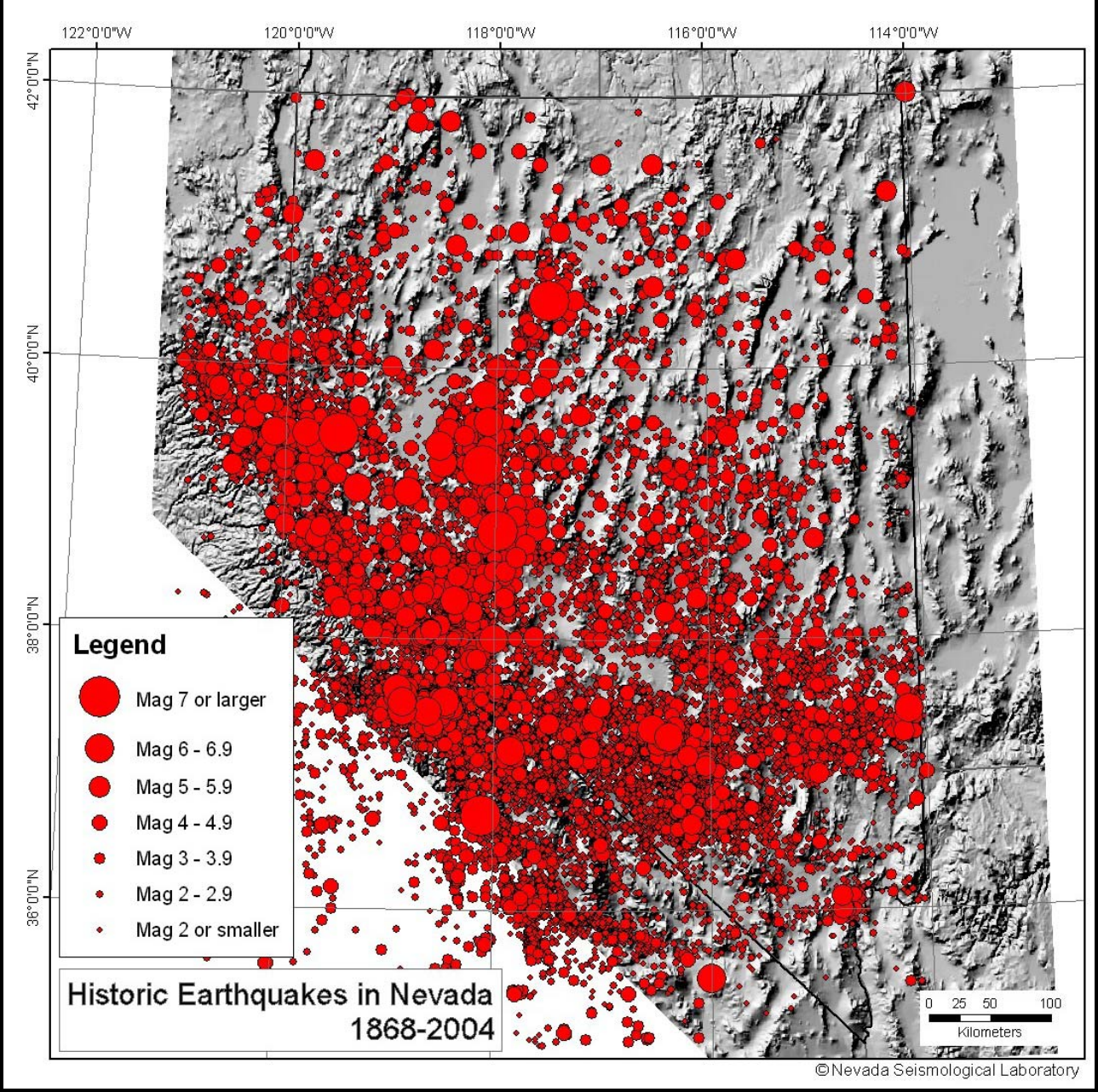
Loss-Estimation Modeling of Earthquake Scenarios for Each County in Nevada Using HAZUS-MH

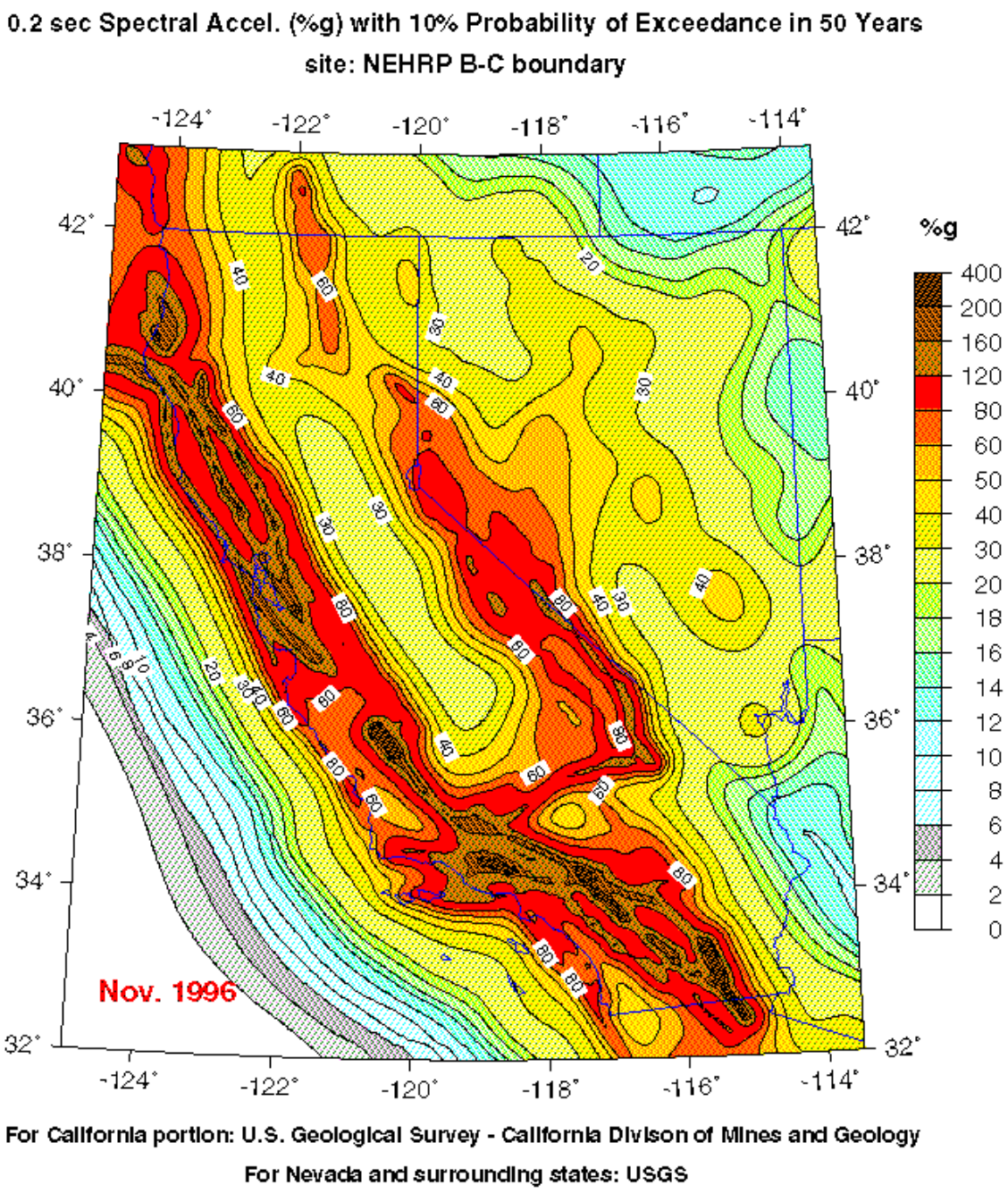
Nevada Bureau of Mines and Geology
Open-File Report 06-1
University of Nevada, Reno

There are huge risks.

We can take action to reduce the risks.

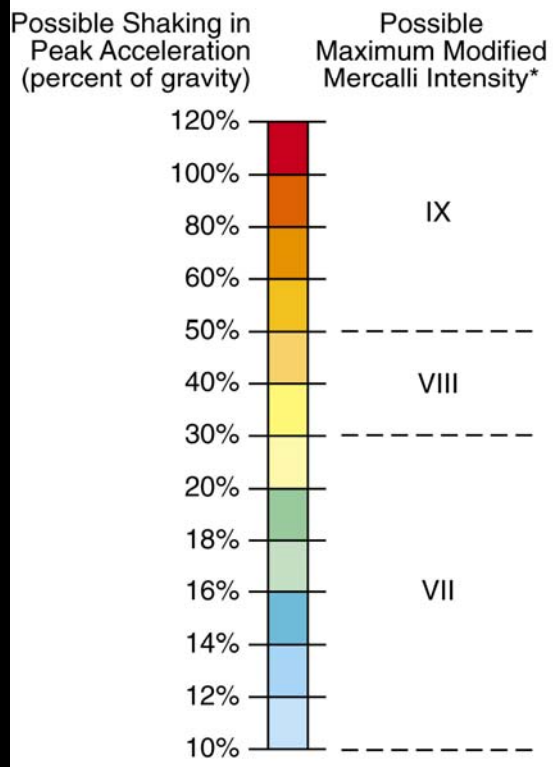


Earthquakes have occurred throughout Nevada.

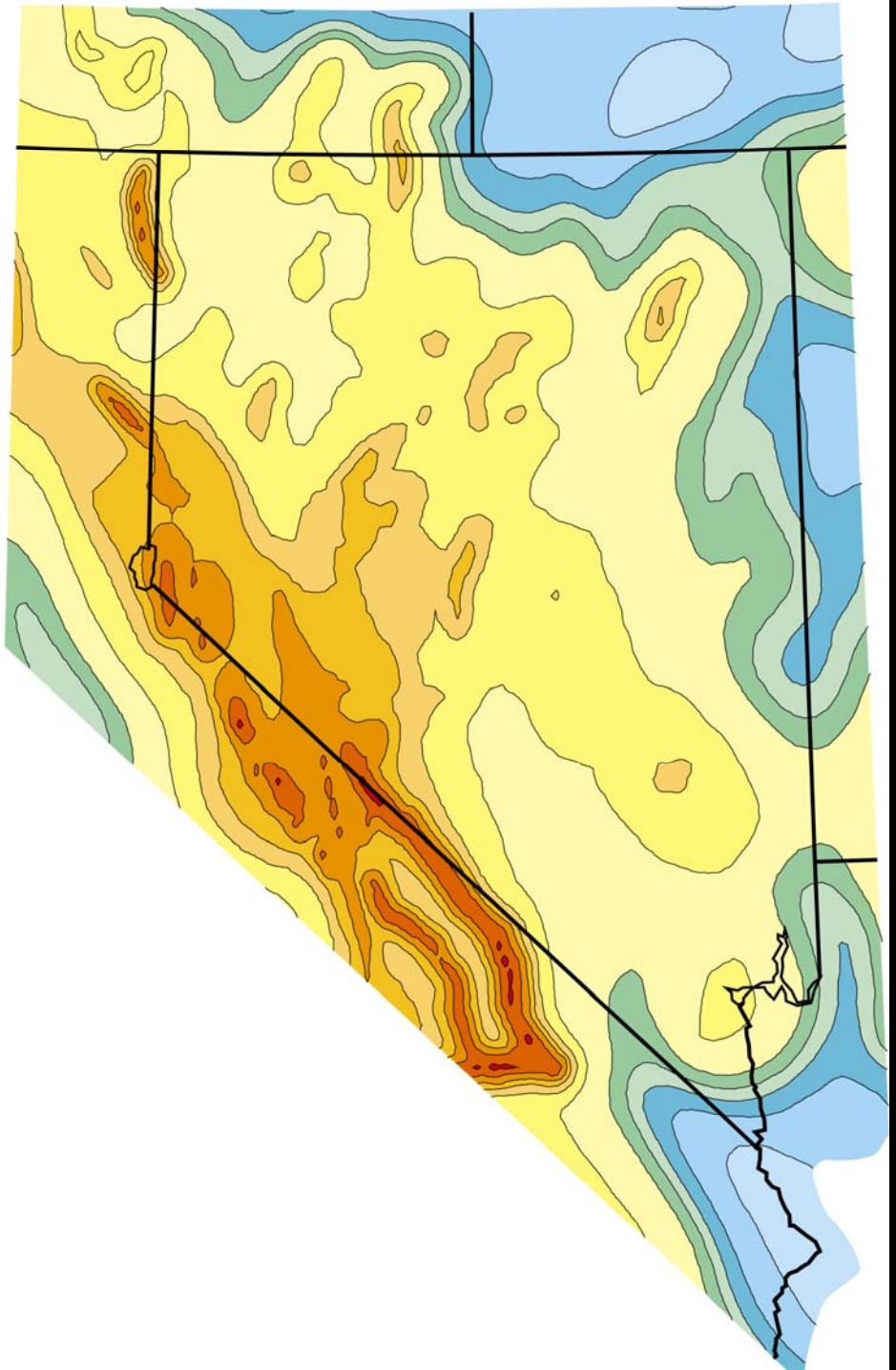


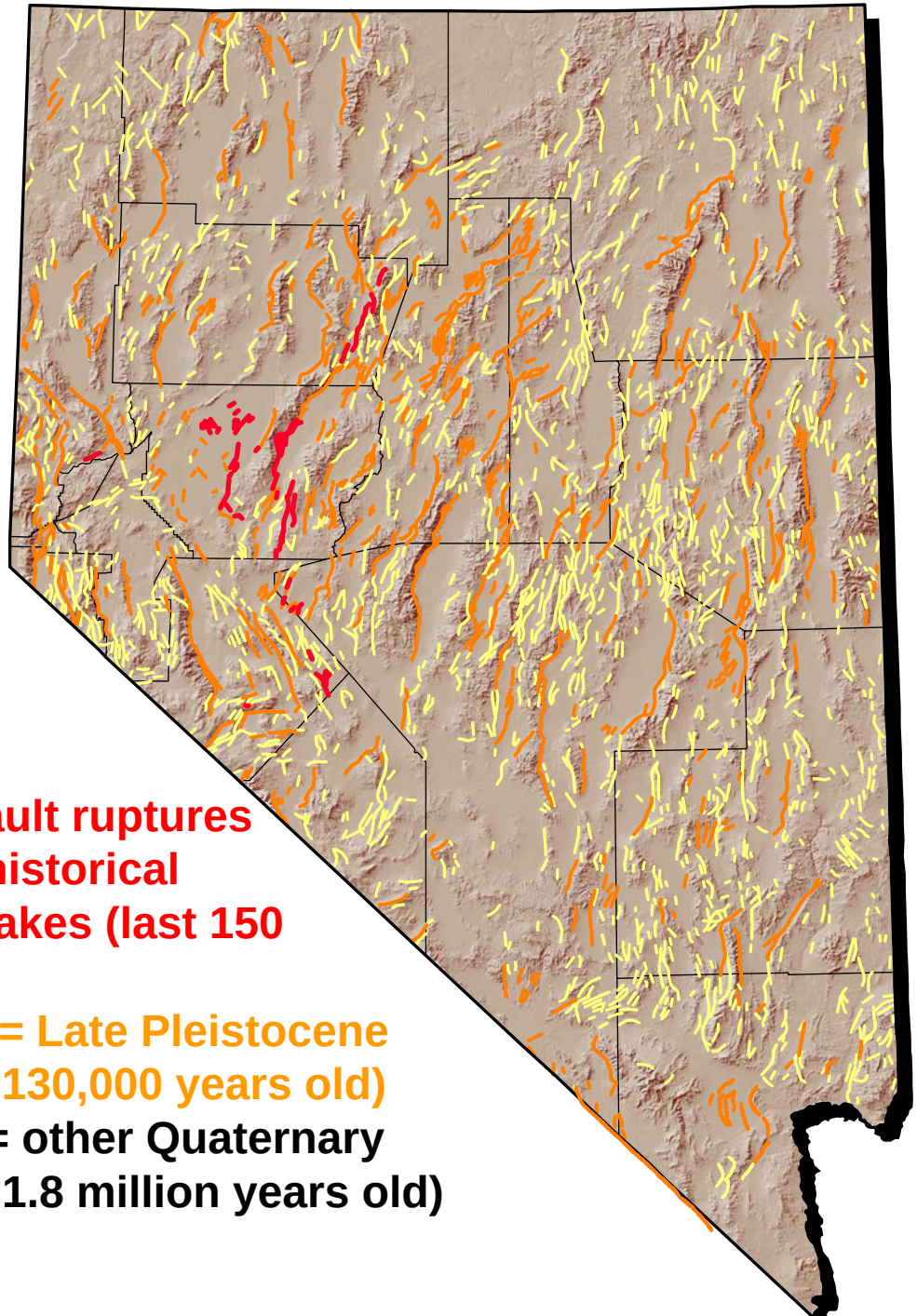
The earthquake hazards in Nevada are comparable to those in seismically active areas of California.

Shaking Potential Map for Nevada



* See page 4 for descriptions of Intensity VII and VIII. In Intensity IX, general panic occurs and there may be damage to some well-built structures.





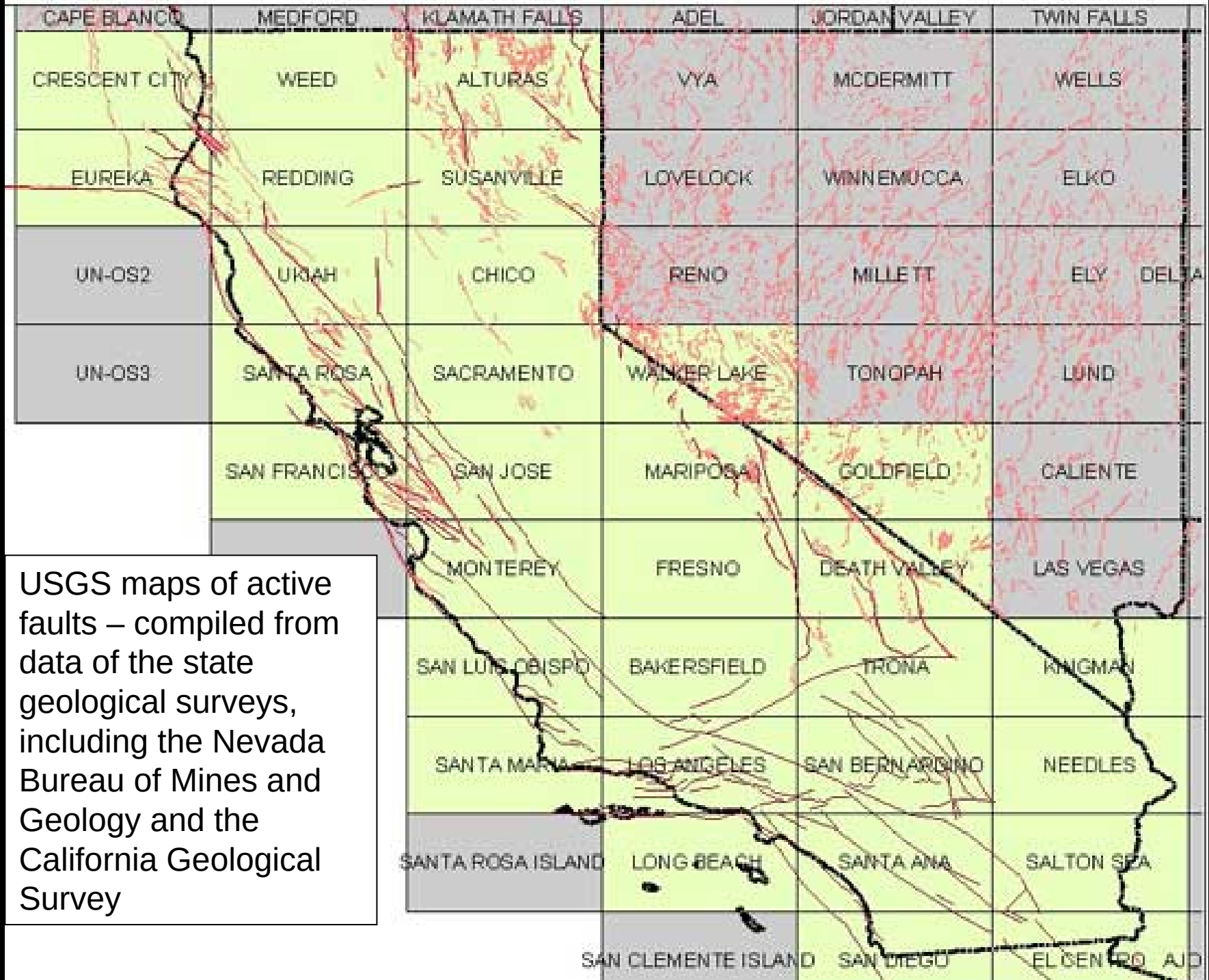
Red = fault ruptures during historical earthquakes (last 150 years)
Orange = Late Pleistocene faults (<130,000 years old)
Yellow = other Quaternary faults (<1.8 million years old)

There are active faults nearly everywhere in Nevada,

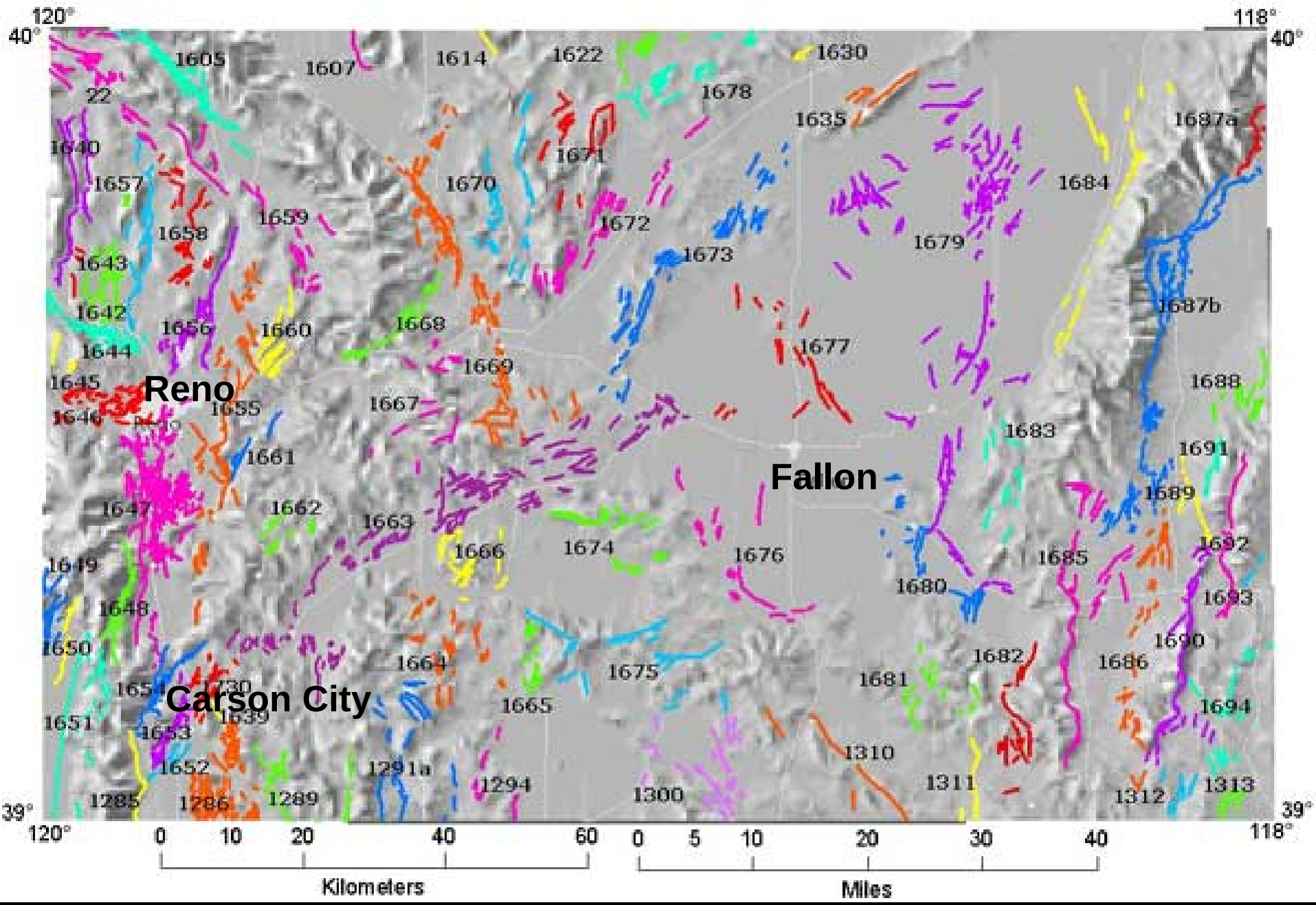
but not everywhere.

We used FEMA's loss-estimation model, HAZUS-MH, to estimate the effects of potential earthquakes near each of the county seats in Nevada, and we made an extra calculation for Pahrump.

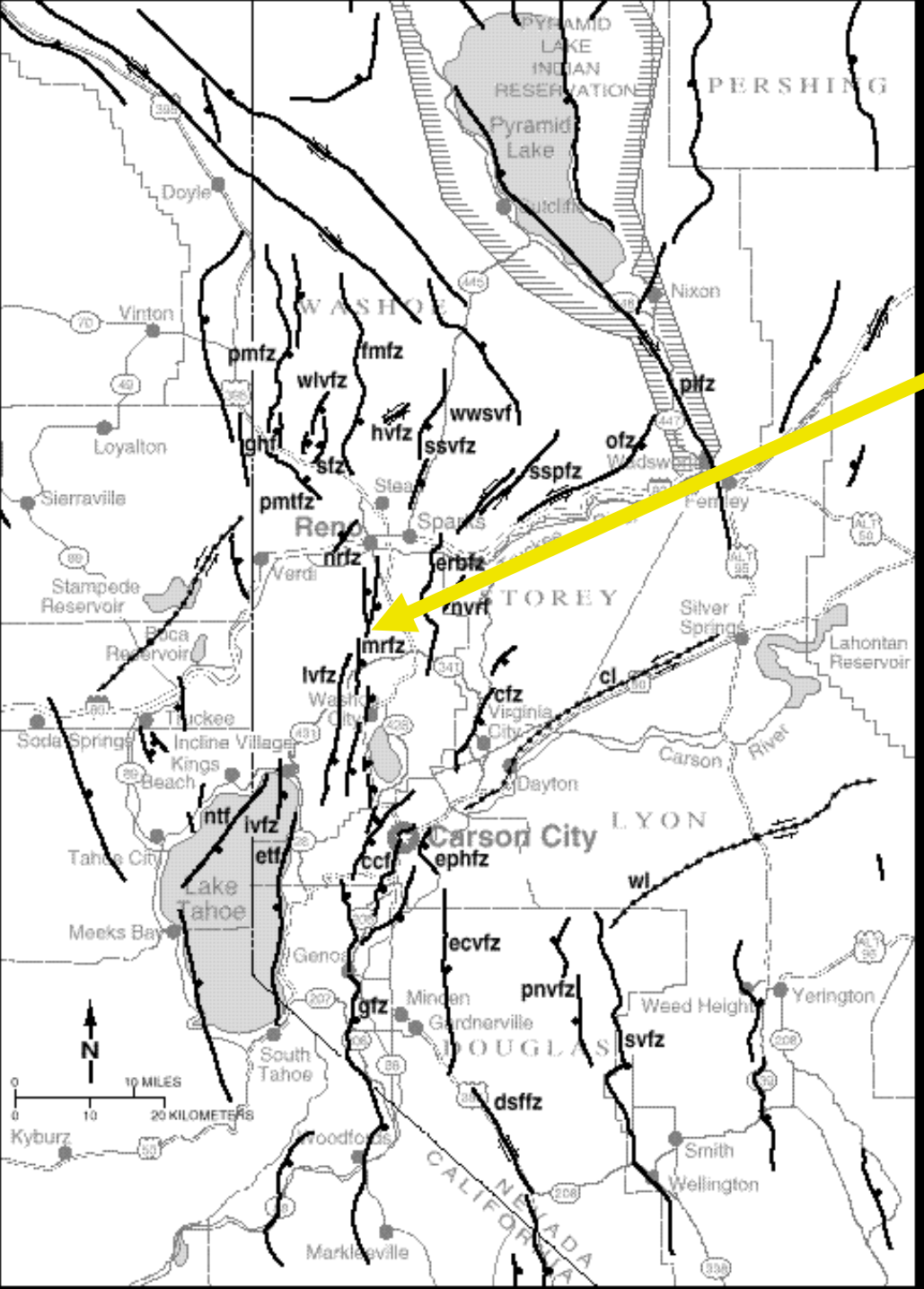
This model is used in emergency-response and recovery exercises and will be used to help rapidly estimate the scope of damage and losses immediately after an earthquake (information that helps with a Presidential Declaration of Disaster).



USGS maps of active faults – compiled from data of the state geological surveys, including the Nevada Bureau of Mines and Geology and the California Geological Survey



Active faults on the Reno 1 x 2-degree sheet



Mount Rose fault zone

The risks are huge.

For a magnitude 6.9 earthquake on the Mount Rose fault, HAZUS estimated, for the Washoe-Carson-Storey-Douglas region:

up to $7.6 billion in economic loss
(~2.9 billion in Washoe County alone)

major damage to approximately 12,000 buildings

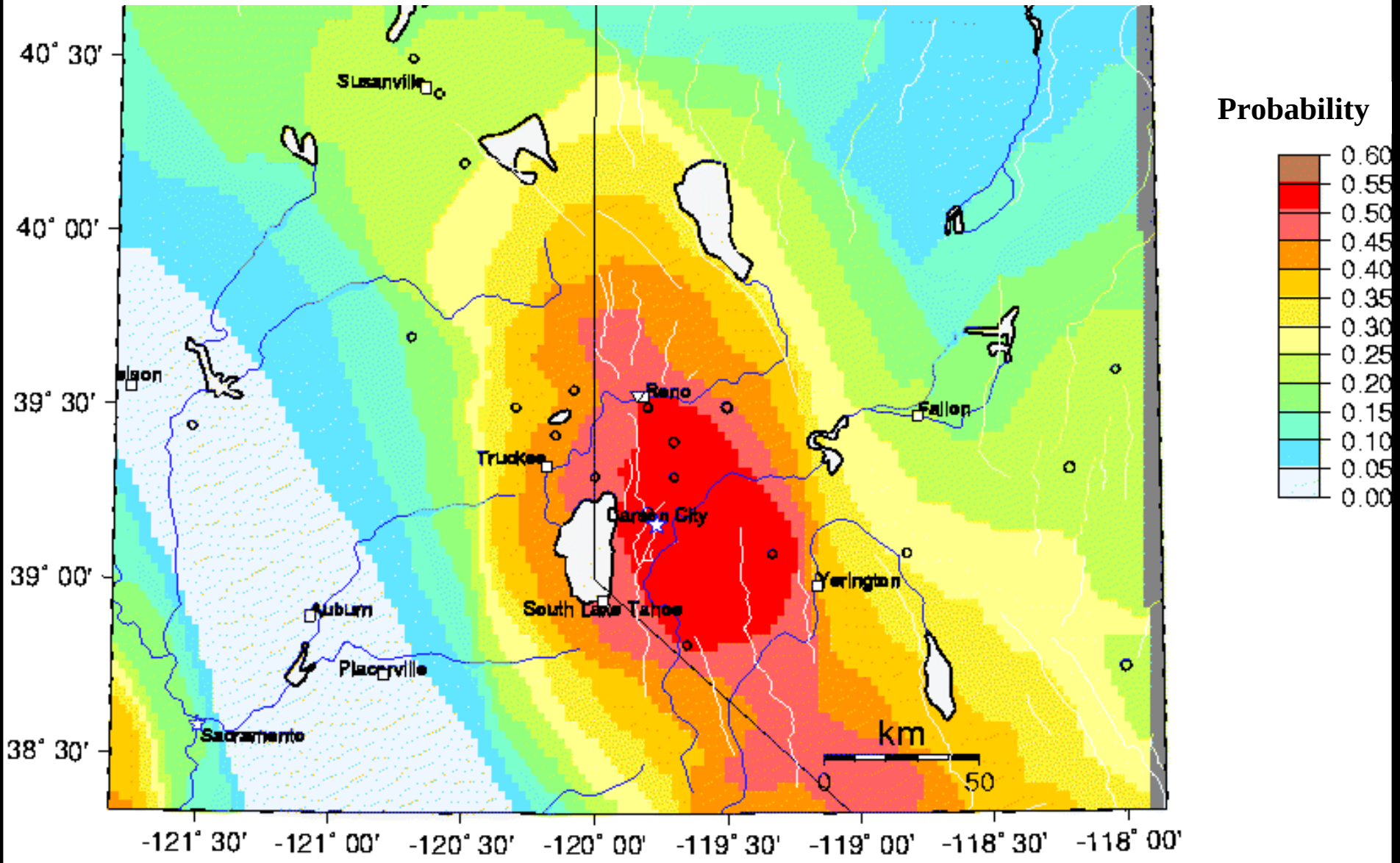
800 to 3,000 people needing public shelter

80 to 300 fatalities.

We don’t know exactly how often these specific earthquakes occur, but we do have reasonable estimates of earthquake rates for each region.

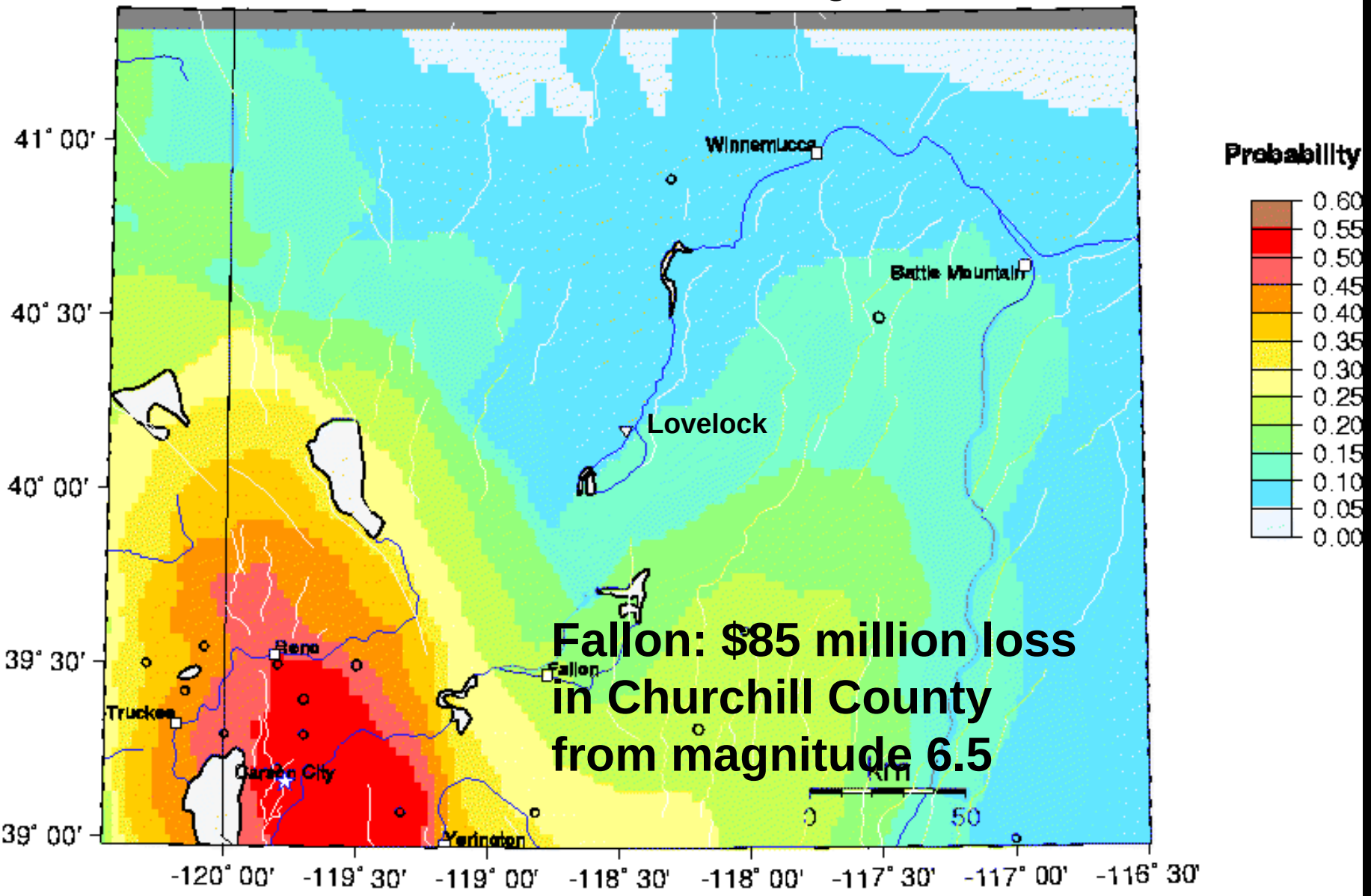
Probability of an earthquake of magnitude 6.5 or greater occurring within 50 km in 50 years (from USGS probabilistic seismic hazard analysis)

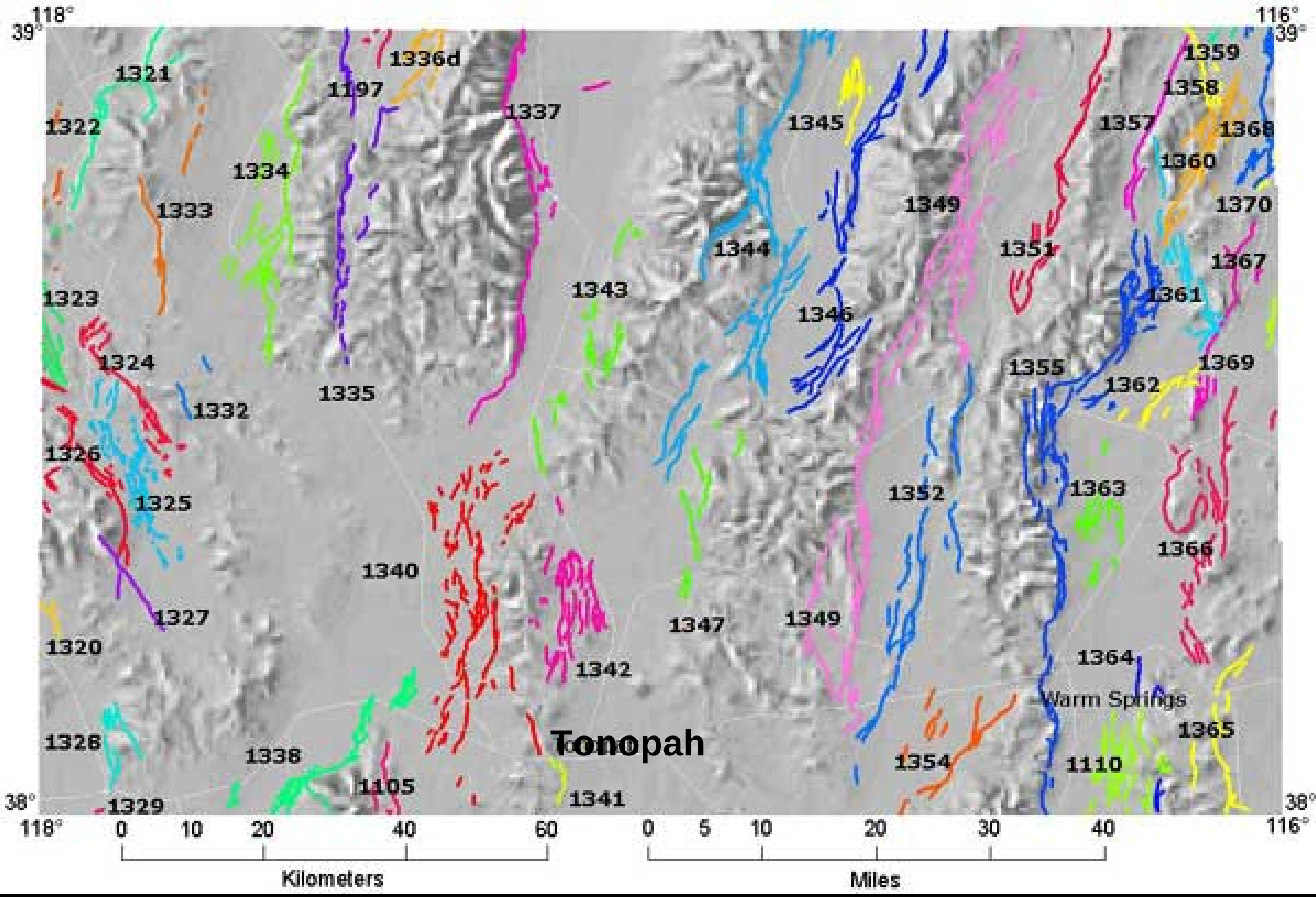
~50% chance for Reno and Carson City, magnitude 6.5



Probability of an earthquake of magnitude 6.5 or greater occurring within 50 km in 50 years (from USGS probabilistic seismic hazard analysis)

20-25% chance for Fallon, magnitude 6.5

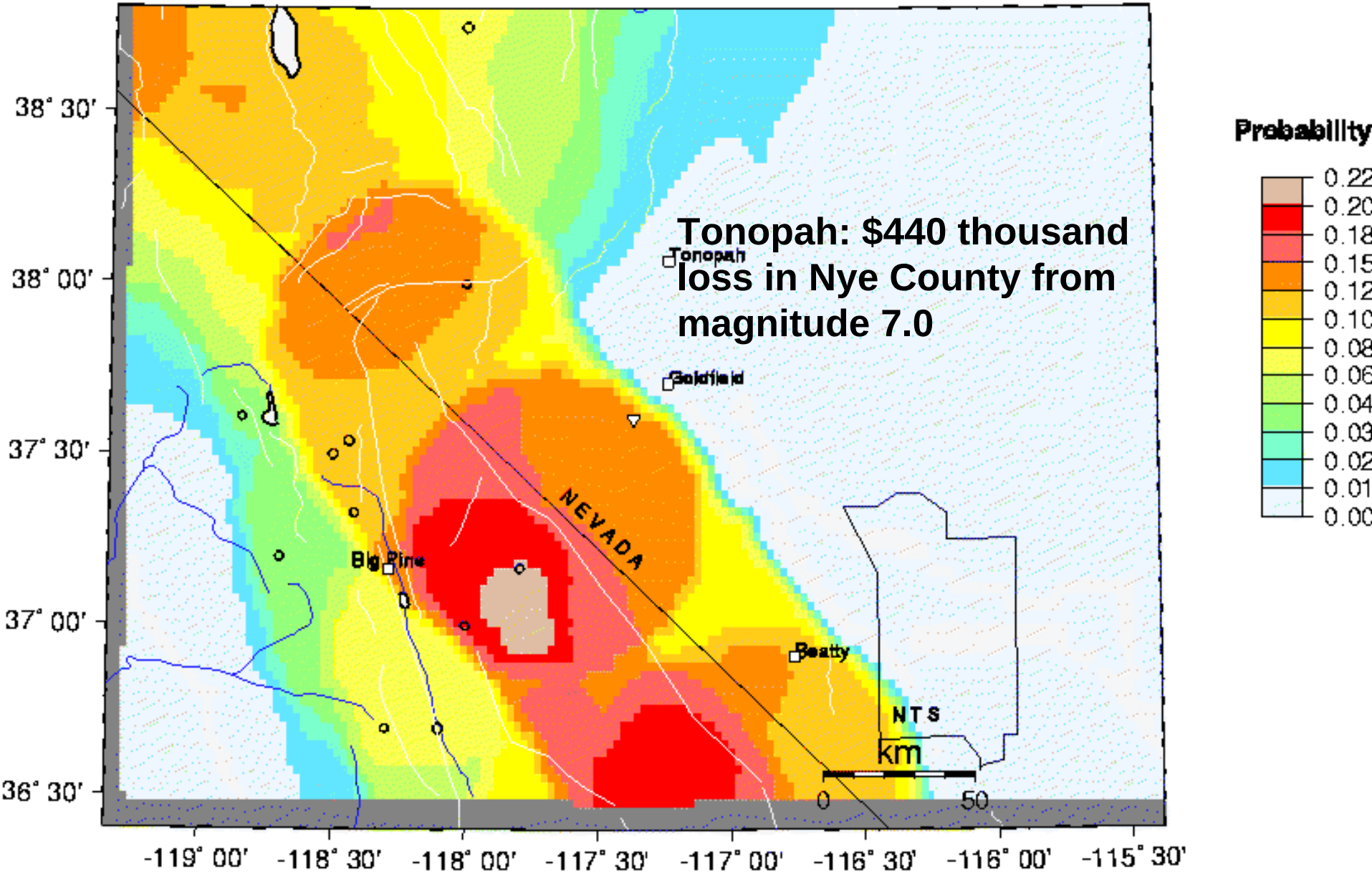




Active faults on the Tonopah 1 x 2-degree sheet

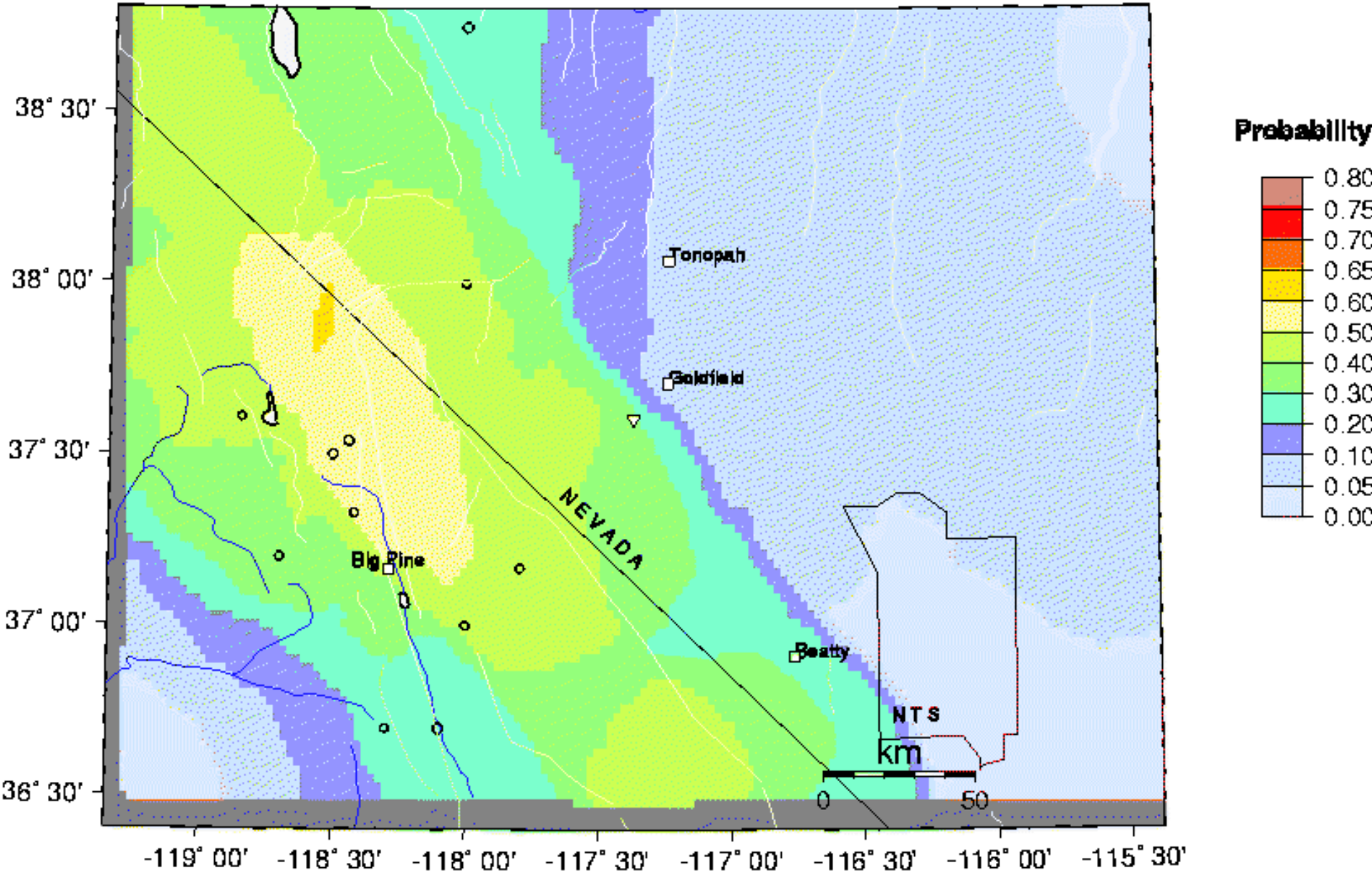
Probability of an earthquake of magnitude 7.0 or greater occurring within 50 km in 50 years (from USGS probabilistic seismic hazard analysis)

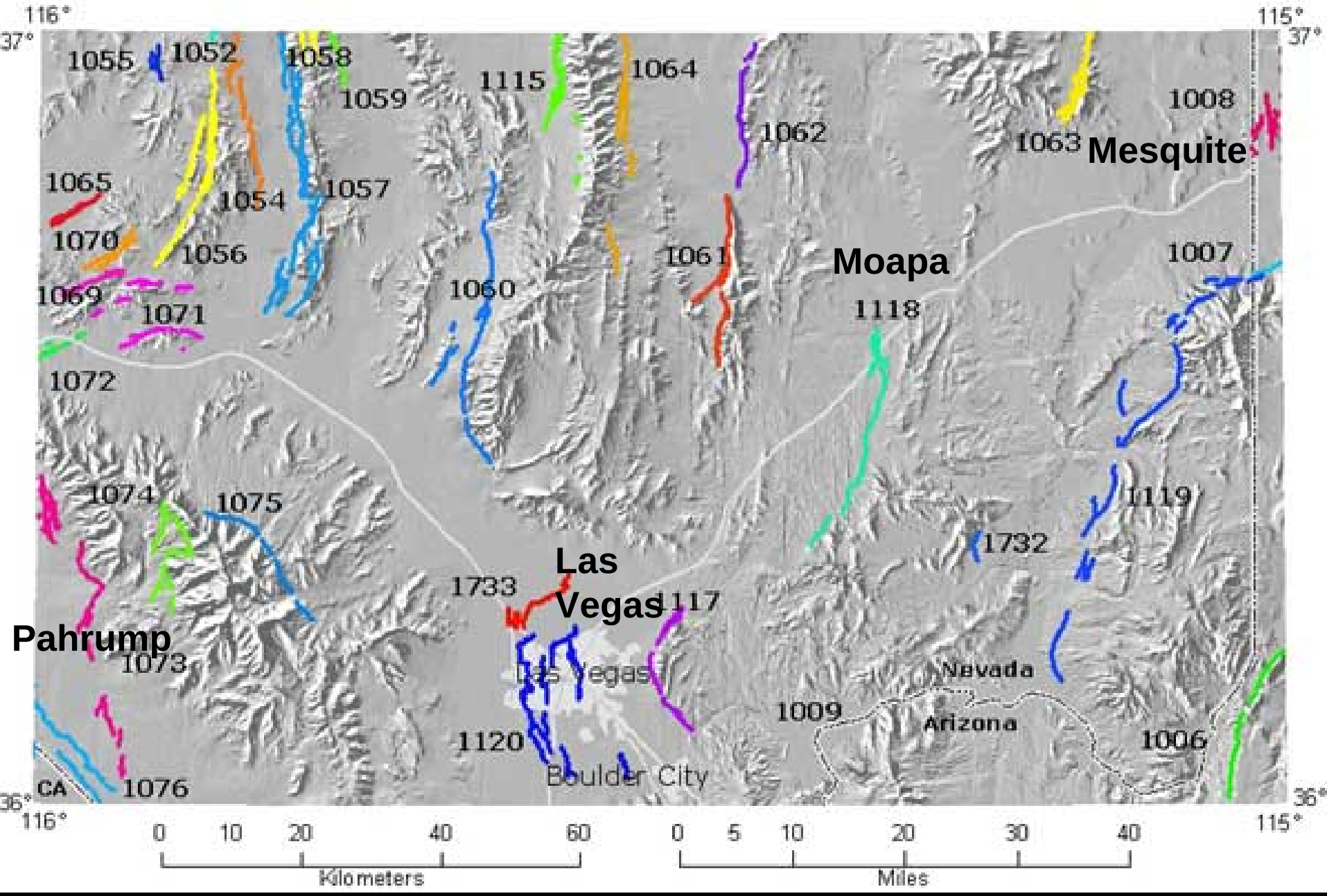
<1% chance for Tonopah, magnitude 7.0



Probability of an earthquake of magnitude 6.5 or greater occurring within 50 km in 50 years (from USGS probabilistic seismic hazard analysis)

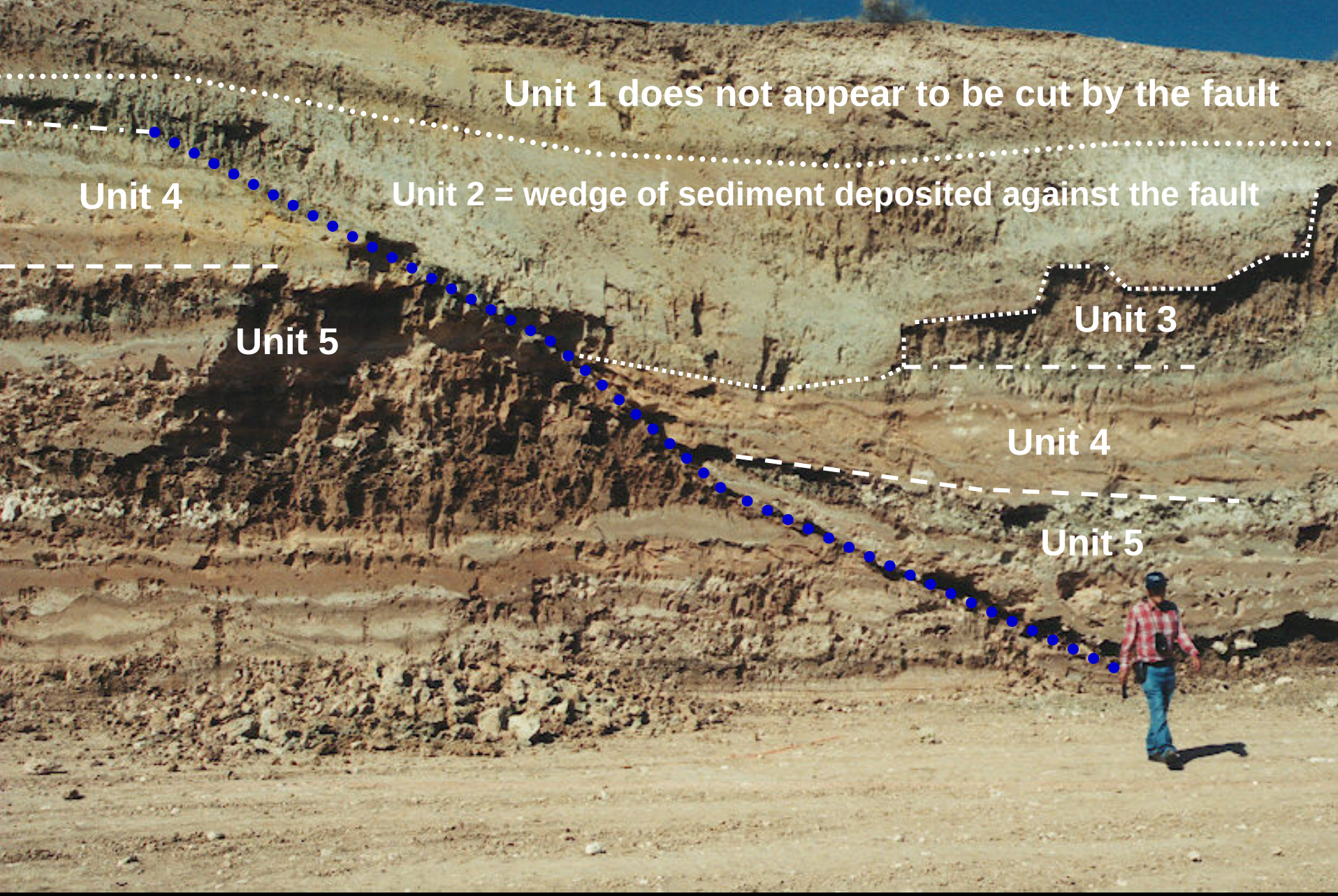
5-10% chance for Tonopah, magnitude 6.5



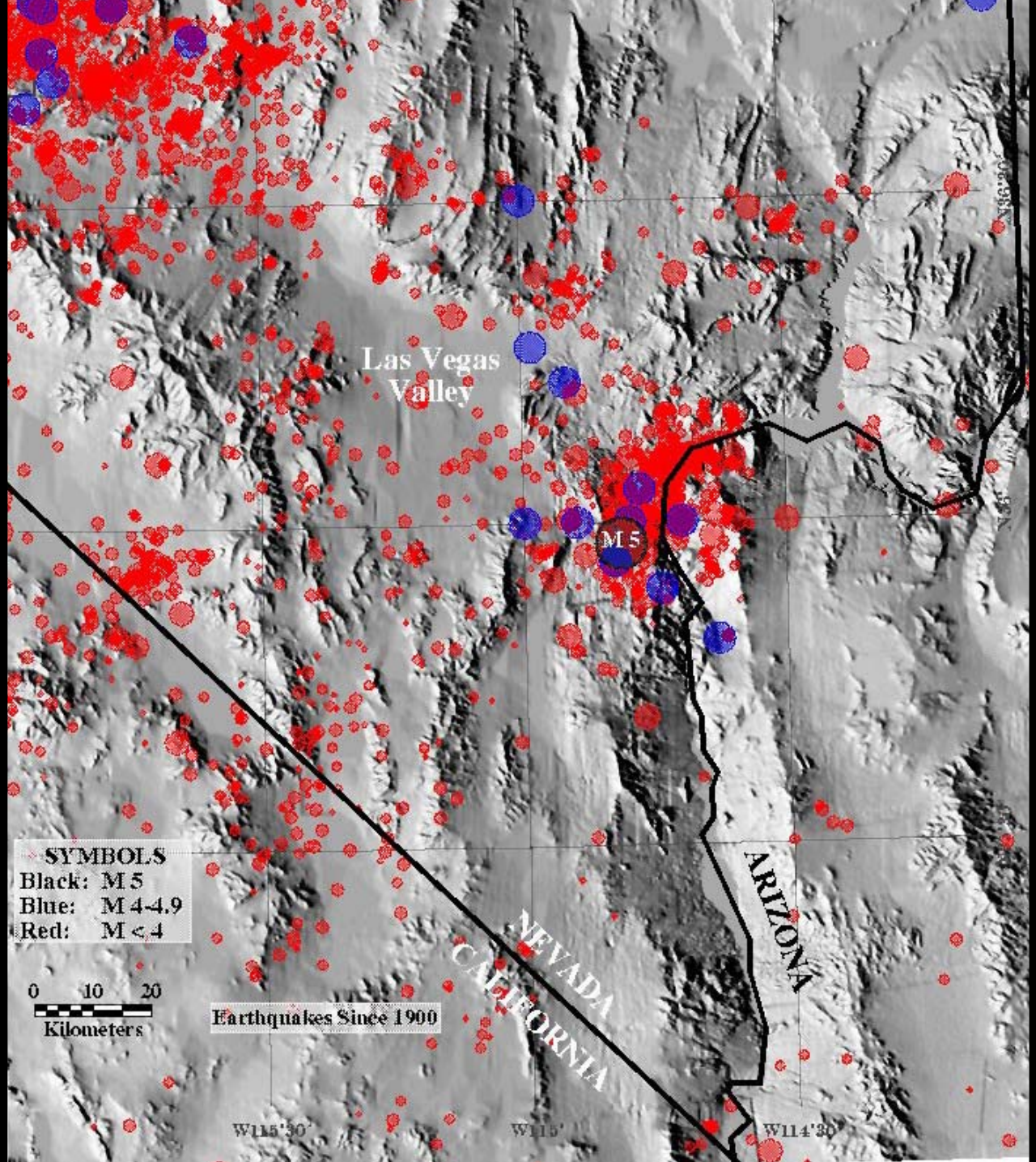


Faults on the Las Vegas 1 x 2-degree sheet

Quaternary fault exposed at construction site in Las Vegas Valley



Quaternary fault exposed at construction site in Las Vegas Valley



Measured earthquakes in the Las Vegas area

The risks are huge.

For a magnitude 6.6 earthquake on the Frenchman Mountain fault, HAZUS estimated:

$4.4 to 17.7 billion in economic loss

major damage to approximately 30,000 buildings

3,000 to 11,000 people needing public shelter

200 to 800 fatalities.

For a magnitude 5.9 daytime earthquake on the Frenchman Mountain fault, HAZUS estimated, for all of Clark County:

$2.2 to 8.9 billion in economic loss,

of which $1.2 to 4.7 billion would be in building damage,
$0.3 to 1.3 billion would be in damage to building contents, and
$0.7 to 2.9 billion in business interruption losses related to the building stock;

major damage to 4,000 to 17,000 buildings

(655 completely destroyed),

3,000 to 12,000 people needing public shelter,

300 to 1,200 people needing hospital care (*but only 768 of 2,341 beds would be available in the county during the first day, up to 910 at Day 3 and 1,730 at Day 30*)**; and**

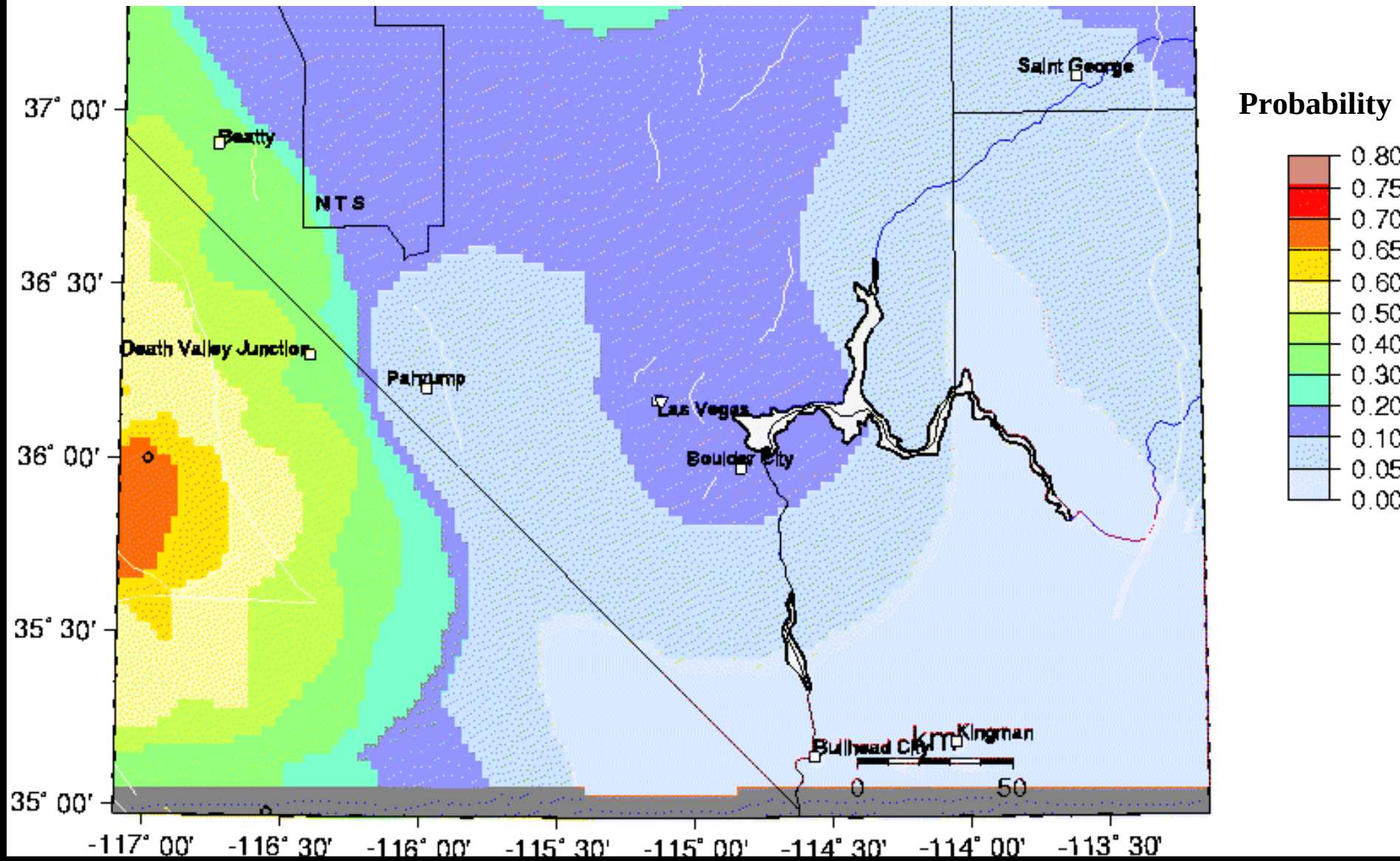
80 to 300 fatalities.

(Casualty numbers are expected to be less for either a night-time or commute-time earthquake.)

(from NBMG-NDEM-FEMA-sponsored earthquake exercise for the City of Las Vegas, 2003)

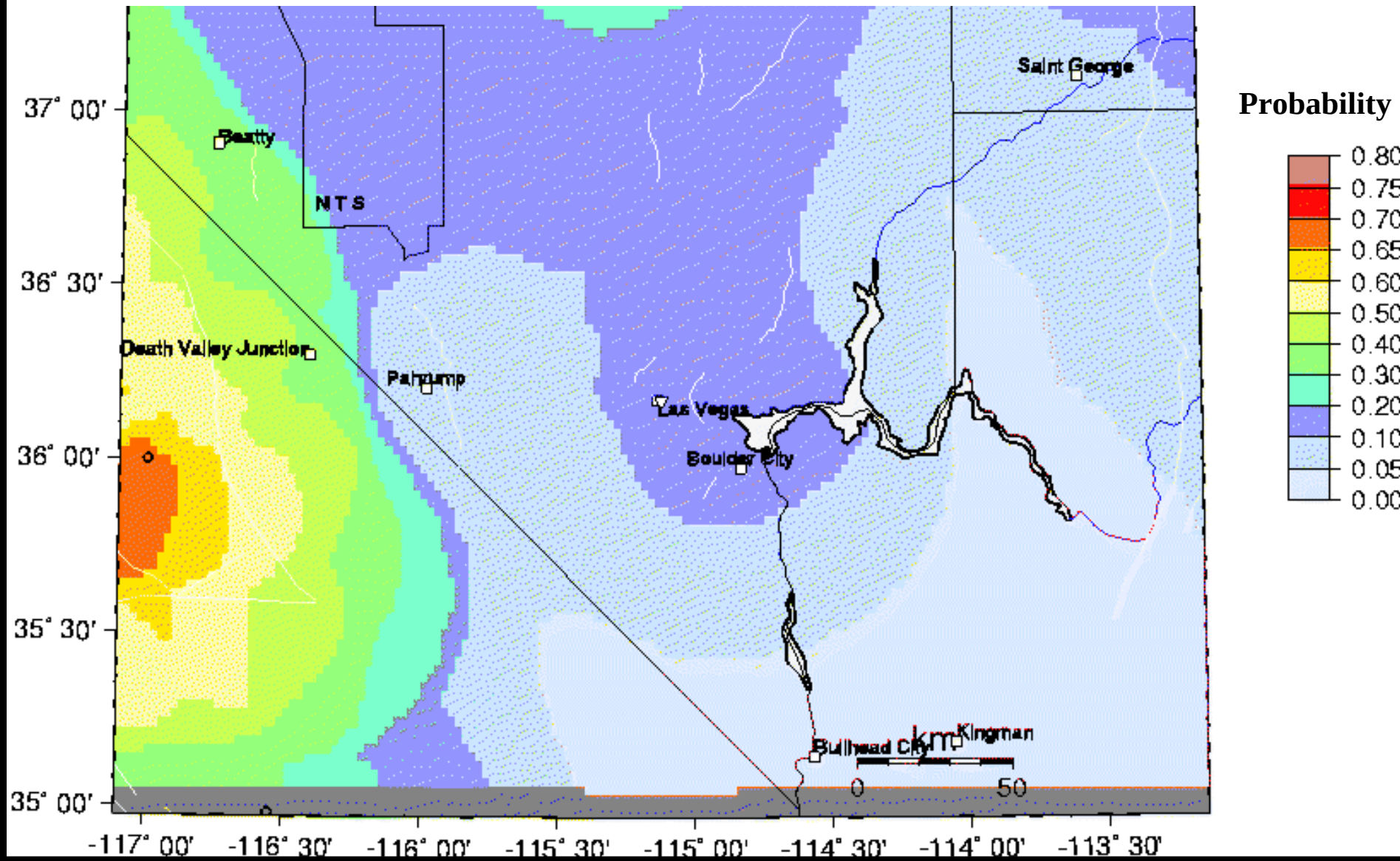
Probability of an earthquake of magnitude 6.0 or greater occurring within 50 km in 50 years (from USGS probabilistic seismic hazard analysis)

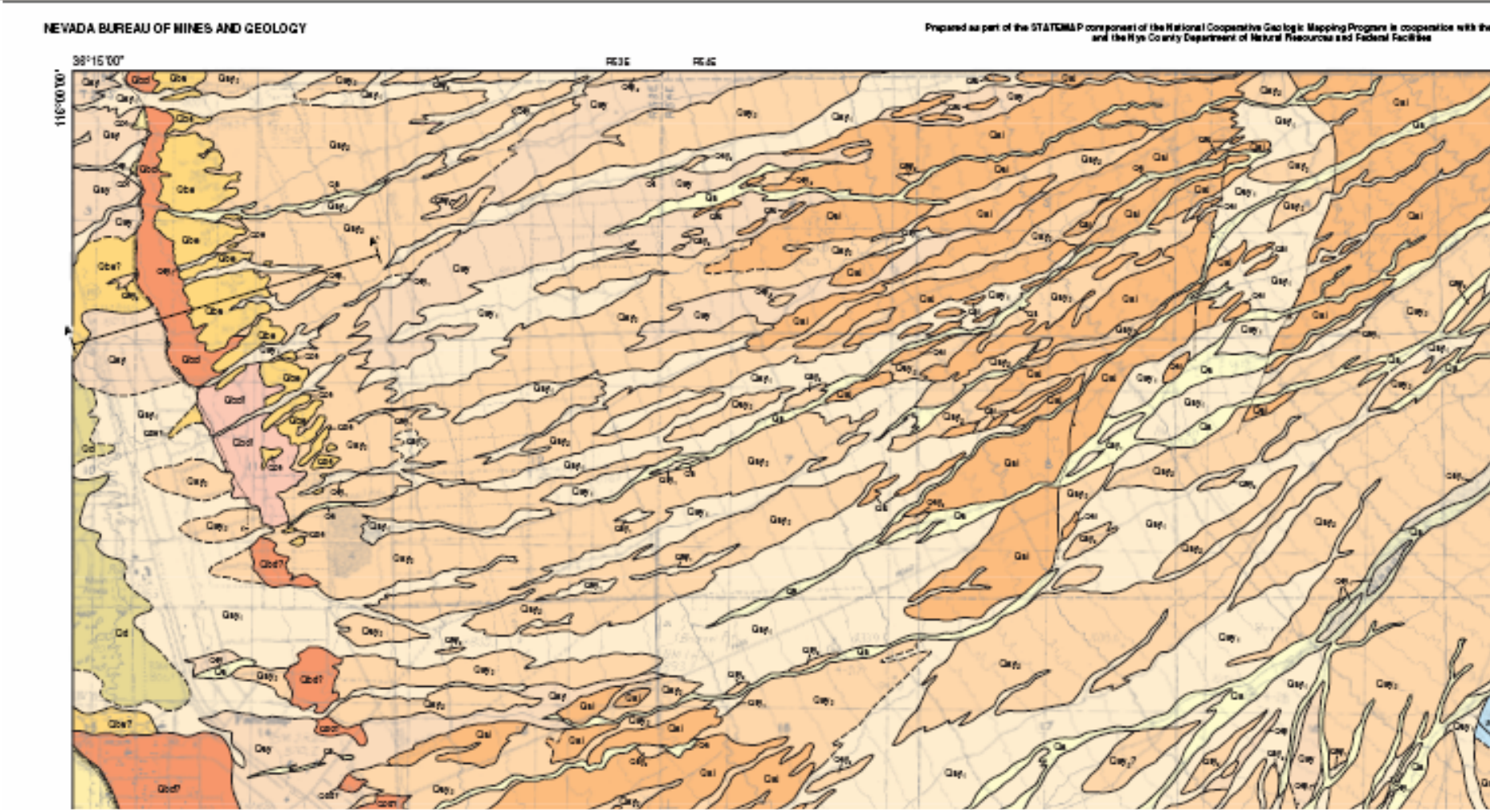
10-20% chance for Las Vegas area, magnitude 6



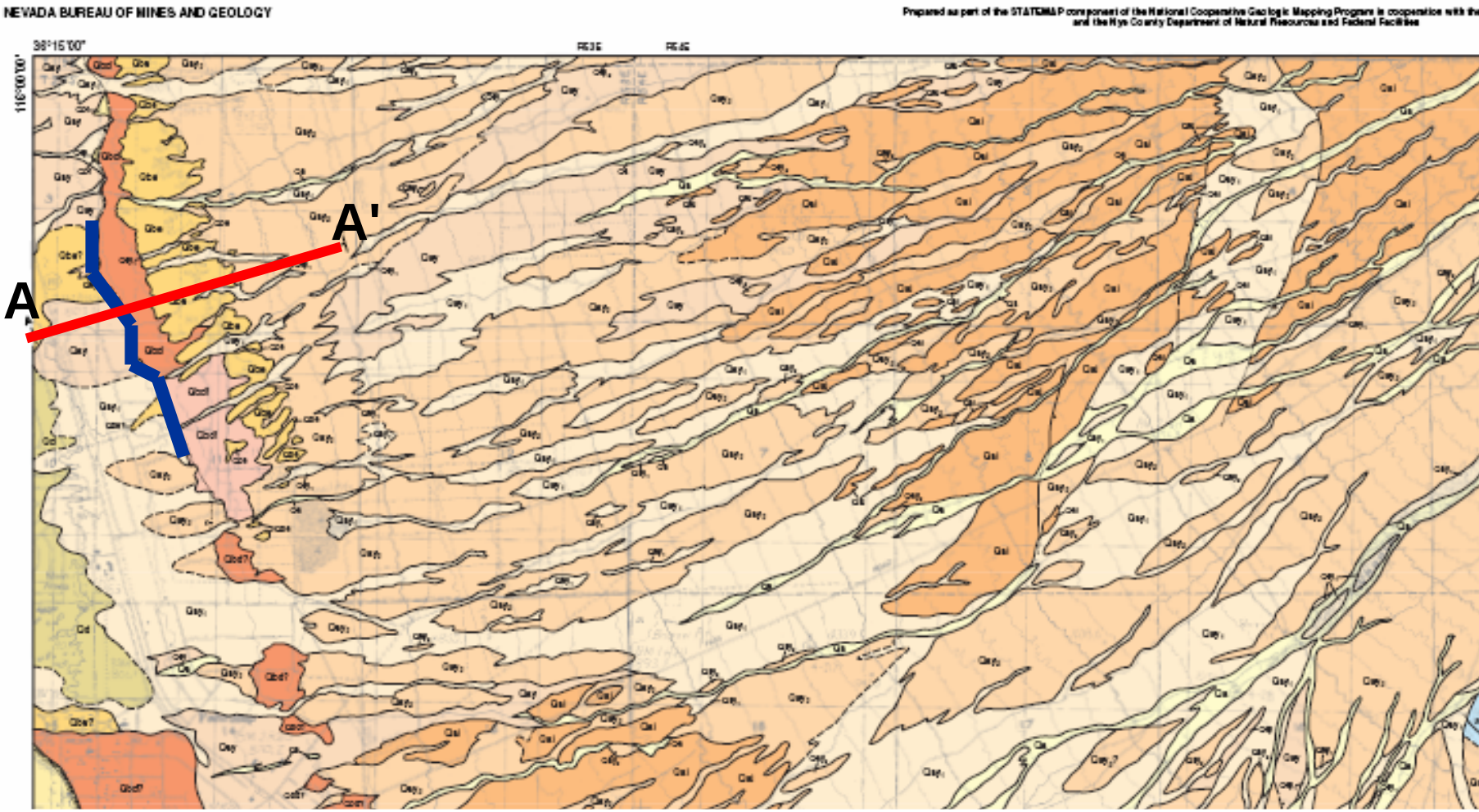
Probability of an earthquake of magnitude 6.0 or greater occurring within 50 km in 50 years (from USGS probabilistic seismic hazard analysis)

5-10% chance for Pahrump, magnitude 6

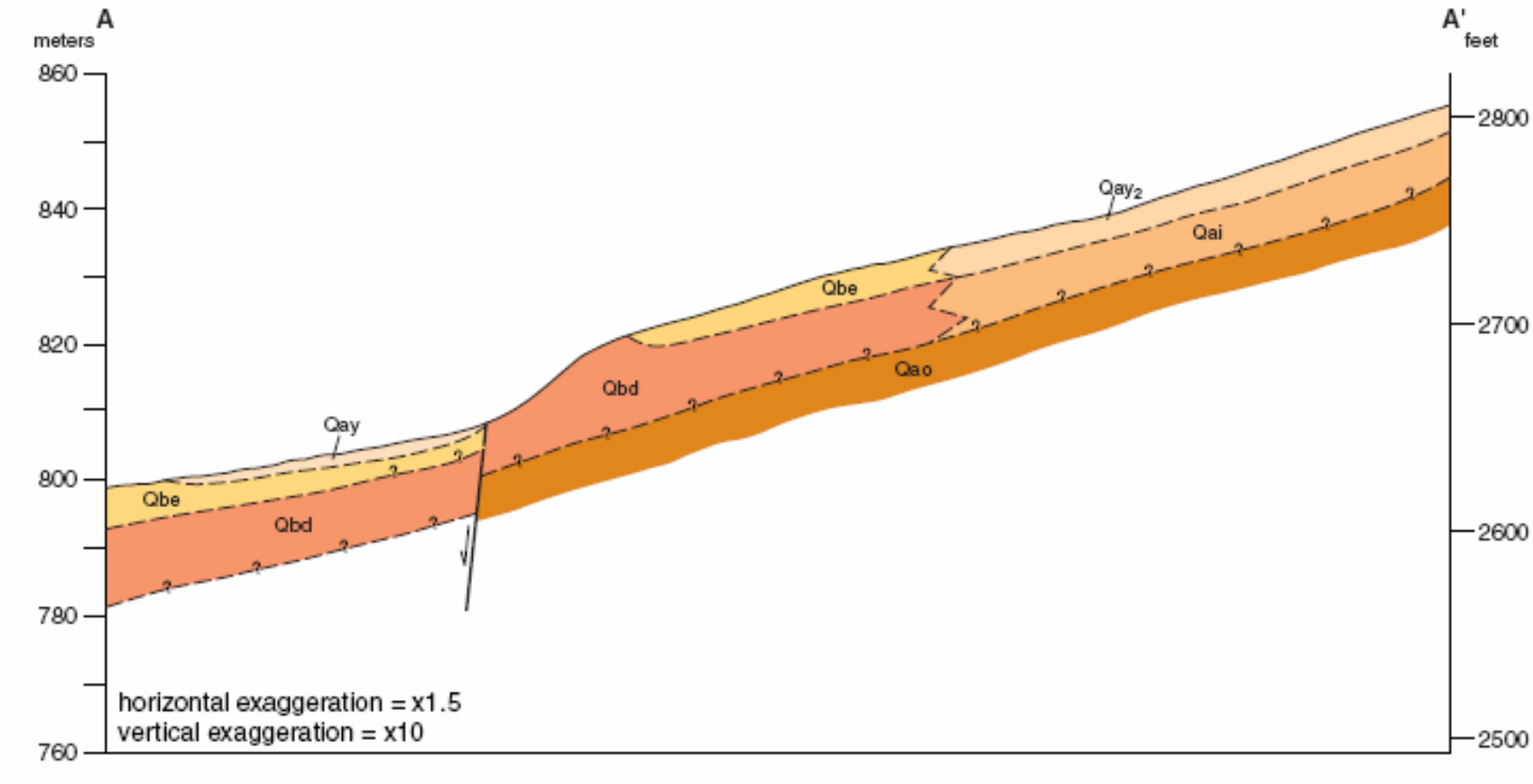




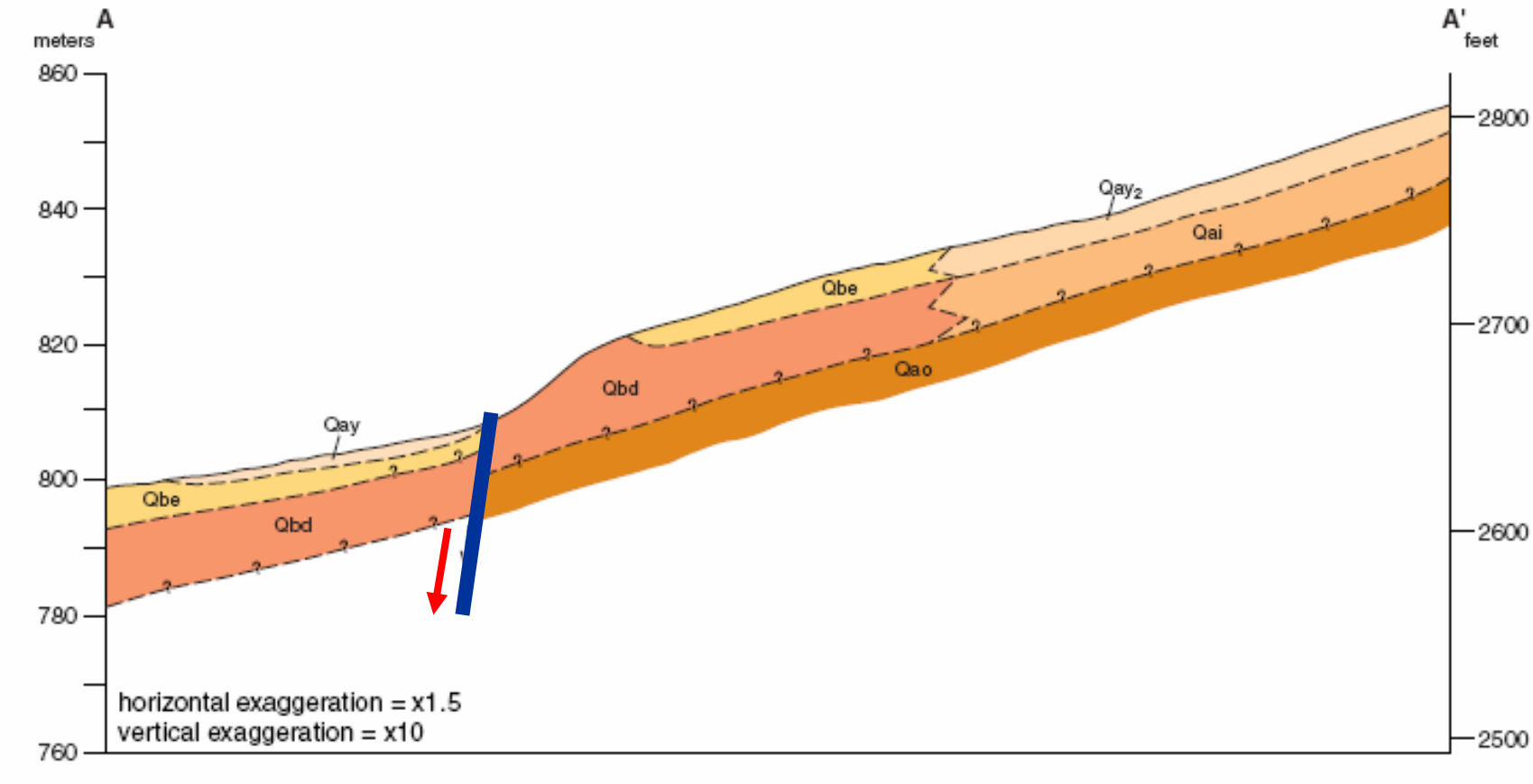
Northwest corner of the geologic map of the Pahrump Quadrangle (7.5-minute – Nevada Bureau of Mines and Geology Open-File Report 99-14), showing the location of the cross section illustrating displacement across a normal fault



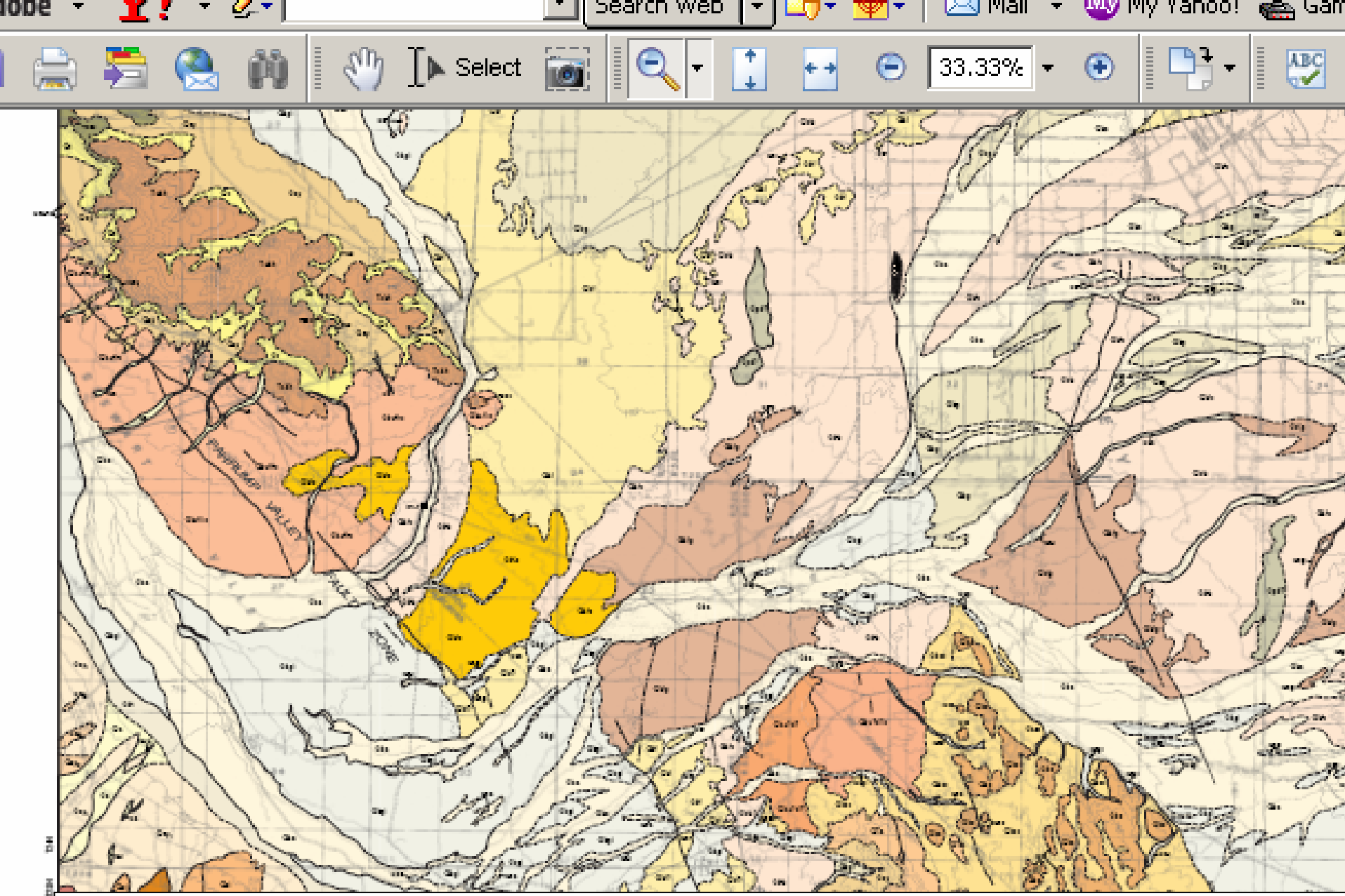
Northwest corner of the geologic map of the Pahrump Quadrangle (7.5-minute – Nevada Bureau of Mines and Geology Open-File Report 99-14), showing the location of the cross section illustrating displacement across a normal fault



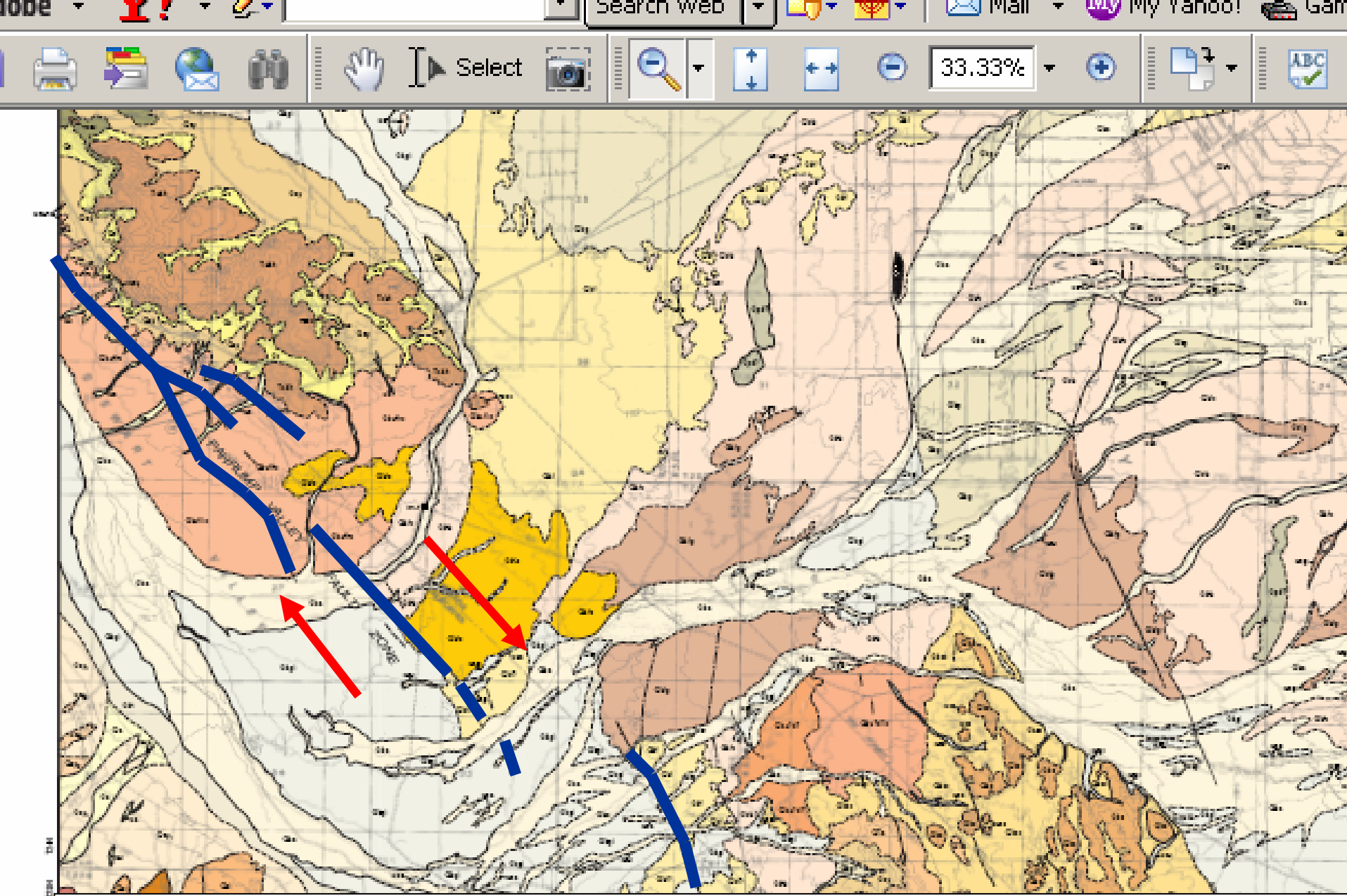
Vertical cross section showing a part of a fault that cuts Quaternary alluvial sediments on the north side of Pahrump



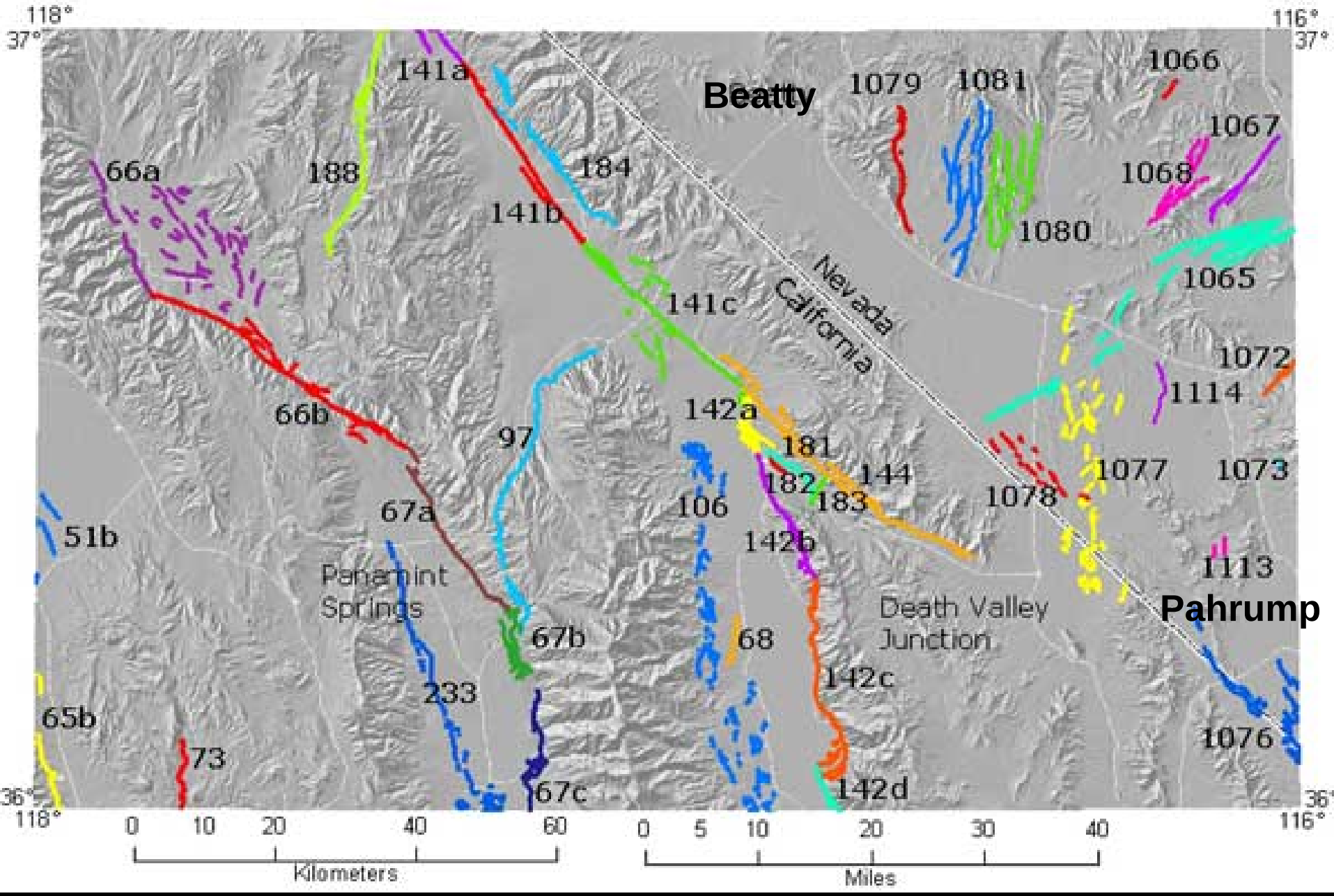
Vertical cross section showing a part of a fault that cuts Quaternary alluvial sediments on the north side of Pahrump



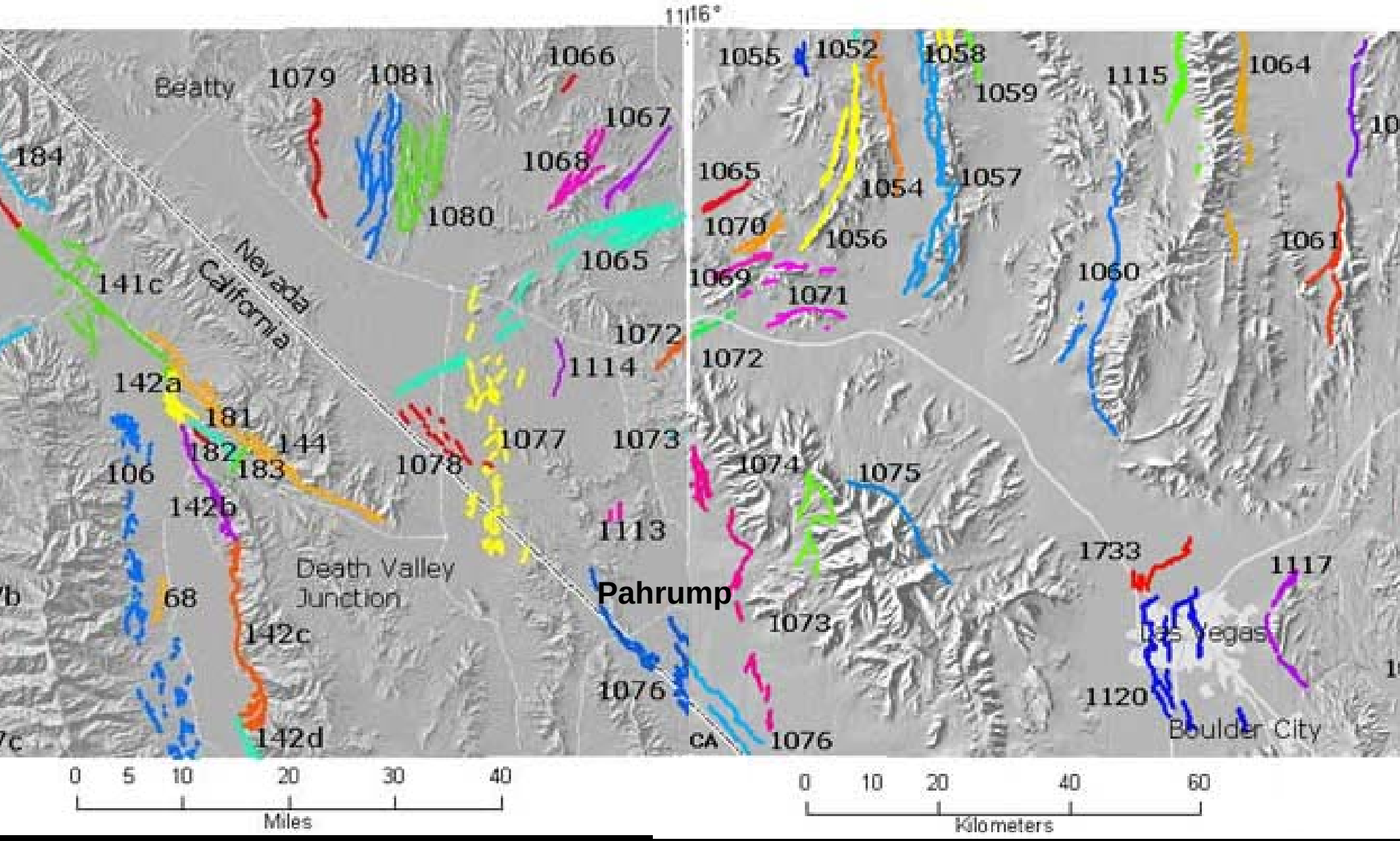
Pahrump Valley fault zone, mapped on the southeast corner of the Sixmile Spring Quadrangle (Nevada Bureau of Mines and Geology Open-File Report 03-11)



Pahrump Valley fault zone, mapped on the southeast corner of the Sixmile Spring Quadrangle (Nevada Bureau of Mines and Geology Open-File Report 03-11)



Faults on the Death Valley 1 x 2-degree sheet



1076 = Pahrump fault (Pahrump Valley fault zone); this is a right-lateral strike-slip fault, as are the San Andreas fault and the Death Valley fault system.

1073 = West Spring Mountains fault; this is a “normal” fault.

The risks are huge.

For a magnitude 7.0 earthquake on the Pahrump Valley fault zone, HAZUS estimated:

$200 million to $800 million in economic loss
($200 million for Nye County alone)

major damage to approximately 6,000 buildings

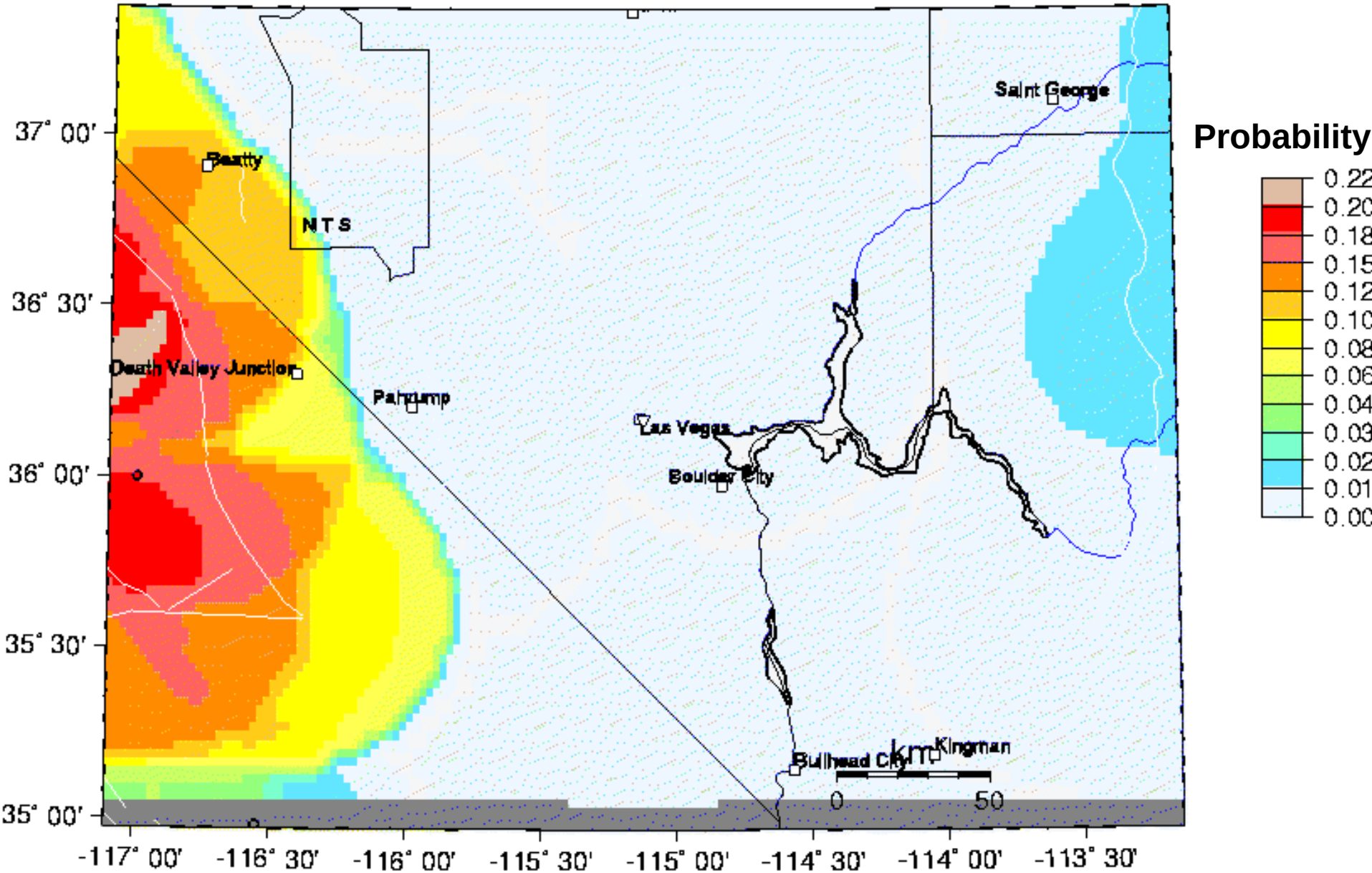
40 to 140 people needing public shelter

<20 fatalities.

*** Figures could be higher; populations in Nye and Clark Counties has increased by about 30% since the 2000 census.**

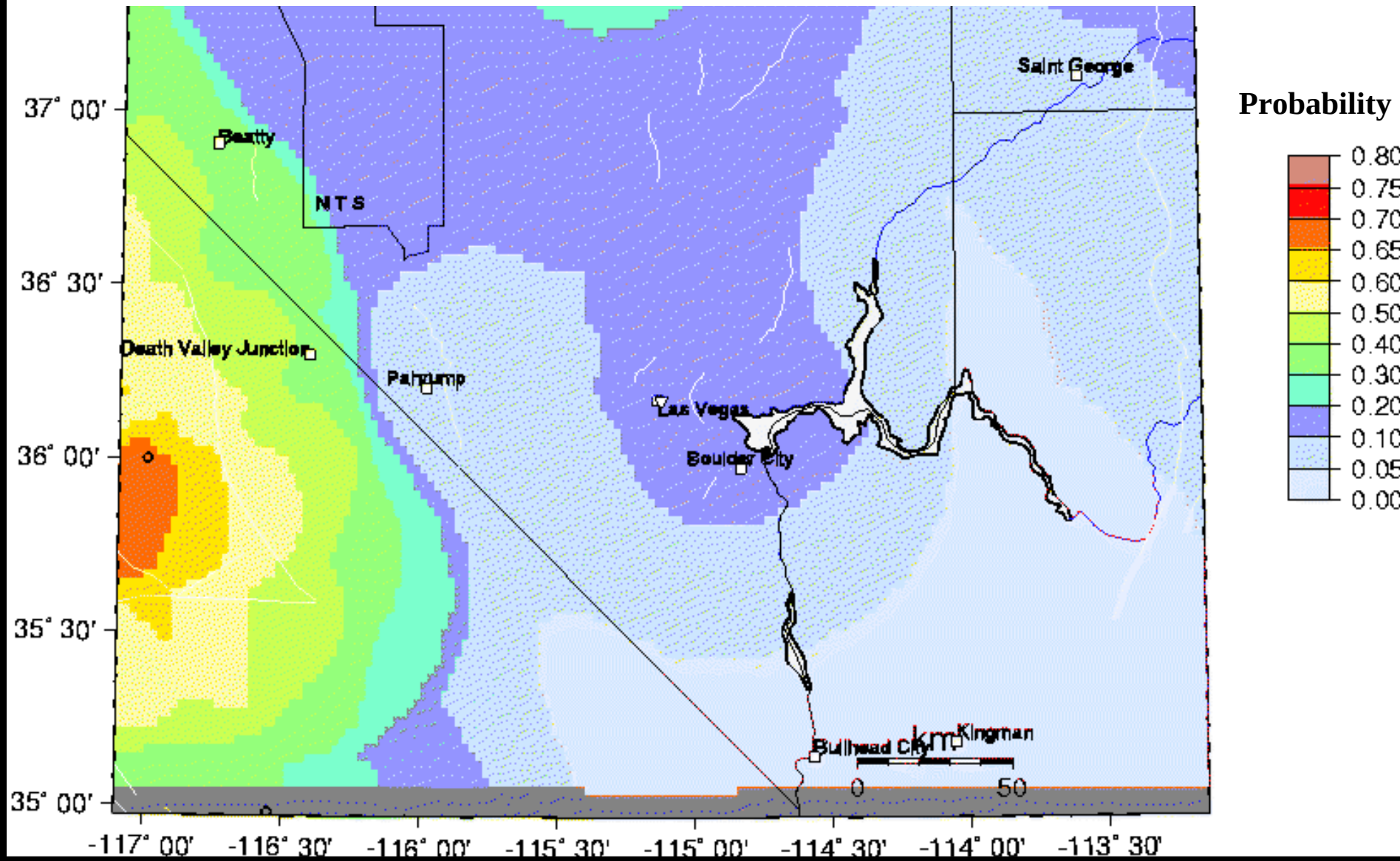
Probability of an earthquake of magnitude 7.0 or greater occurring within 50 km in 50 years (from USGS probabilistic seismic hazard analysis)

<1% chance for Las Vegas or Pahrump, magnitude 7



Probability of an earthquake of magnitude 6.0 or greater occurring within 50 km in 50 years (from USGS probabilistic seismic hazard analysis)

5-10% chance for Pahrump, magnitude 6



The main points:

1. The earthquake risks are huge in Nevada.

2. We can do something about it.

   a. Be prepared to respond.

   b. Mitigate structural risks, largely through building codes and avoiding faults and areas of liquefaction.

   c. Mitigate nonstructural risks.

Nonstructural damage often can be easily prevented.

Earthquake-secure bookshelves in the office of the State Geologist

Secured computers at the Clark County Building Department

Information about Nevada earthquakes and what you can do:

Nevada Bureau of Mines and Geology

www.nbmg.unr.edu

Nevada Seismological Laboratory

www.seismo.unr.edu

THE UNIVERSITY OF NEVADA RENO

nbmg Nevada Bureau of Mines and Geology

NEVADA Seismological Laboratory

Nevada Earthquake Safety Council

THE GREAT SEAL OF THE STATE OF NEVADA ALL FOR OUR COUNTRY

U.S. DEPARTMENT OF HOMELAND SECURITY FEMA

Nevada Department of Public Safety

Division of Emergency Management

Loss-Estimation Modeling of Earthquake Scenarios for Each County in Nevada Using HAZUS-MH

Nevada Bureau of Mines and Geology
Open-File Report 06-1
University of Nevada, Reno

There are huge risks.

We can take action to reduce the risks.

Be prepared for fires (Loma Prieta = World Series Earthquake, 1989).

Loma Prieta = World Series Earthquake, 1989

San Francisco, 1906

COPYRIGHTED 1906
BY STEWART & ROGERS

San Francisco, 1906, after the earthquake and fire

Expect damage to the infrastructure (I-5, Northridge Earthquake, 1994).

Expect damage to highways (Oakland, 1989 World Series Earthquake).

Retrofitting can sometimes help (Oakland, 1989).

Expect disruptions to utilities (electricity, water, sewage, telephones, etc., Northridge, 1994).

Expect disruptions to communications (radio tower, Bay area, 1989).

Expect damage in areas with poor soil or rock conditions
(Loma Prieta, 1989).

Expect liquefaction (Loma Prieta, 1989).

Loma Prieta Earthquake, Marina district, San Francisco, 1989

Expect lateral spreading (Loma Prieta, 1989).

Expect damage to unreinforced masonry buildings (Northridge, 1994).

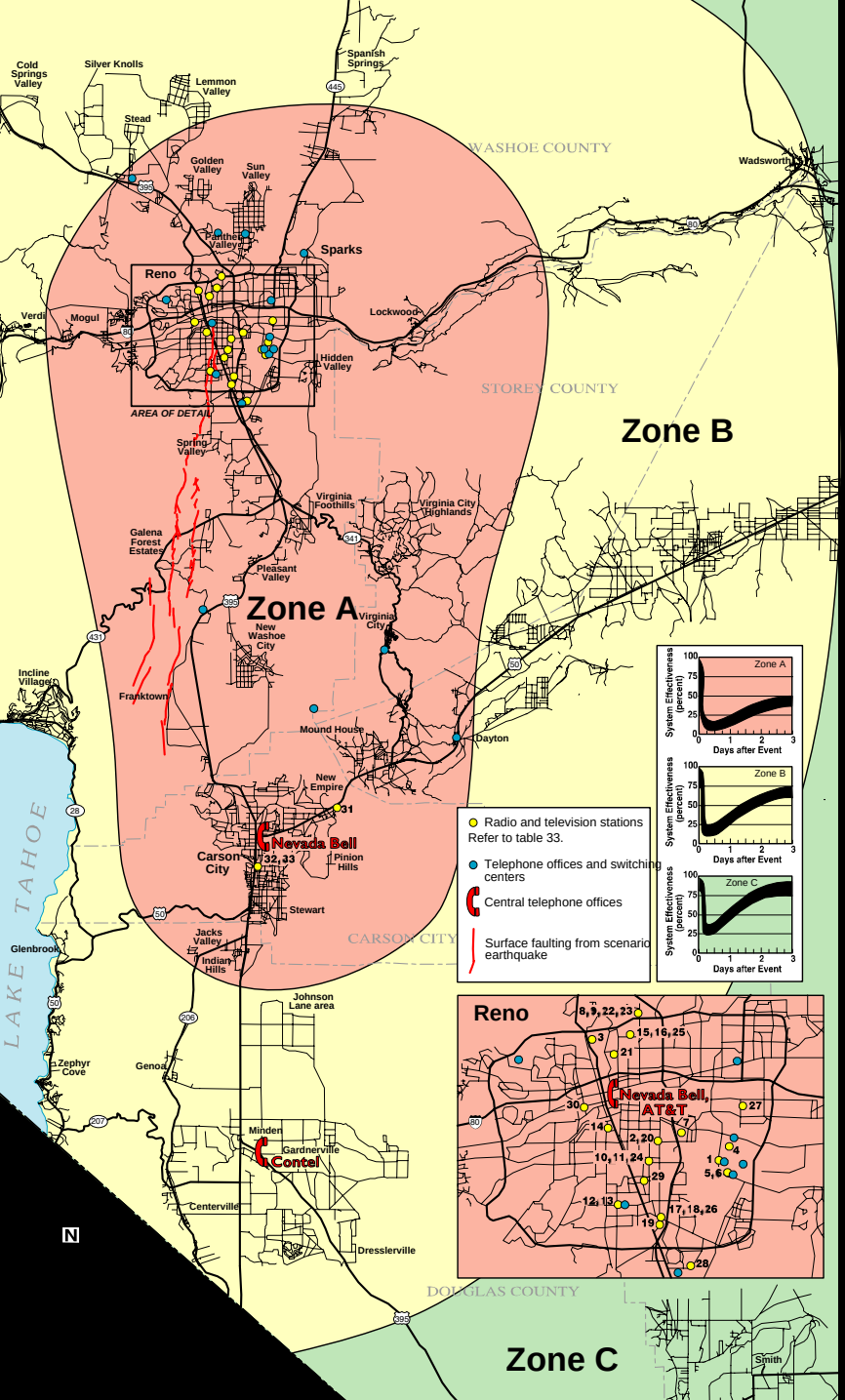
Expect damage to older buildings with soft-story construction (Northridge, 1994).

Hope that construction practices were up to code (6-story bldg, Izmit, Turkey, 1999).

Expect problems with unusual construction (Cal State Northridge parking structure, 1994).

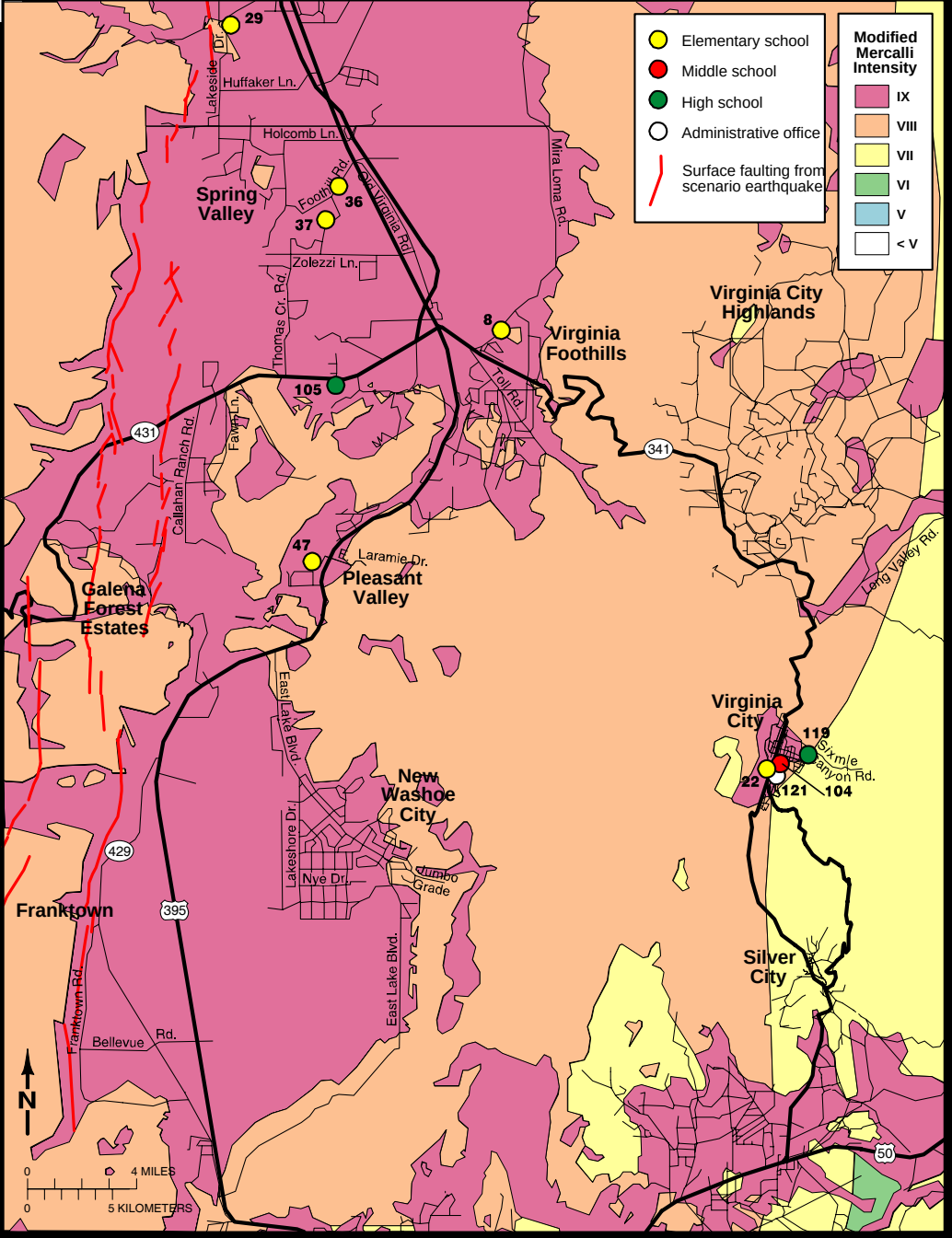
Hope people keep a sense of humor (but expect looting).

Expect large numbers of people needing food, clothing, and shelter (Loma Prieta, 1989).



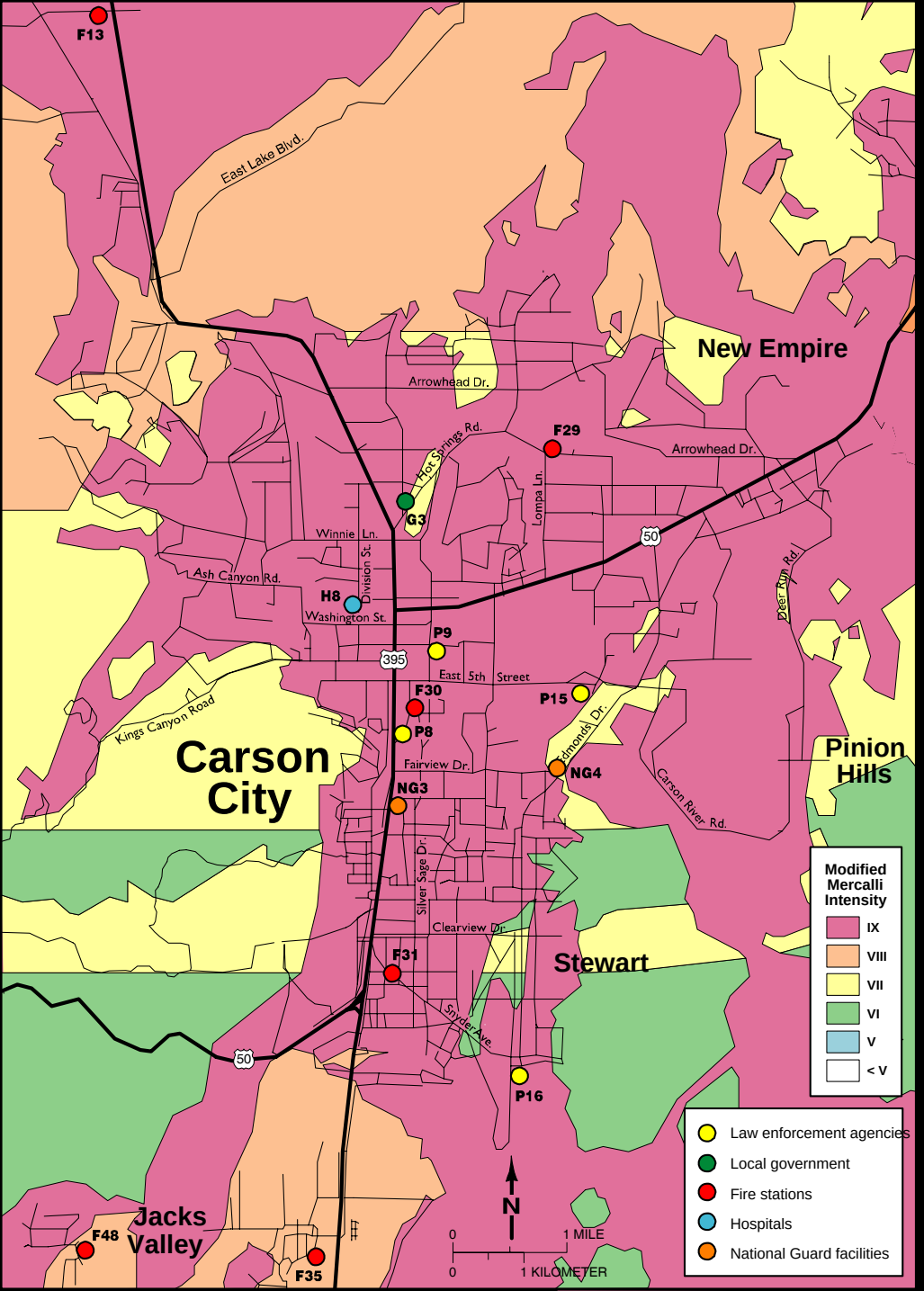
Be aware of potential loss of normal communications by telephones and cell phones.

from NBMG's 1996 "Planning Scenario for a Major Earthquake in Western Nevada" – A magnitude 7.1 earthquake on the Mt. Rose fault near Reno could cause loss of telephone and cell communications.



Be aware that potential shelters may be damaged.

from NBMG's 1996 "Planning Scenario for a Major Earthquake in Western Nevada"



Be aware of potential damage to fire, police, and other emergency operations.

from NBMG's 1996 "Planning Scenario for a Major Earthquake in Western Nevada" – A magnitude 7.1 earthquake on the Mt. Rose fault near Reno could cause significant shaking in Carson City.

Loss-Estimation Modeling of Earthquake Scenarios for Each County in Nevada Using HAZUS-MH

Nevada Bureau of Mines and Geology
Open-File Report 06-1
University of Nevada, Reno

There are huge risks.

We can take action to reduce the risks.