.0 earthquake.



Source: Utah Geological Survey



Salt Lake City

How Likely is a "Big One"?

Earthquake Source	Annual Likelihood
Salt Lake City segment of the Wasatch fault	1 in 450 to 1 in 1,600
One of the Wasatch fault's five central segments (Brigham City to Nephi, page 7)	1 in 300 to 1 in 400
One of 30 active faults in the Wasatch Front region (page 6)	1 in 200

* A large surface-faulting earthquake of about magnitude 7

Sources: Likelihood calculated by the University of Utah Seismograph Stations from data provided in UGS, USGS, GeoHaz Consultants, and URS Corporation reports.

Reality Check

(for comparing to the chance of a "Big One")

Cause of Death	Your Annual Risk
Heart disease	1 in 450
Cancer	1 in 530
Stroke	1 in 2,100
Motor-vehicle accident	1 in 6,500

Source: Centers for Disease Control and Prevention; causes of death in the U.S. in 2005.

Working Group on Utah Earthquake Probabilities

...57% probability ...Wasatch Front
region will experience at least one
Magnitude (M) 6.0 or greater...

and a 43% probability of at least one
M6.75 or greater...

in the next 50 years.



What about the Utah Earthquake

Death and injury

Building damage

Liquefaction

Damage to Critical Infrastructure

Recovery



Christchurch-Salt Lake Similarities

1. Both areas have a population center and central business district sitting directly on a earthquake source.
2. Both have very similar histories of building code adoption and enforcement, including construction of Unreinforced Masonry prior to the threat being understood, as well as code improvement in the 1970 and 1990s.
3. Both have significant liquefaction and landslide hazards that result in significant lifeline interruption.



Darfield Earthquake Summary

- **September 2010 “Mainshock”**
M7.1
- **February 2011 “Aftershock”**
 - M6.3

Magnitude or Intensity?

Magnitude is a measure of the energy released in an earthquake—a single value that depends on the area of fault rupture and amount of slip. For example, the 1934 Hansel Valley earthquake had a magnitude of 6.6. The largest expected earthquakes in Utah are magnitude 7.0-7.5.

Intensity is a measure of the strength of ground shaking at a particular place, and varies by location, proximity to the source of the earthquake, and type of material underlying the site. The intensity scale ranges from low (I) to high (XII). Near the epicenter of the Hansel Valley earthquake, the intensity reached VIII; however, in Salt Lake City, intensity levels were about VI.



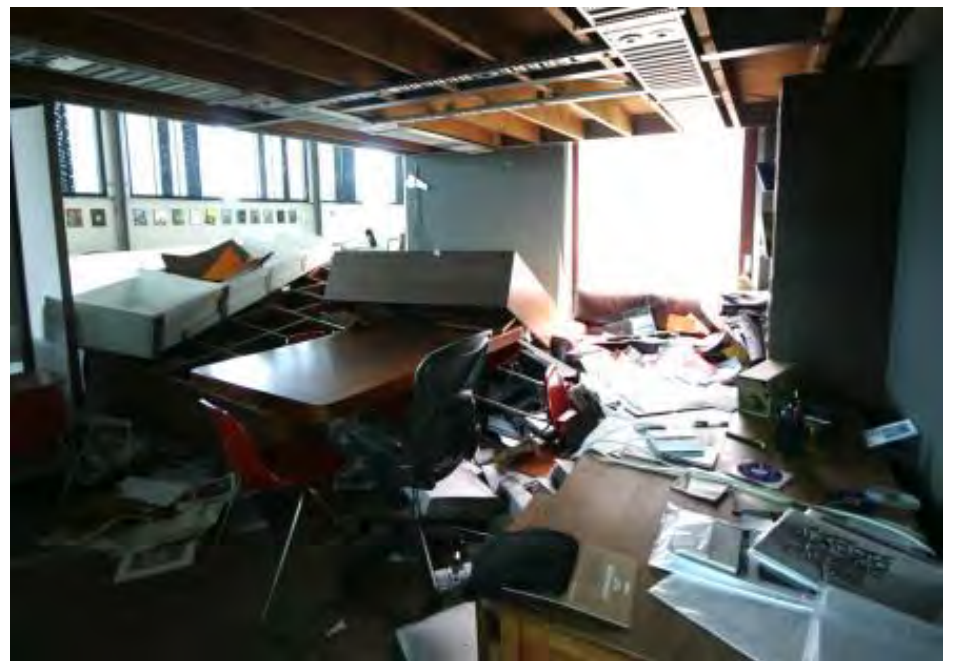
New CCTV Footage Of Christchurch Earthquake - YouTube.flv



Damage to Structures



Nonstructural Damage Remains an Issue



Irregular Foundation Settlement





Christchurch URM Debris from Buildings



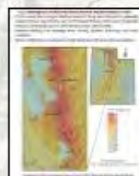


Building Damage Estimate for 7.0 Earthquake

Prepared For Simulation Purposes Only

Probability of Destruction	
• None	125,350
• Green Tag: 5 - 30%	45,358
• Yellow Tag: 30 - 70%	44,483
• Red Tag: 70 - 100%	68,133
• Black: Potentially Collapsed	1,228
— Fault Lines	

Salt Lake County
Unreinforced Masonry Buildings:
227,577 residential URM's
26,987 multi-unit URM's



The damage estimates are a product of using various data sources and engineering judgment. There are uncertainties inherent in any damage estimate. Therefore, there may be significant differences between the modeled results and the actual results. These results are intended for planning purposes only. They are not intended to be used for legal or financial purposes.

0 0.5 1 2 3 4 Miles

Map of Salt Lake County
Utah
2010
Scale: 1:50,000





Liquefaction





UNCLASSIFIED

CHRISTCHURCH EARTHQUAKE – 22.02.2011

New Brighton, Christchurch, South Island, New Zealand

Not to be used for commercial purposes. Not to be distributed to third parties without prior approval of the NZDF Geospatial Intelligence Organisation



Date of image 22 Feb 2011



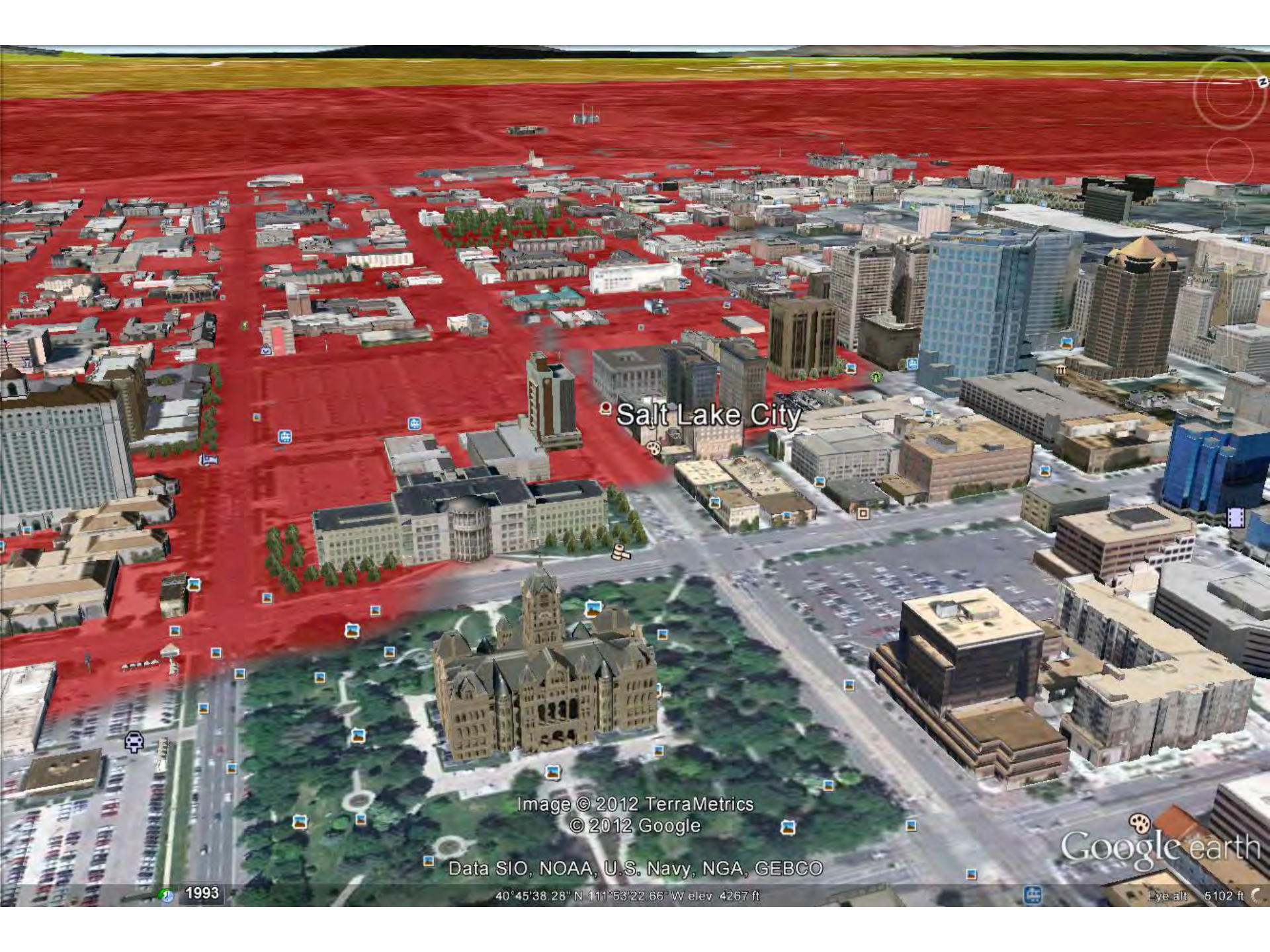
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Extent of Liquefaction





Salt Lake City

Image © 2012 TerraMetrics
© 2012 Google

Data SIO, NOAA, U.S. Navy, NGA, GEBCO

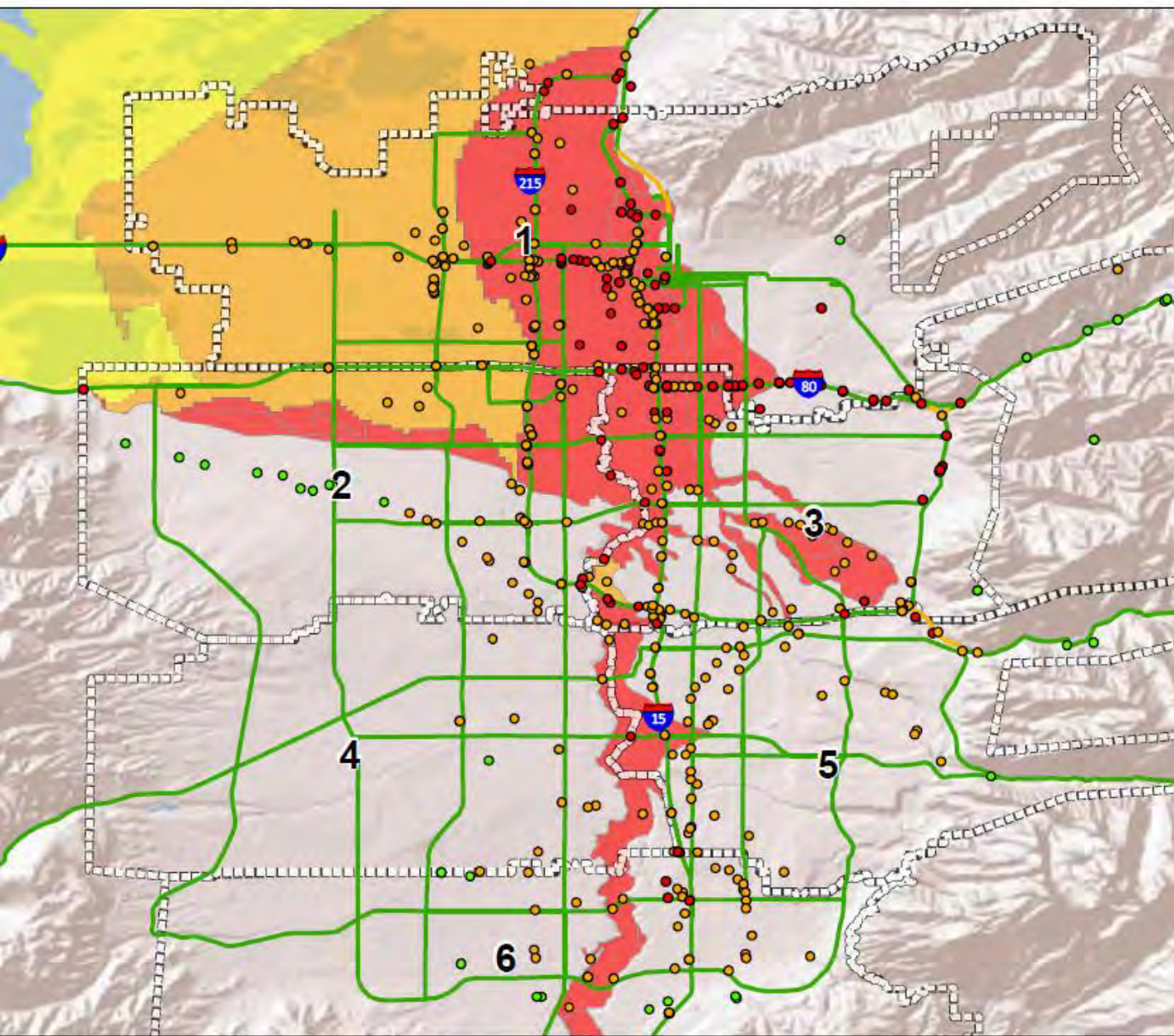
Google earth

1993

40°45'38.28" N 111°53'22.66" W elev. 4267 ft

Eye alt 5102 ft

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



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

- Low
- Moderate
- High

Highway Segment Impact

- Low
- Moderate
- High

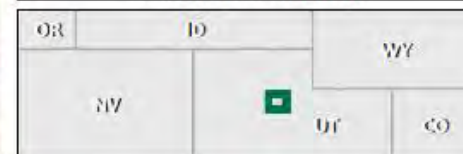
Impassable Areas Based on Potential Ground Deformation

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





Lifeline Critical Infrastructure

Casualties

Life Threatening Injuries	7,400 - 9,300
Fatalities	2,000 - 2,500

Shelter Needs

Displaced Households	84,400
Individuals Seeking Temporary Shelter	52,700

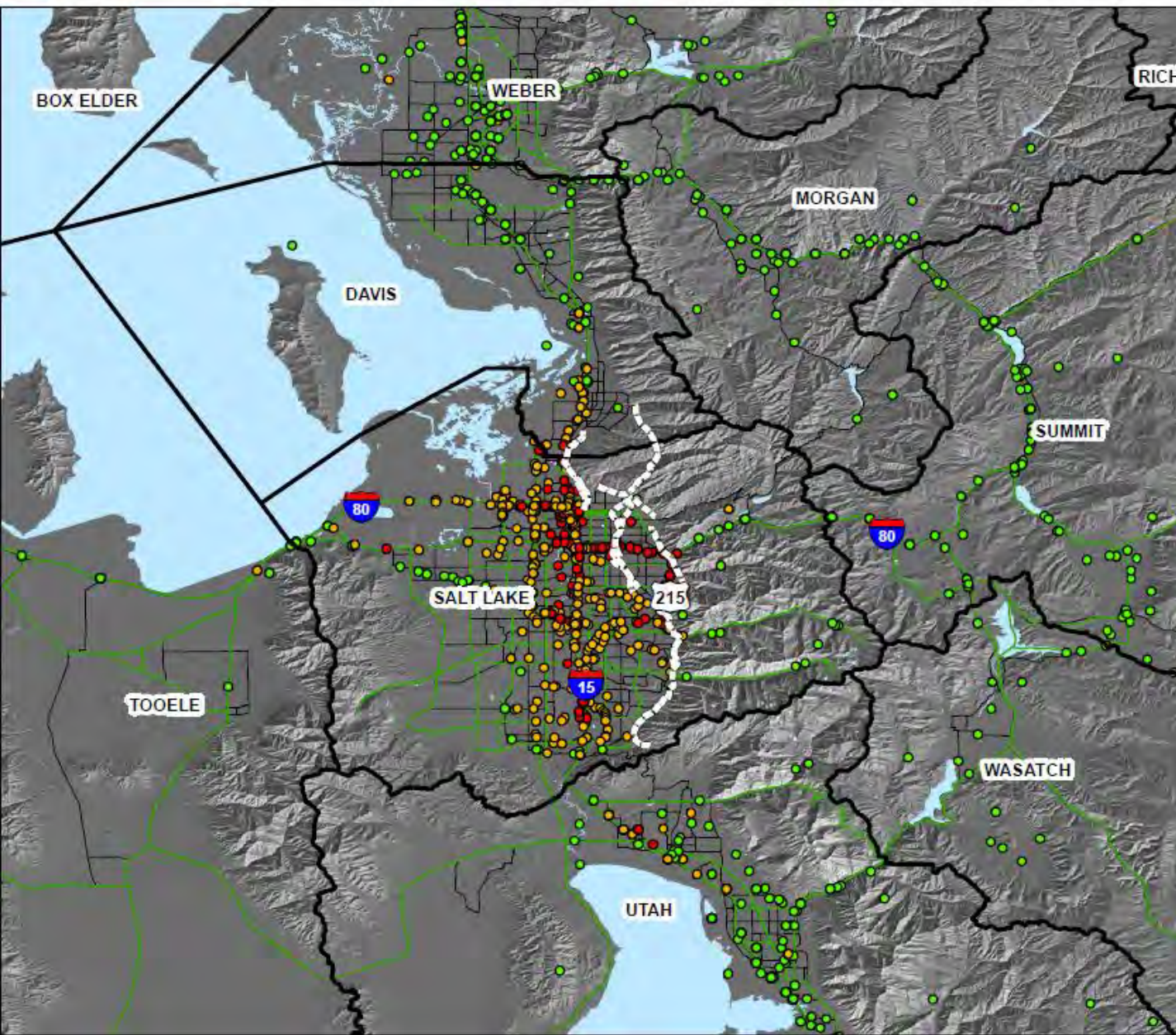
Utility System Performance

	Day 1	Day 3	Day 7	Day 30	Day 90
Households without Potable Water	483,600	466,100	442,800	362,900	332,800
Households without Electricity	444,600	251,200	105,900	27,300	800



Lifeline Critical Infrastructure

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



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

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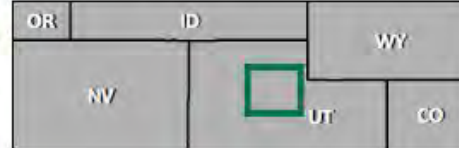
Highway Segment Impact

- Low
- Moderate
- High

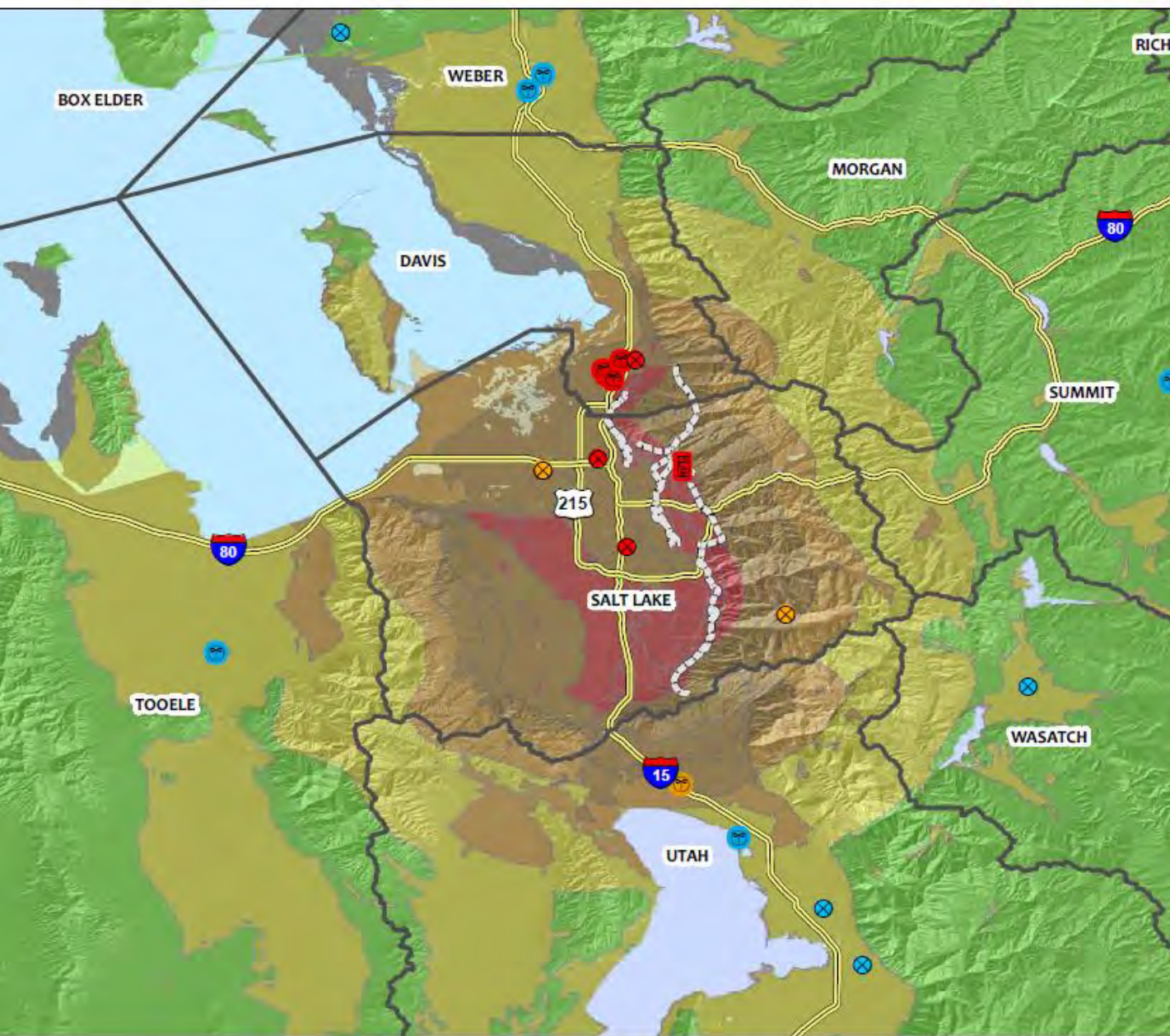
County	Total # of Bridges	# of Bridges Needing Priority Inspection	# of Bridge Engineers Needed*
Salt Lake	608	420	56
Juab	80	0	0
Weber	141	0	0
Tooele	54	0	1
Cache	62	0	0
Rich	23	0	0
Morgan	80	0	0
Summit	156	0	0
Wasatch	24	0	0
Box Elder	230	0	0
Utah	314	36	5
Davis	130	13	2
Total	1,902	469	64

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

--- Fault Source — Major Roads



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

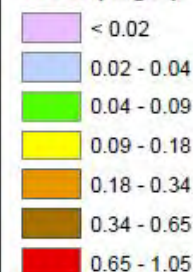


M 7.0 Salt Lake City Segment

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)



Counties
 Fault Source
 Interstate

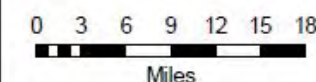
Oil Facility



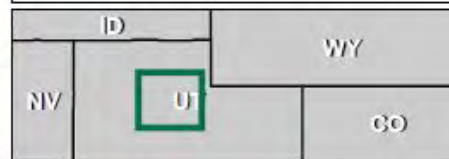
Electric Power Facility



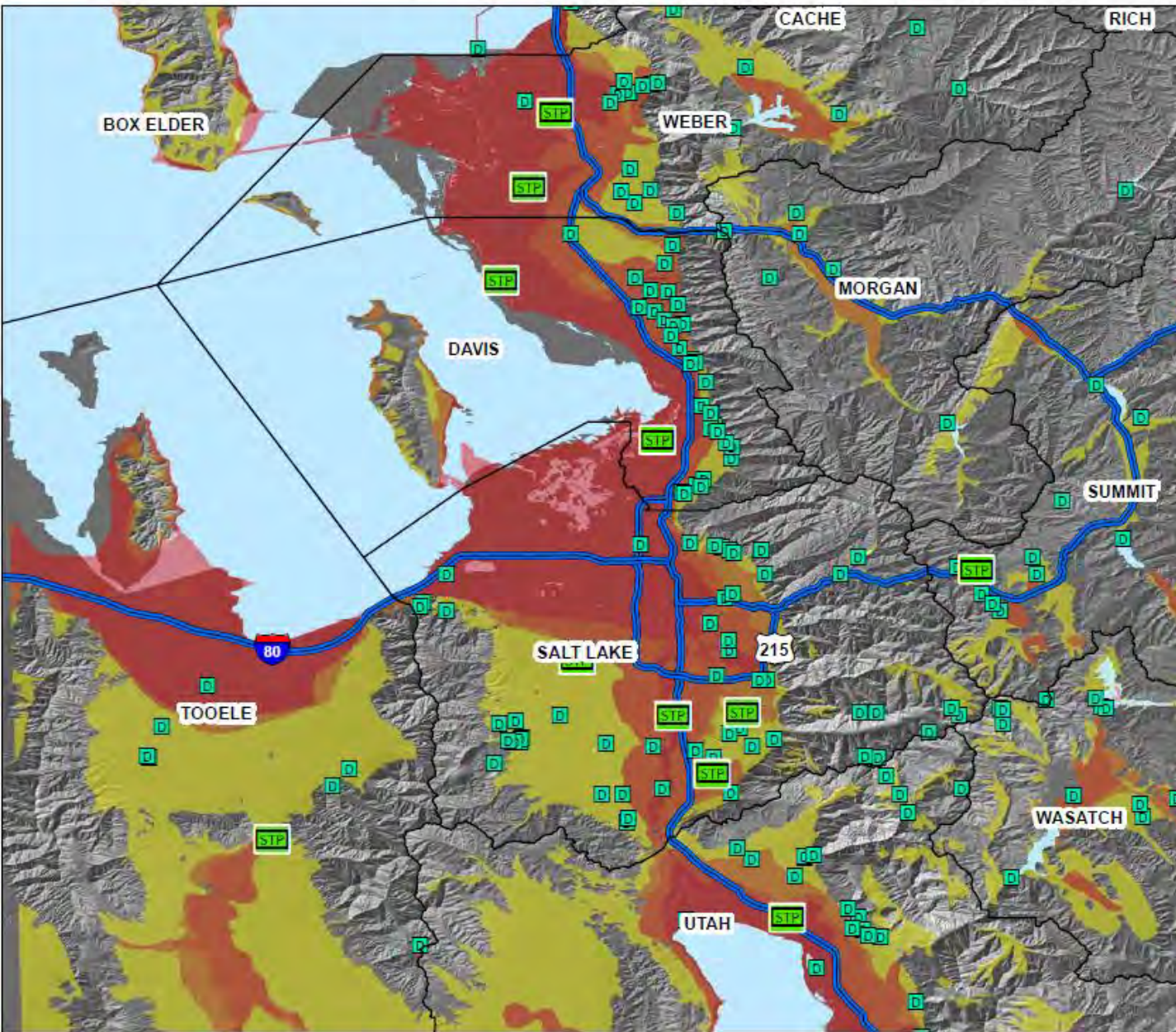
Natural Gas Facility



4/1/10 FEMA & URS Corporation



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

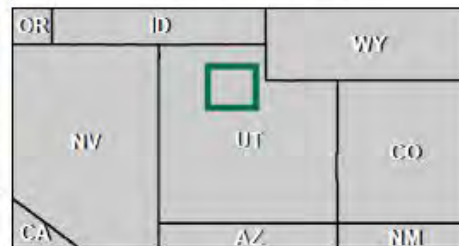
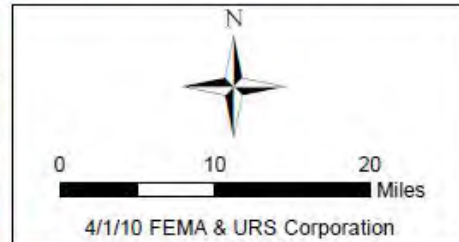


STP Sewage Treatment Facilities

D Dams

County	# Households without Potable Water (at Day 1)	Daily Potable Water Needs Per Person (Gallons/day)	Number of Truckloads needed Daily
Davis	22,017	66,051	14
Salt Lake	284,640	853,920	180
Utah	55	165	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.)





Community Recovery



Recovery from Liquefaction Damage-Christchurch





- Christchurch –
500,000 tons of sand
from liquefaction



Temporary Water Supplies



Community Shower Facilities





Temporary Sewerage 'System'



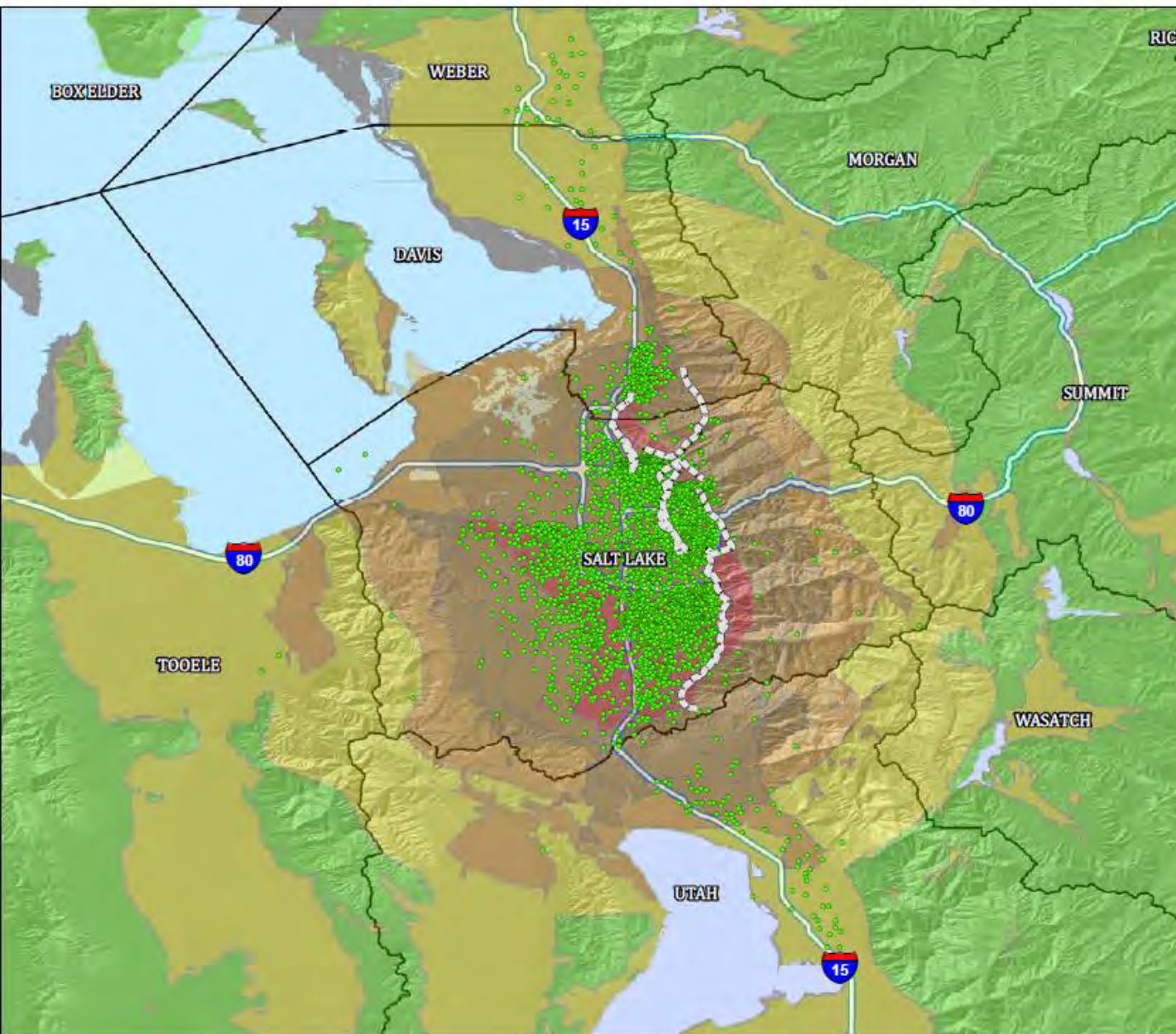
Temporary Electricity Facilities



© Patrick Dunford. 2011:03:12 10:25:01



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



M 7.0 Salt Lake City Segment

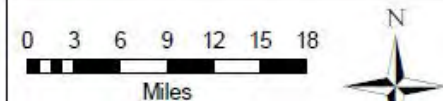
PGA (%g's)



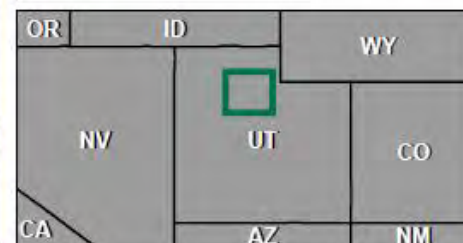
Total Direct Economic Loss: \$35.4B

County	Cost Structural Damage	Cost Non-Structural Damage	Total Loss (Including Contents)
Utah	110,255	\$300,397	\$773,731
Wasatch	\$9	\$216	\$463
Box Elder	\$47	\$105	\$241
Tooele	\$3,639	\$10,019	\$24,257
Salt Lake	\$4,396,113	\$14,669,992	\$32,193,838
Weber	\$38,139	\$86,339	\$231,258
Summit	\$480	\$5,717	\$10,478
Morgan	\$113	\$386	\$822
Davis	\$329,924	\$1,055,212	\$2,205,365
Total	\$4,878,719	\$16,128,383	\$35,439,454

* All values are thousands of dollars



4/1/10 FEMA & URS Corporation





NOVOTEL

WISCONSIN



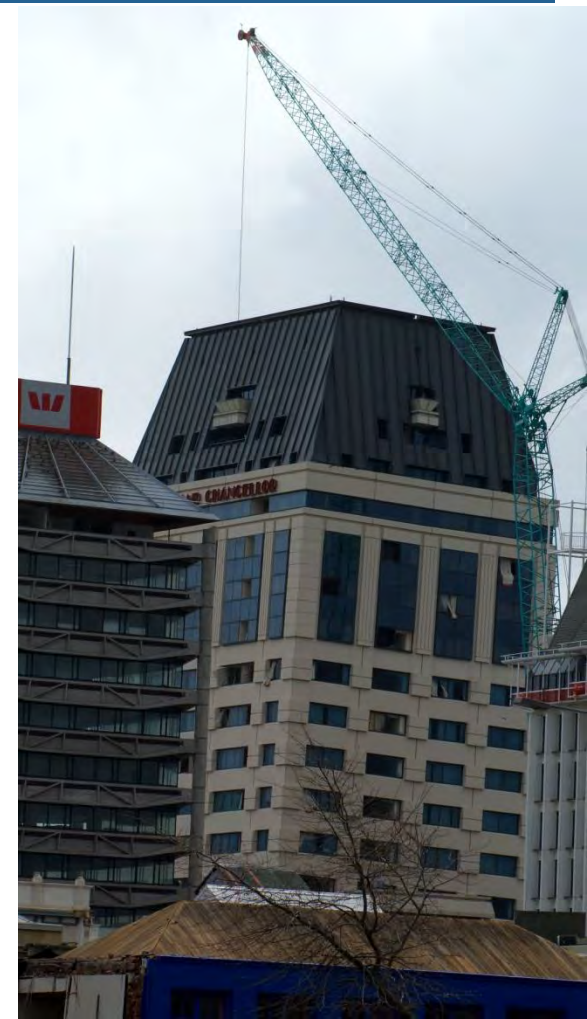
Central Business District

- There were about 6,000 companies and/or institutions with over 50,000 employees.
- 25% of the total employment in the city.
- A significant portion is still closed.
- Slowly being opened block by block as buildings are verified as being safe for re-entry and hazards are removed.





Christchurch – CBD: 900 Buildings to be Demolished

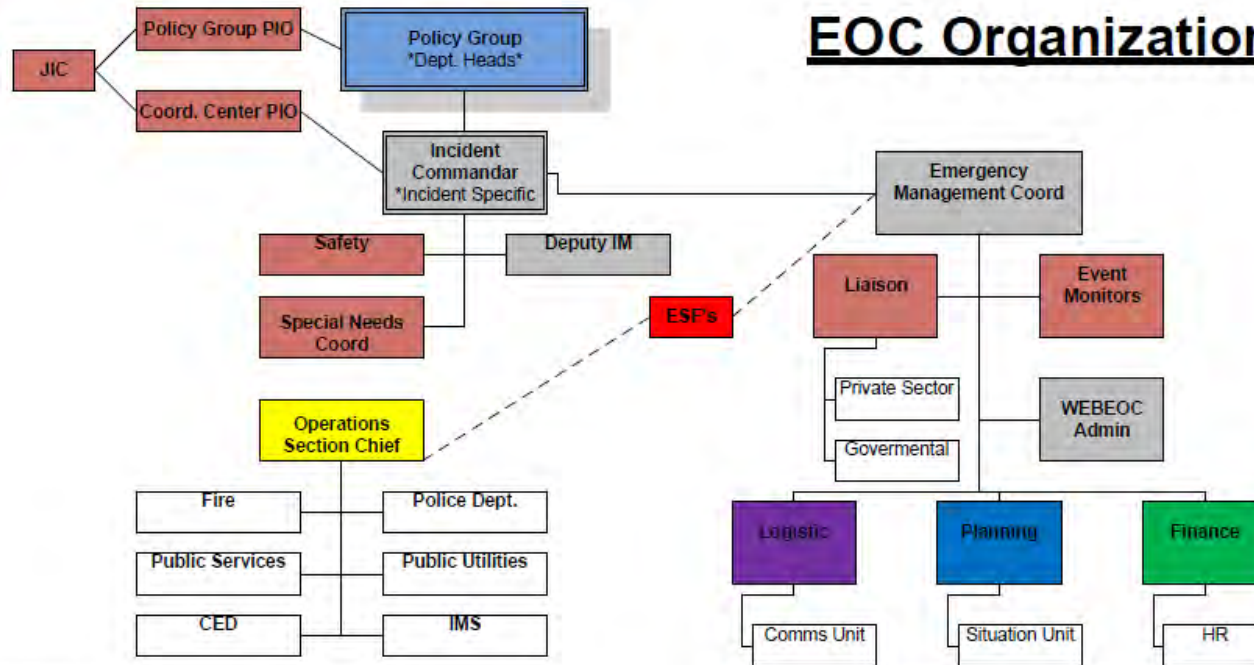




Emergency Management Program

- Director
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 - Community Preparedness Coordinator
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 - Multi-language Media Outreach Coordinator

EOC Organizational Chart



Incident/Hazards

Flood Natural or Human Caused	Public Utilities
Contamination Water Supply	Public Utilities
Earthquake	Fire Dept.
Fire Multi-Structure/Wildland	Fire Dept.
Hazardous Materials	Fire Dept.
Mass Injury/Death	Fire Dept.
Building Collapse	Fire Dept.
Extreme Weather Cold	Public Services
Weapons of Mass Destruction	Police Dept.
Cyber Event	IMS
Extraordinary Criminal Event	Police Dept.
Crowd Management	Police Dept.
Civil Disruption	Police Dept.
Evacuation	Police Dept.
Community Protection	Police Dept.
Air Crash (On Airport)	Airport
Air Crash (Off Airport)	Fire Dept.
Utility Disruption	Emergency Management
Public Health	Fire Dept.
Disease Outbreak	Fire Dept.
Tornado or High Winds	Public Services
Extreme Hot Weather	Fire Dept.
Economic Disruption	CED
Large Scale Special Events	Public Services

each hazard needs to be planned for in your departments COOP Plan

ESF Responsibility

1 – Transportation	CED
2 – Communications	IMS
3 – Public Works and Engineering	Public Utilities
4 – Fire Fighting	Fire Dept.
5 – Emergency Management	Emergency Management
6 – Mass Care	Public Services/Parks
7 – Logistics Management	Public Services
8 – Public Health	Fire Dept.
9 – Search and Rescue	Fire Dept.
10 – Hazmat	Fire Dept.
11 – Agriculture	CED
12 – Energy	Emergency Management
13 – Public Safety and Security	Police Dept.
14 – Long Term Recovery	Mayor's Office
15 – Public Information	Mayor's Office



Critical Infrastructure Liaison

- Local Energy Assurance Plan (LEAP)
- Building Occupancy Resumption Plan (BORP)
- Life-line Infrastructure Regional Resilience Assessment Plan (RRAP)
- Critical Infrastructure IP Gateway
- Life-line Infrastructure Resilience Committee (LIRC)



Loss of Life/Serious Injury

Casualties

Life Threatening Injuries	7,400 - 9,300
Fatalities	2,000 - 2,500

Shelter Needs

Displaced Households	84,400
Individuals Seeking Temporary Shelter	52,700

Utility System Performance

	Day 1	Day 3	Day 7	Day 30	Day 90
Households without Potable Water	483,600	466,100	442,800	362,900	332,800
Households without Electricity	444,600	251,200	105,900	27,300	800

A man with short, light-colored hair, wearing a light-colored button-down shirt with a small grid pattern, stands in an office. Behind him are two computer monitors. The monitor on the left displays a map with a large red area, possibly indicating a seismic hazard zone. The monitor on the right shows a software interface with various maps and data layers. The background consists of light-colored office cabinets.

Doug Bausch

FEMA Region VIII Senior Physical Scientist

“... in the Utah Earthquake, 90% of severe injuries and fatalities will come from this one building type, the unreinforced masonry brick buildings.”

Probability of Destruction

- None 13,749
- Green Tag: 5 - 30% 3,417
- Yellow Tag: 30 - 70% 16,094
- Red Tag: 70 - 100% 19,988
- Black: Potentially Collapsed 688

Fault Lines
Salt Lake City Boundary



Building Damage Estimate for 7.0 Earthquake

Salt Lake City
Unreinforced Masonry Buildings:
31,892 residential URMs
462 multi-unit URMs



Drawn By: K. Bell
Salt Lake City Corporation
Mayor's Office of Emergency Management
April 2012

Building Damage Estimate for 7.0 Earthquake

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Fault Lines

Salt Lake City Boundary

462 multi-unit URMs

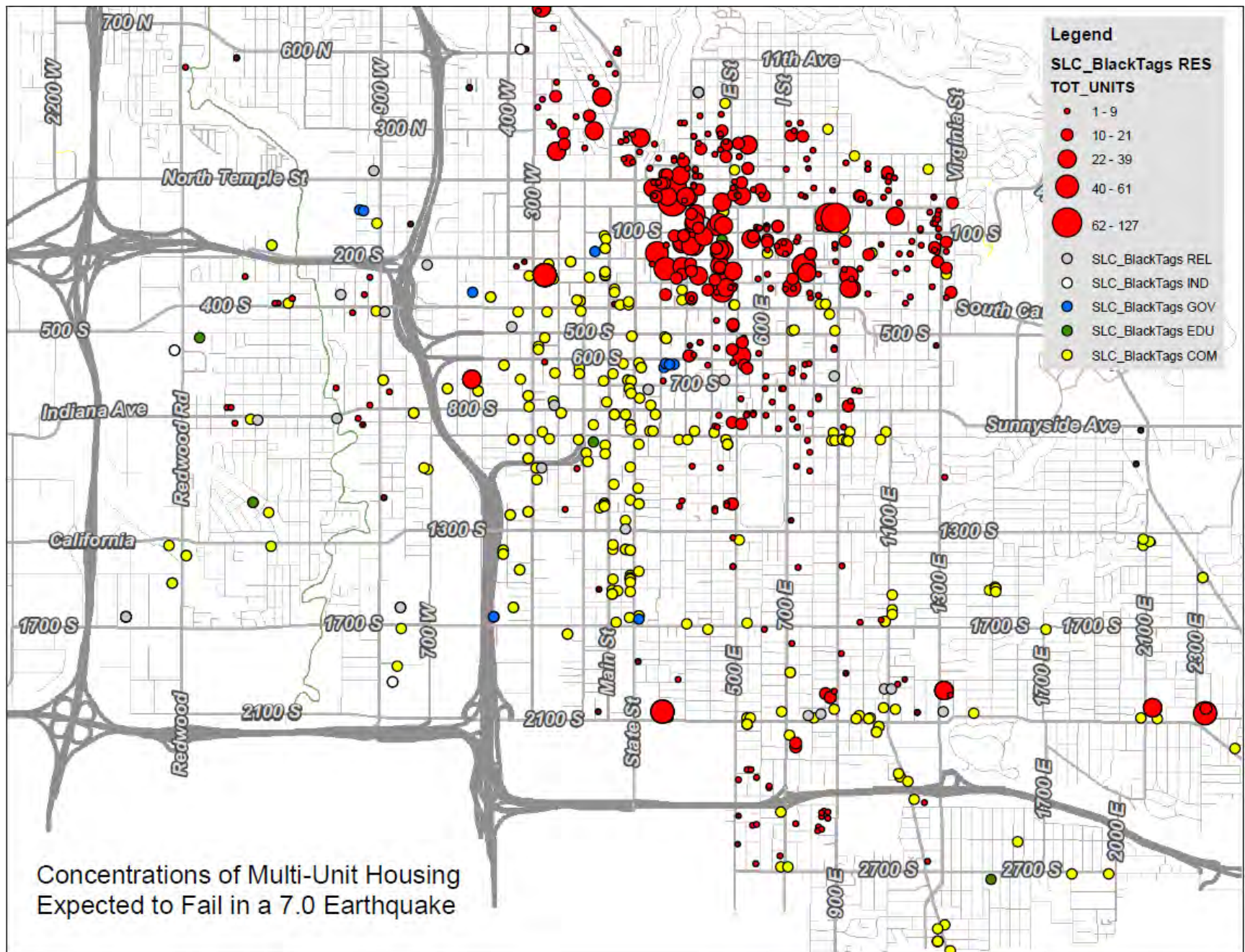
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Fault Lines

Salt Lake City Boundary





SLC Building Permits



1500 Remodel/Re-roof
Permits Annually

20 years = 30,000
buildings



SALT LAKE CITY

Stakeholder Partners





Death and Injury

- Deaths – 1,500 to 2,400
- Serious to Critical Injury –
6,000 to 9,000
- Non life threatening injuries –
– 16, 000 to 25,000
- Death and Serious Injury = 1%
- What about the 99%



CERT Program *English/Spanish/Business*





Amateur Radio



**SALT LAKE CROSSROADS
Amateur Radio Club**





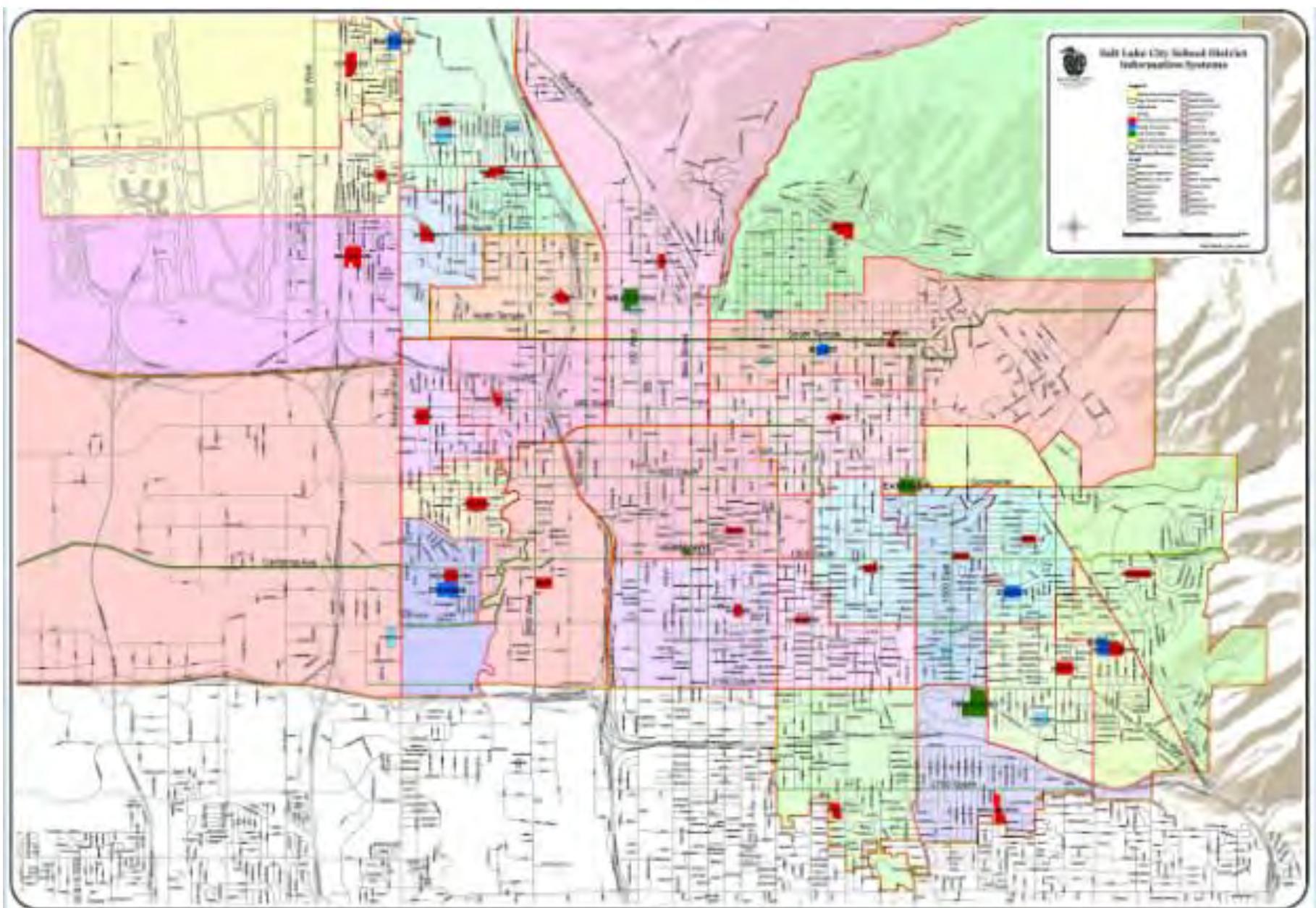
SAFE Neighborhoods *English/Spanish*



Grab your kit, walk to school

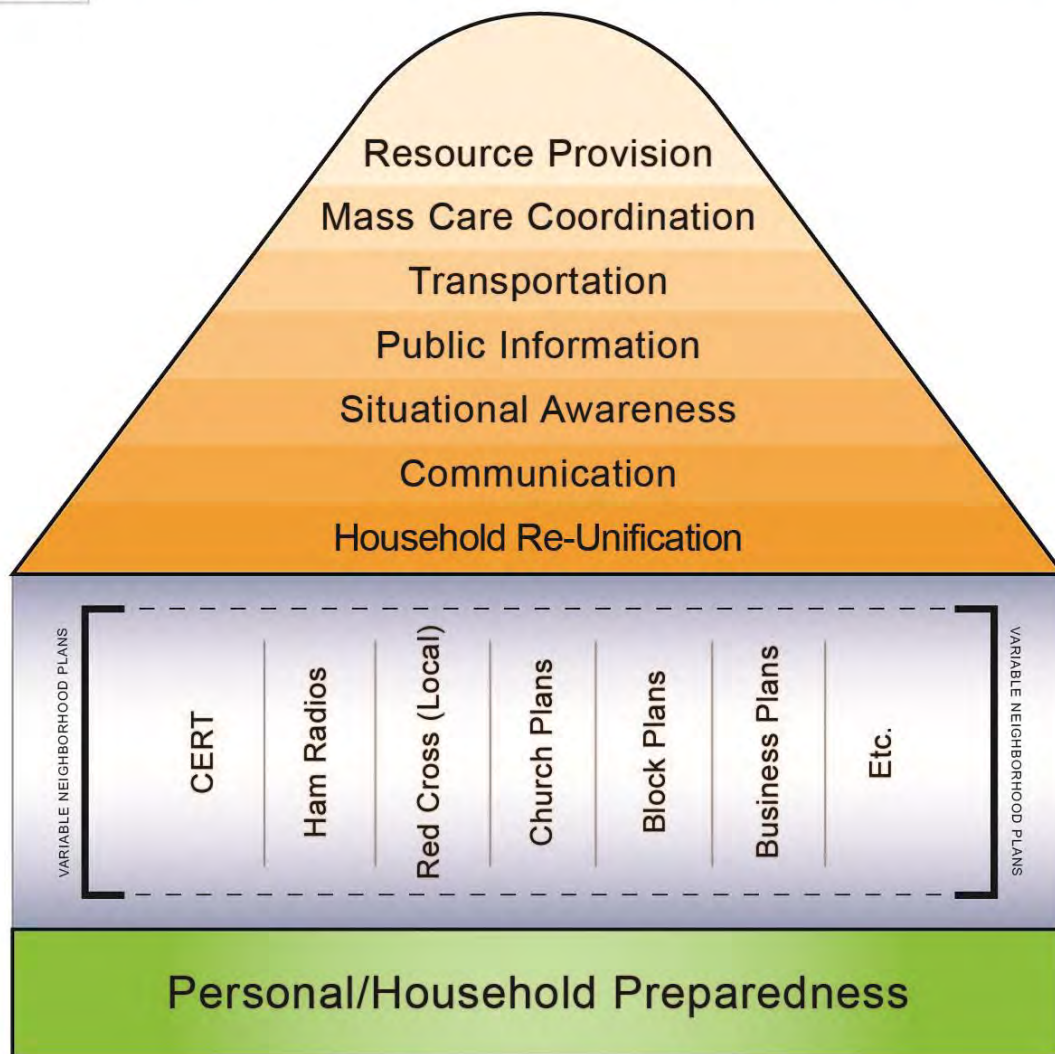


Toma tu equipo de emergencia,
y camina a la escuela





S.A.F.E. Neighborhoods Framework





Multi- language Media Outreach

- Spanish Speaking Community Inclusion
- Outreach and Program Promotion
- Joint Information System Coordinator
 - Emergency Alert and Warning
 - Training & exercise



Recovery Planning

- National Disaster Recovery Framework (NDRF)
- Salt Lake County Recovery Framework
- SLC Local Disaster Recovery Manager (LDRM)



Summary

Planning, Training & Exercise
Community Preparedness
Critical Infrastructure
Multi-language Media
Outreach