

2024 Earthquake Risks

May 2, 2024
Jim Oberhofer KN6PE



We will cover...

1. The Big (earthquake) Picture
2. The situation in the U.S.
3. The situation in California
4. The situation in the SF Bay Area
5. The situation in Cupertino
6. Summary of Risks



Some definitions

def: Earthquake

“...what happens when two blocks of the earth suddenly slip past one another.”
--- *United States Geological Survey*

What causes this *slipping* to occur?

def: Plate Tectonics

“... a scientific theory that explains how major landforms are created as a result of Earth's subterranean **movements.**”
--- *National Geographic Society*

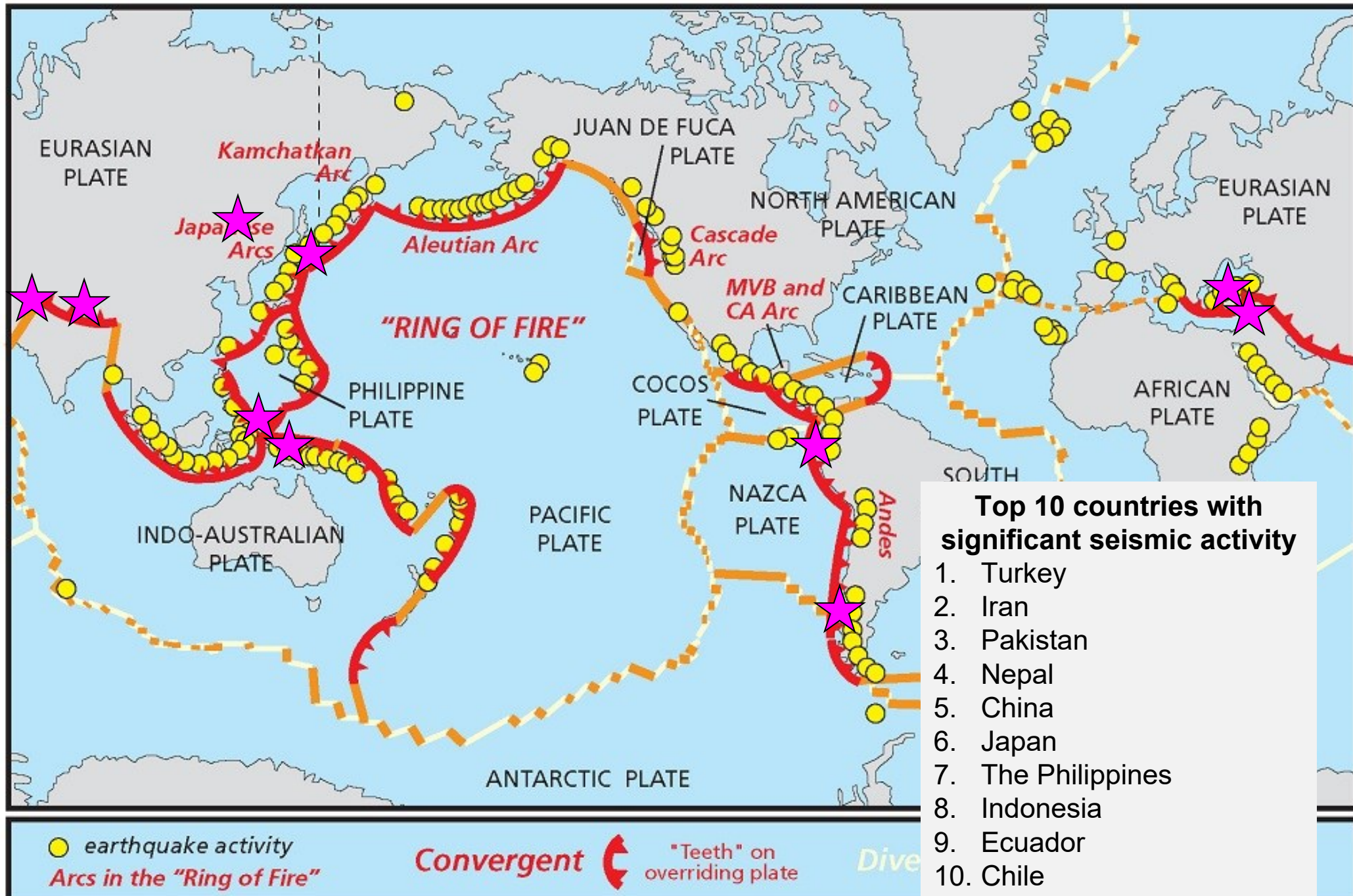


Where causes the movement?

<https://youtu.be/ryrXAGY1dmE>



All the action is at the edges



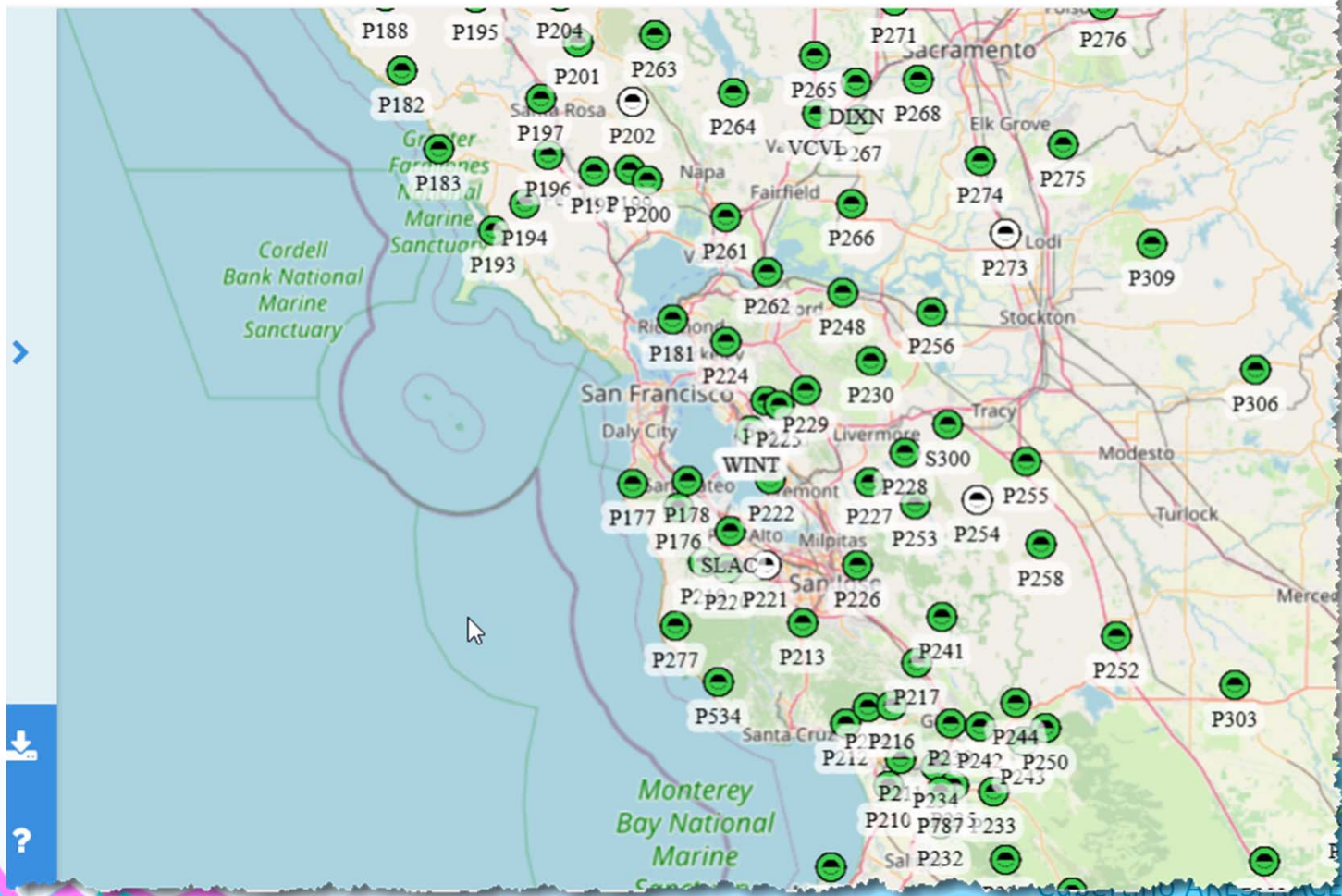
And yes, we are moving!

Real-time GNSS/GPS network

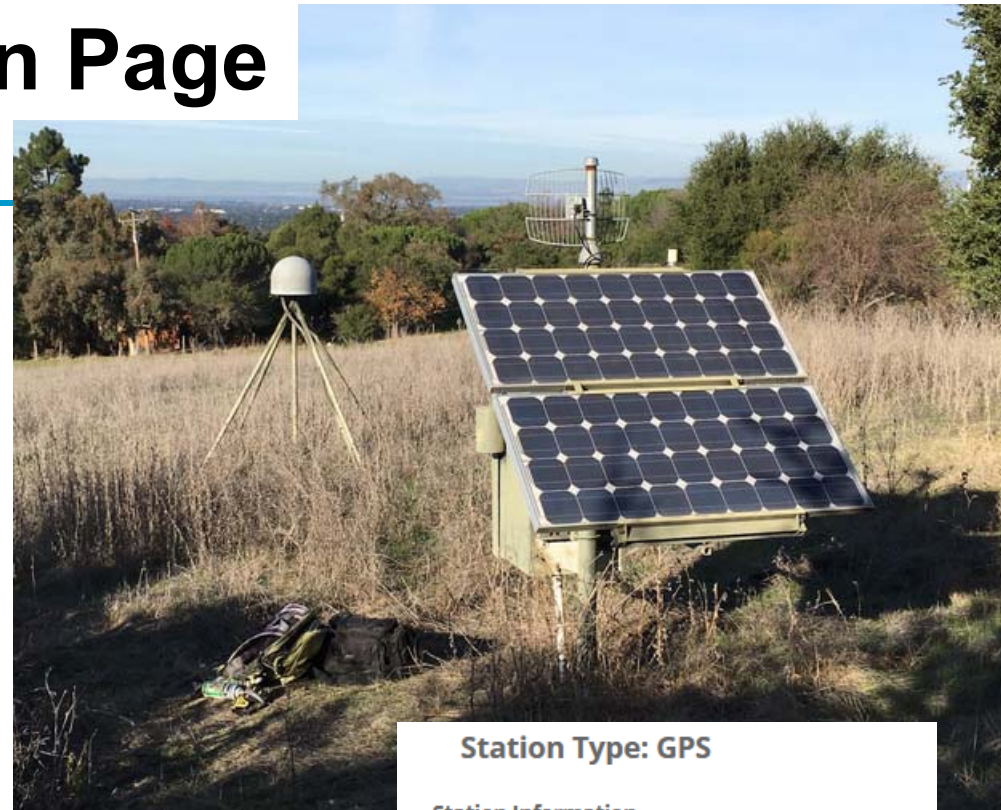
<https://www.unavco.org/instrumentation/networks/status/all/realtime>

ALL REAL-TIME NETWORKS - 1053 STATIONS DISPLAYED

Full Screen Views

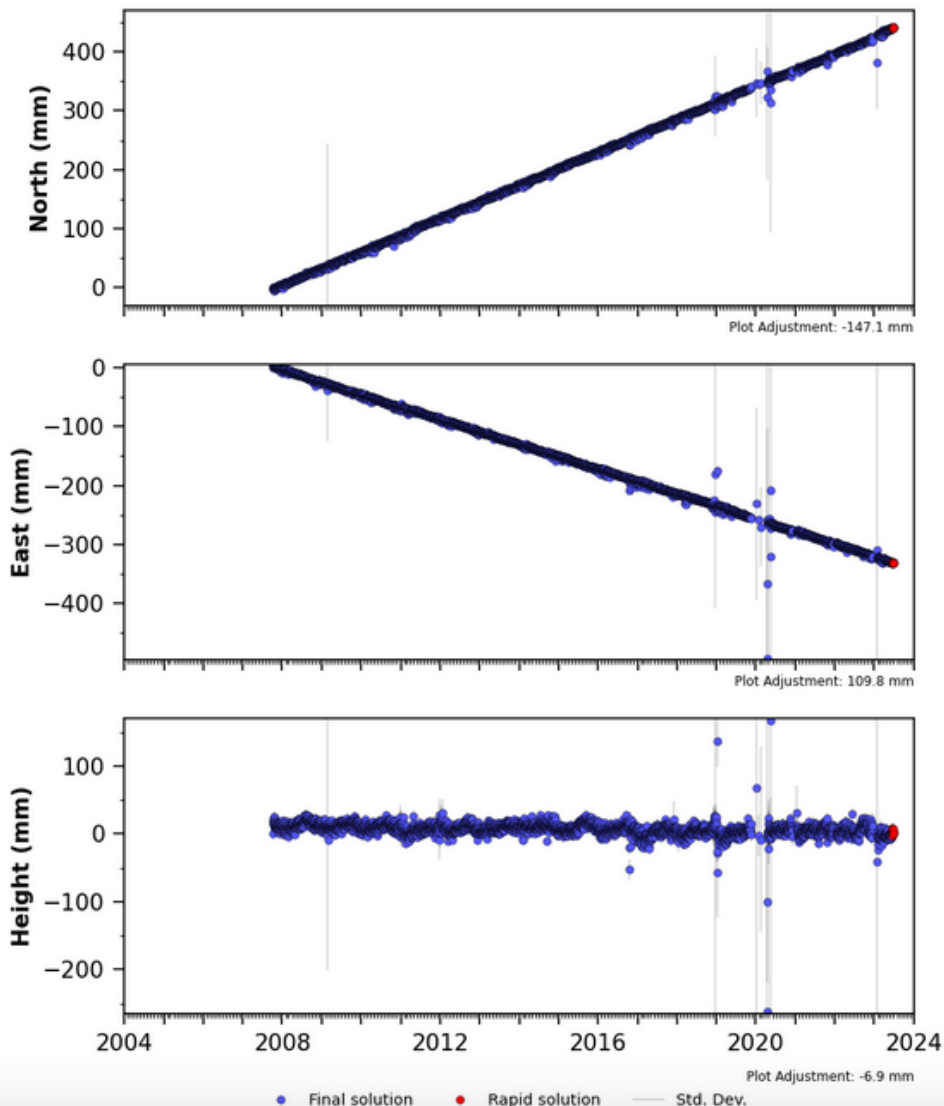


P221 - Overview | Station Page



P221 (SanAntonioCN2007) NAM14

Processed Daily Position Time Series



Source file: P221.cwu.nam14.pos Last epoch plotted: 2023-06-26 12:00:00

Station Type: GPS

Station Information

4-Char ID:	P221 - GPS
Station Status:	Installed / Operable
Station Name:	SanAntonioCN2007
Project:	PBO
Location (City, State):	Los Altos, CA
Latitude, Longitude*:	37.33695, -122.09903
Elevation*:	155.828 m
Monument Type:	DEEP-DRILLED BRACED
Station Install Date:	2007/10/09
Monument Install Date:	2007/10/09
Current Status:	Failure

*GPS receiver values - not precise

The situation in the U.S.



What's the Situation in the U.S.?

Earthquake likelihood?

Best Reference:

[USGS National Seismic Hazard Model \(2023\) - Chance of Damaging Earthquake Shaking](#)

- A map displaying the likelihood of damaging earthquake shaking in the United States over the next 100 years, and
- is applied in seismic provisions of building codes, insurance rate structures, risk assessments, and other public policy.
- Defines the potential for earthquake ground shaking for various probability levels across the United States including Alaska, and Hawaii.

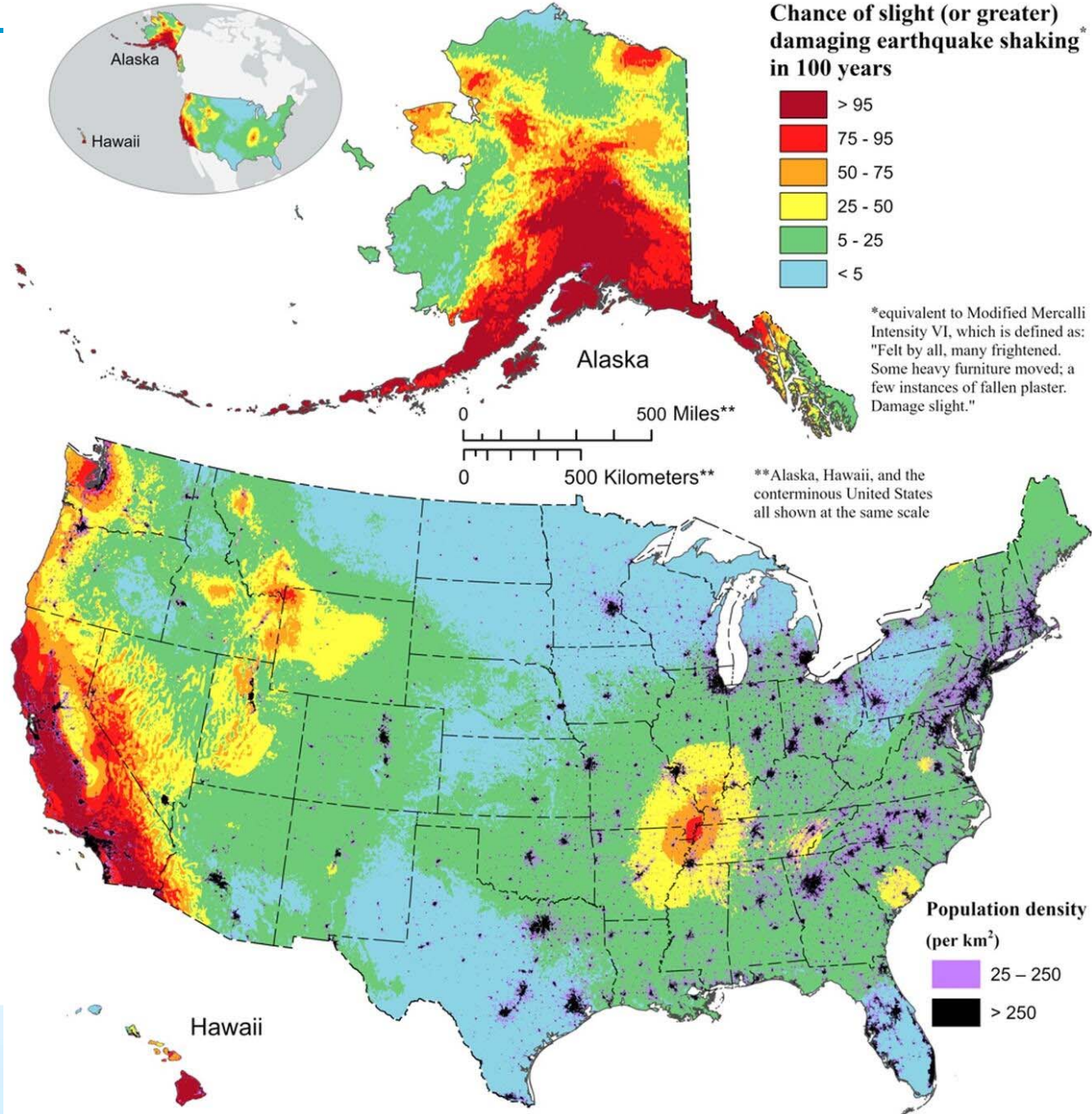
Source: <https://www.usgs.gov/media/images/national-seismic-hazard-model-2023-chance-damaging-earthquake-shaking>



What's the Situation in the U.S.?

In the 2023 USGS study

1. Earthquakes are likely to occur along Atlantic Coast, California, Alaska
2. The most damaging earthquakes are likely to occur along the central and northeastern Atlantic Coast, including Washington D.C., Philadelphia, New York and Boston.
3. California and Alaska were identified as being at a high risk for greater shaking in the decades ahead.
4. Hawaii that has the greatest potential for a cataclysmic quake because of [...] volcanic eruptions and seismic unrest...



Recent NJ Earthquake?

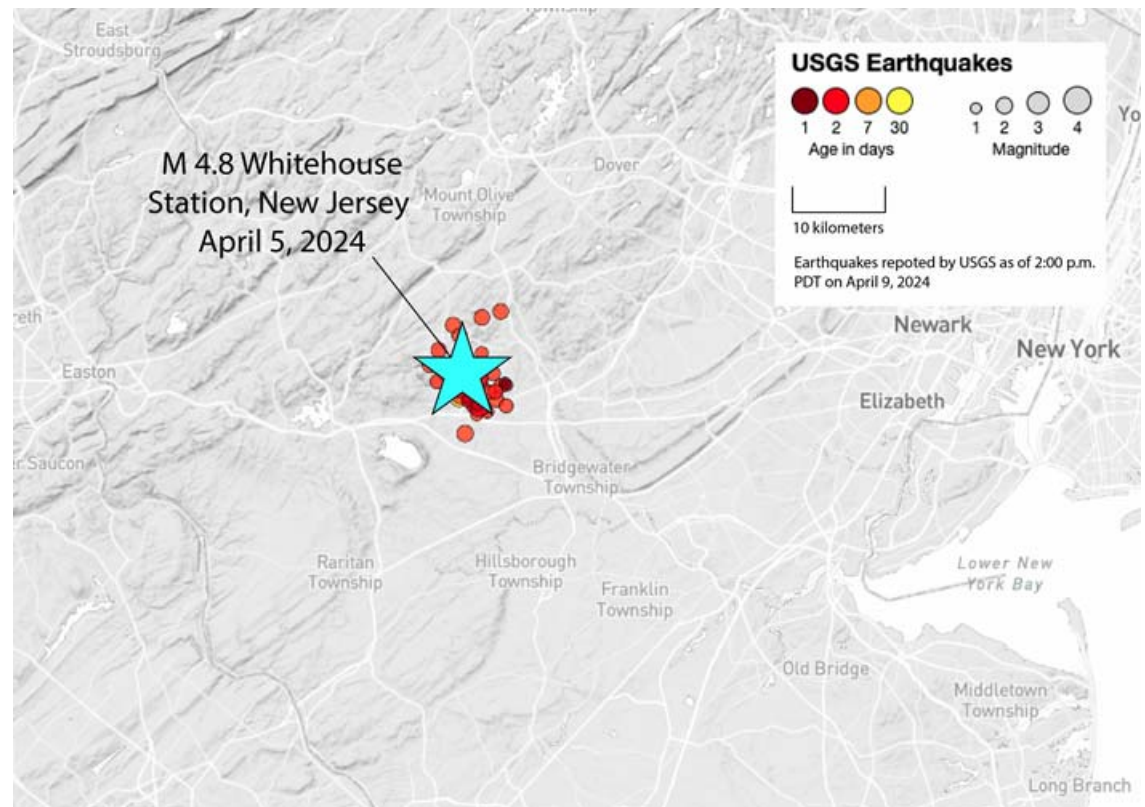
FYI... An interesting read

Magnitude 4.8 earthquake shakes the U.S. East Coast

<https://temblor.net/temblor/april-2024-earthquake-shakes-u-s-east-coast-16079/>

“Temblor, Inc. is an innovative catastrophe modeling company specializing in seismic hazard and risk assessment.

“Founded in 2014 by former USGS scientists, Temblor’s mission is to raise awareness of seismic risk. We serve the insurance, reinsurance and insurance-linked security communities, and mortgage lenders.”



The situation in California



The situation in California



Top 10 biggest CA earthquakes since 1800

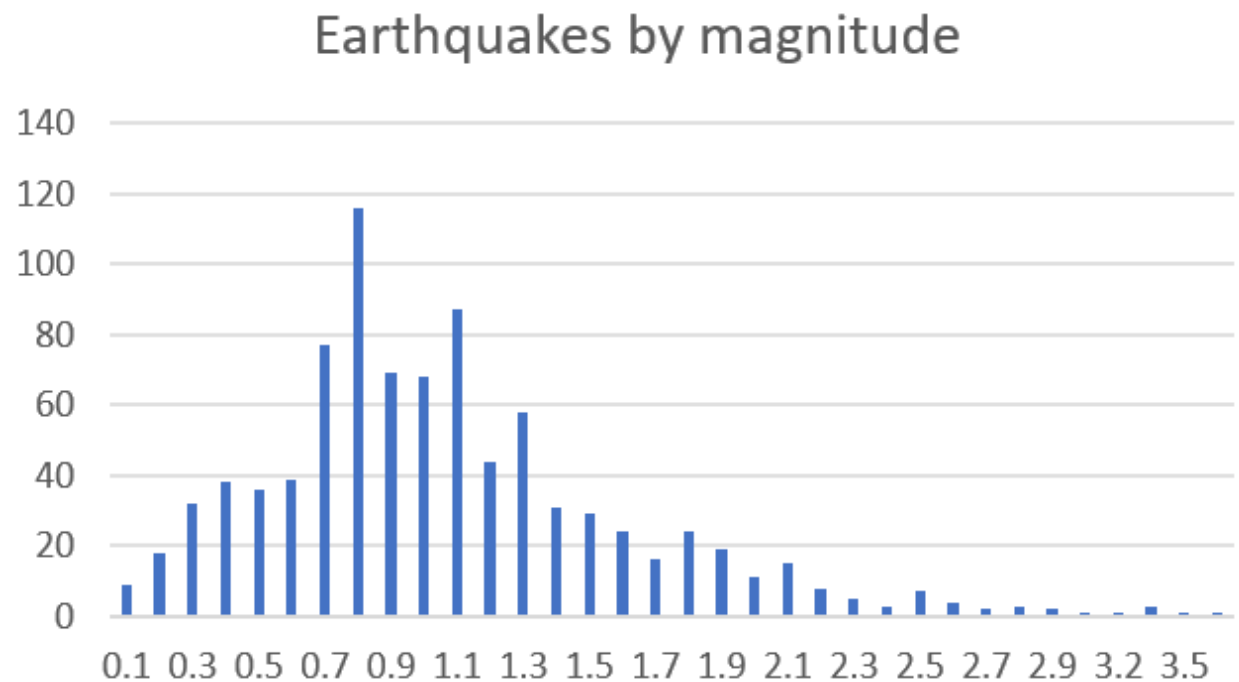
1. Fort Tejon, 1857, 7.9
2. San Francisco, 1906, 7.9
3. Owens Valley, 1872, 7.8
4. West of Eureka, 1980, 7.4
5. Santa Cruz Mountains, 1838, 7.4
6. Imperial Valley, 1892, 7.3
7. Wrightwood, 1812, 7.3
8. Landers, 1992, 7.3
9. Kern County, 1952, 7.3
10. Petrolia, 1992, 7.2

(Wondering about Loma Prieta?
At 6.9, it didn't quite make the list.)



The situation in California

- Even though things have been quiet locally, CA is also on the move!
- ***Southern California Earthquake Data Center*** reported over 900 earthquakes on the west coast over a one week period ending 24 April 2024.



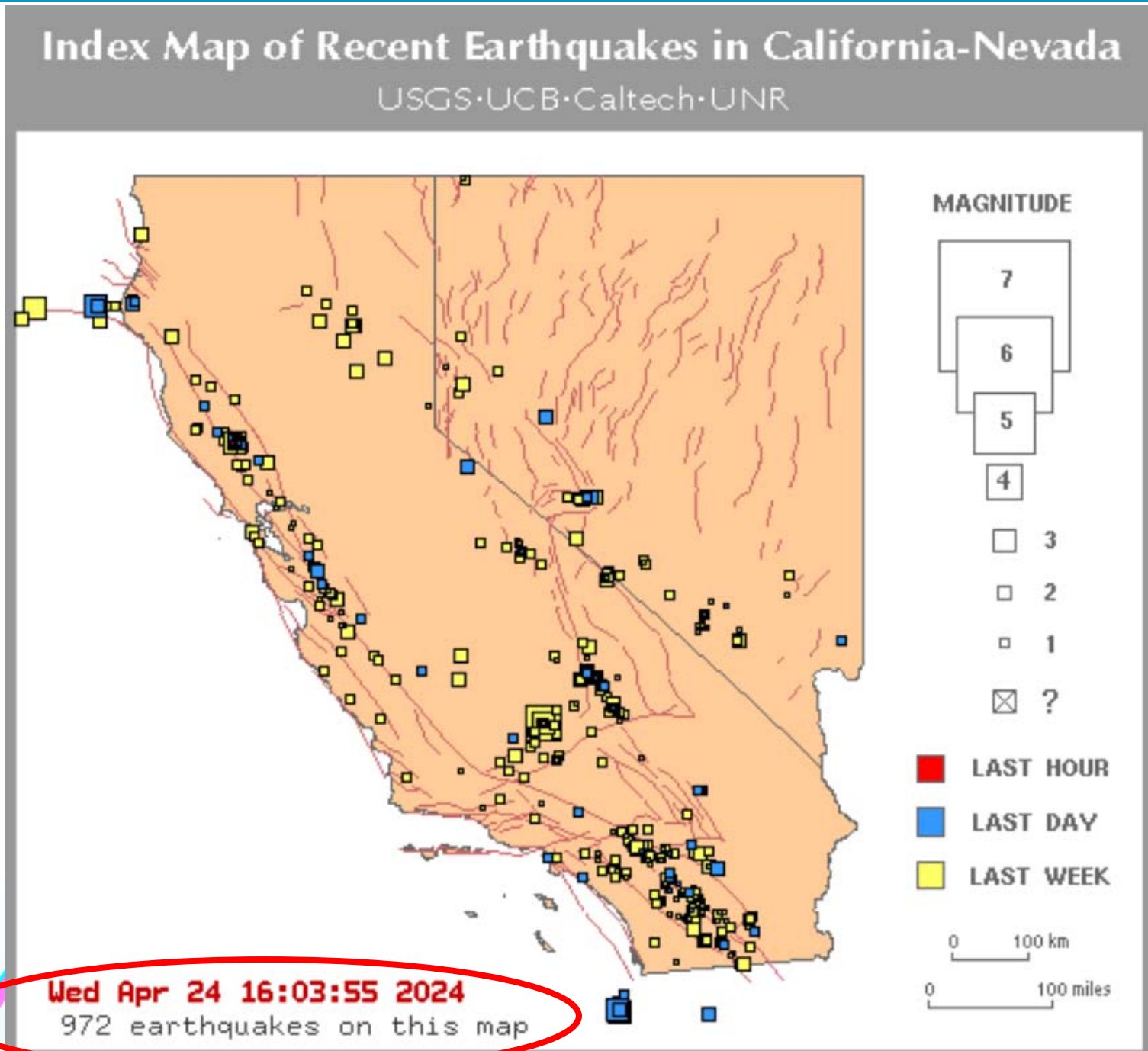
Source: **Southern California Earthquake Data Center**

<https://scedc.caltech.edu/recent/Quakes/quakes0.htm>



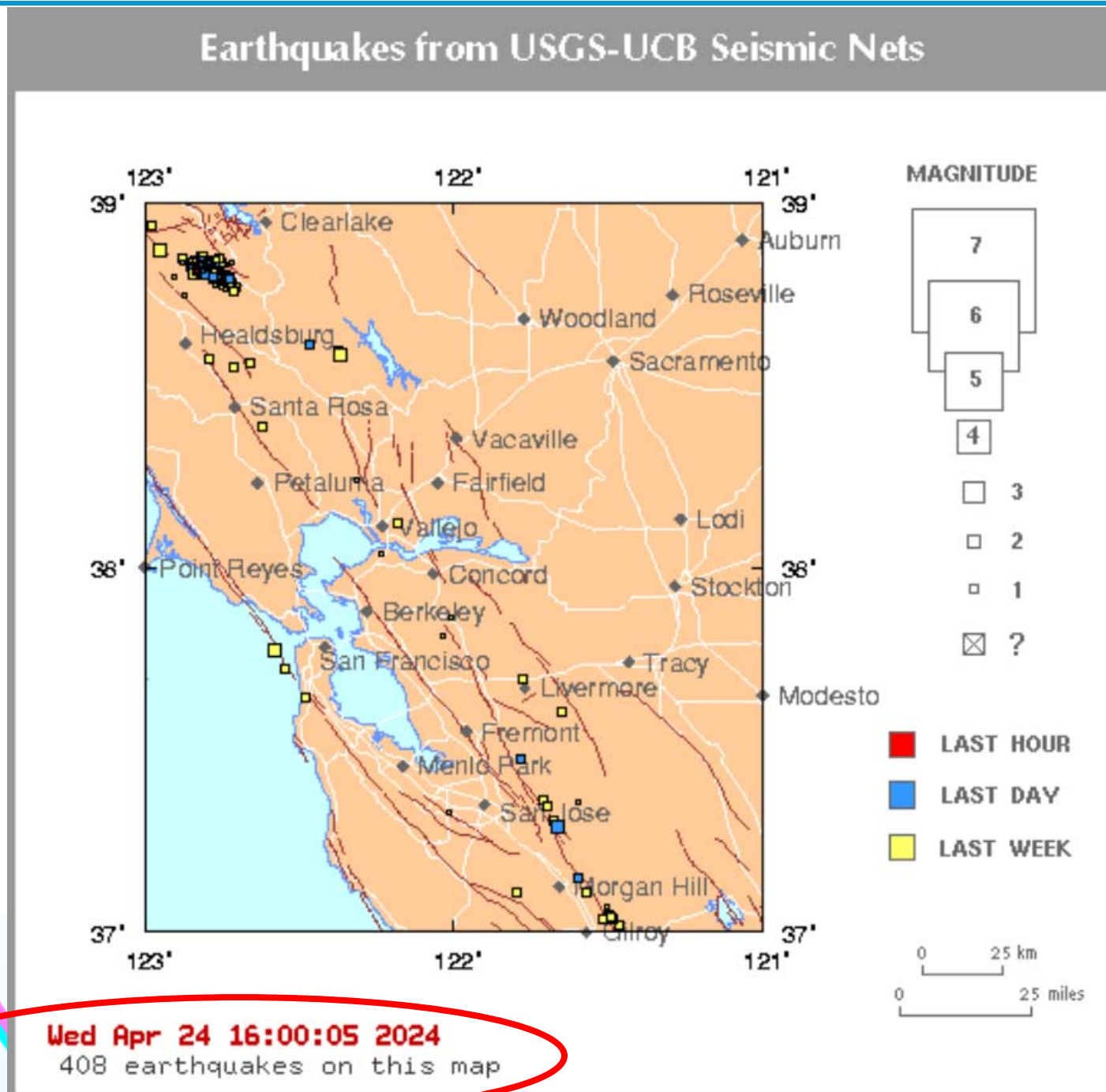
Recent Earthquakes in CA and NV

<https://scedc.caltech.edu/recent/>



Recent Earthquakes in CA and NV

<https://scedc.caltech.edu/recent/>



What is the risk of a California earthquake?

<https://www.scec.org/ucerf>

The **Uniform California Earthquake Rupture Forecast, Version 3 (UCERF3)** is a comprehensive model of earthquake occurrence for California.

According to the UCERF3 report, in the next 30 years (beginning 2014), there is:

1. More than 99% chance that one or more M6.7 or greater earthquakes will strike somewhere in California.
2. a 76% chance one or more M7.0 or greater earthquakes will strike Northern California.
3. a 75% chance one or more M7.0 or greater earthquakes will strike Southern California.

Source: **Southern California Earthquake Center**



The situation in the SF Bay Area



The situation in the SF Bay Area

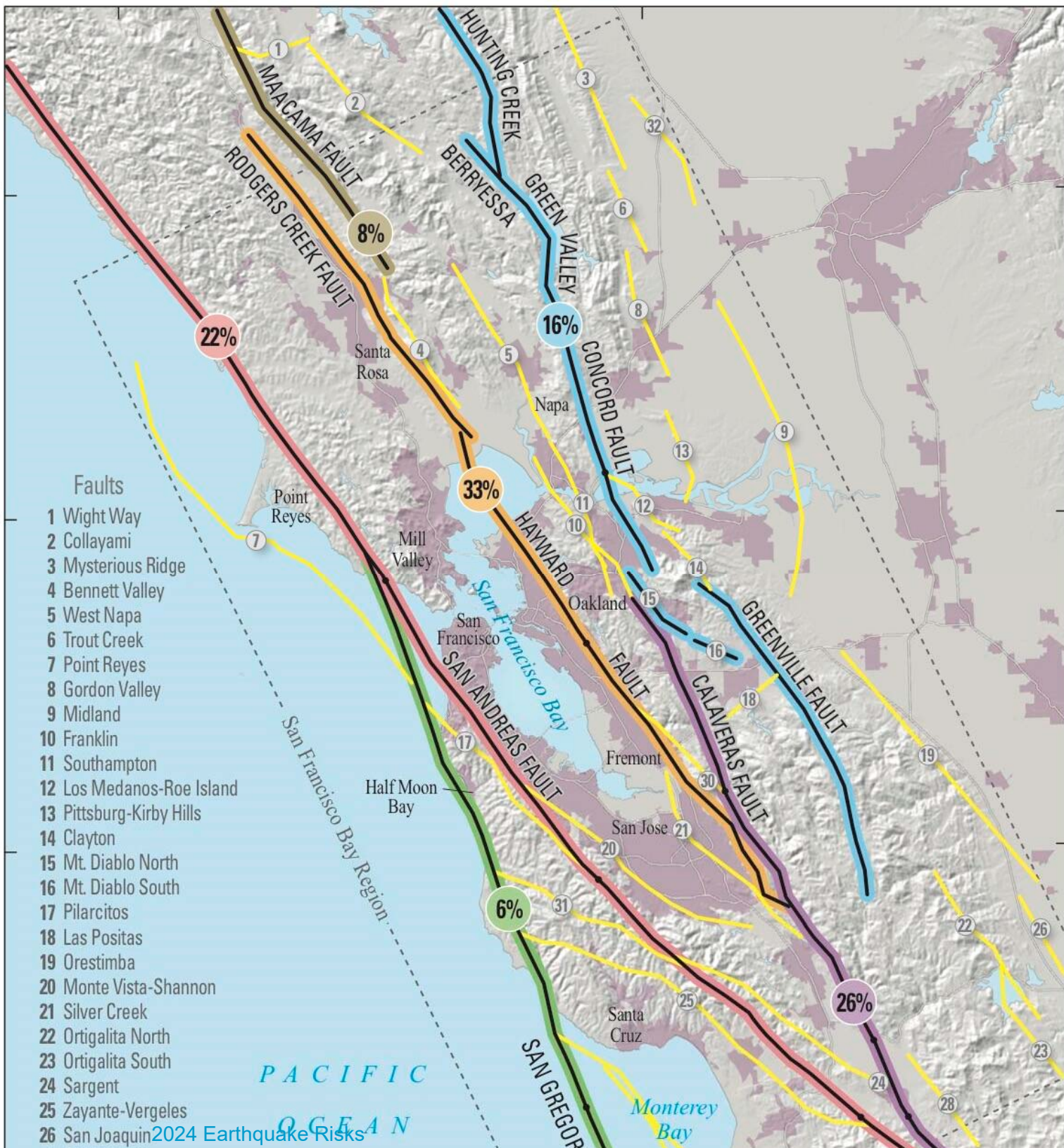
def: San Francisco Bay Area

Counties: Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Solano, Sonoma

- The greater SF Bay Area has a high likelihood of future damaging earthquakes as it straddles the San Andreas fault system.
- The Calaveras and Hayward faults extend up the east side of the SF Bay. These and other major faults in the region are part of the San Andreas fault system.
- Scientists predict that within a 30-year period (beginning in 2014), there's a...
 - 98% chance of one or more magnitude-6.0 or greater quakes hitting the Bay Area in that same timeframe.



38°30'
38°
37°30'



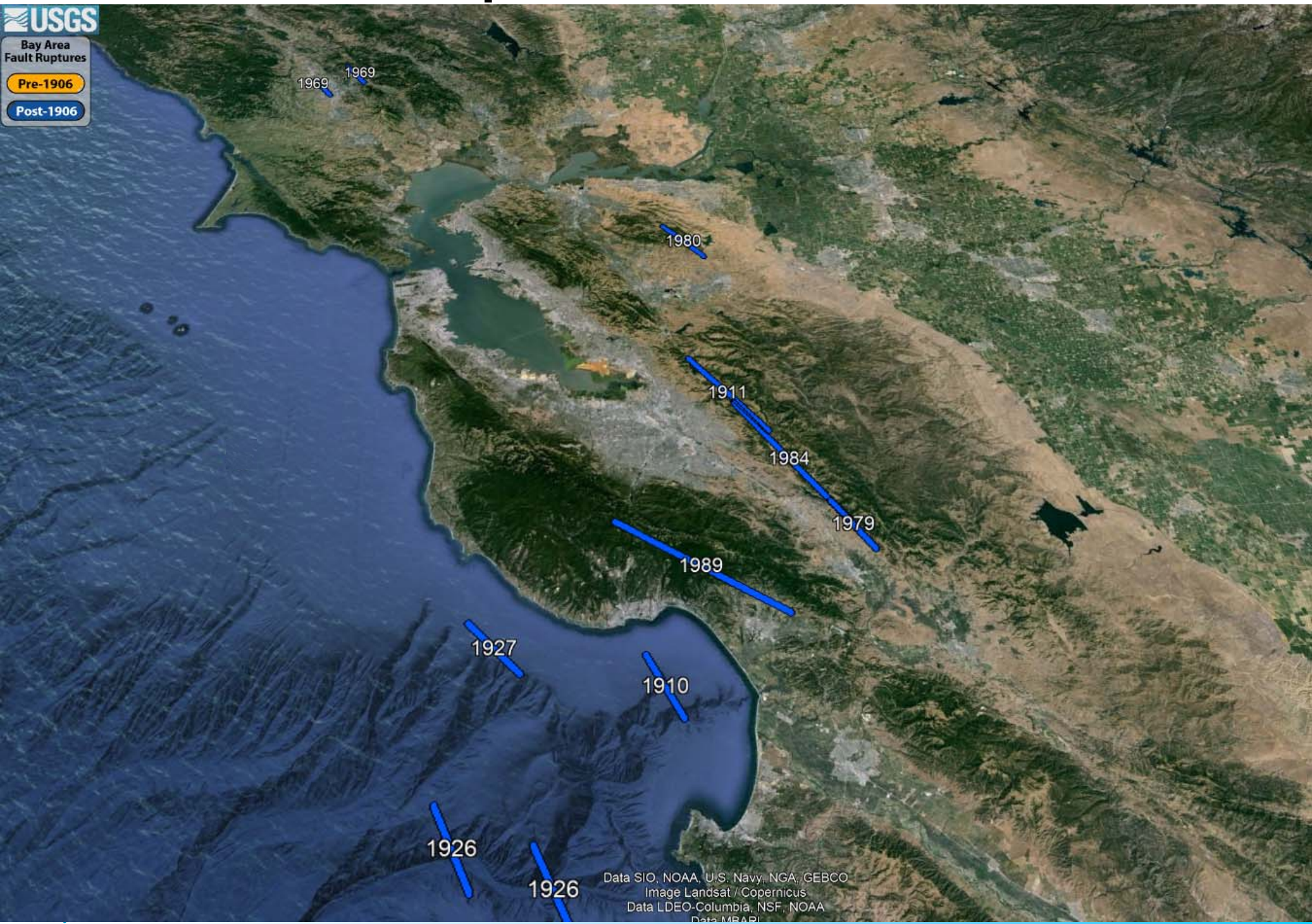
- Faults
- 1 Wight Way
 - 2 Collayami
 - 3 Mysterious Ridge
 - 4 Bennett Valley
 - 5 West Napa
 - 6 Trout Creek
 - 7 Point Reyes
 - 8 Gordon Valley
 - 9 Midland
 - 10 Franklin
 - 11 Southampton
 - 12 Los Medanos-Roe Island
 - 13 Pittsburg-Kirby Hills
 - 14 Clayton
 - 15 Mt. Diablo North
 - 16 Mt. Diablo South
 - 17 Pilarcitos
 - 18 Las Positas
 - 19 Orestimba
 - 20 Monte Vista-Shannon
 - 21 Silver Creek
 - 22 Ortigalita North
 - 23 Ortigalita South
 - 24 Sargent
 - 25 Zayante-Vergeles
 - 26 San Joaquin

5 May 2024

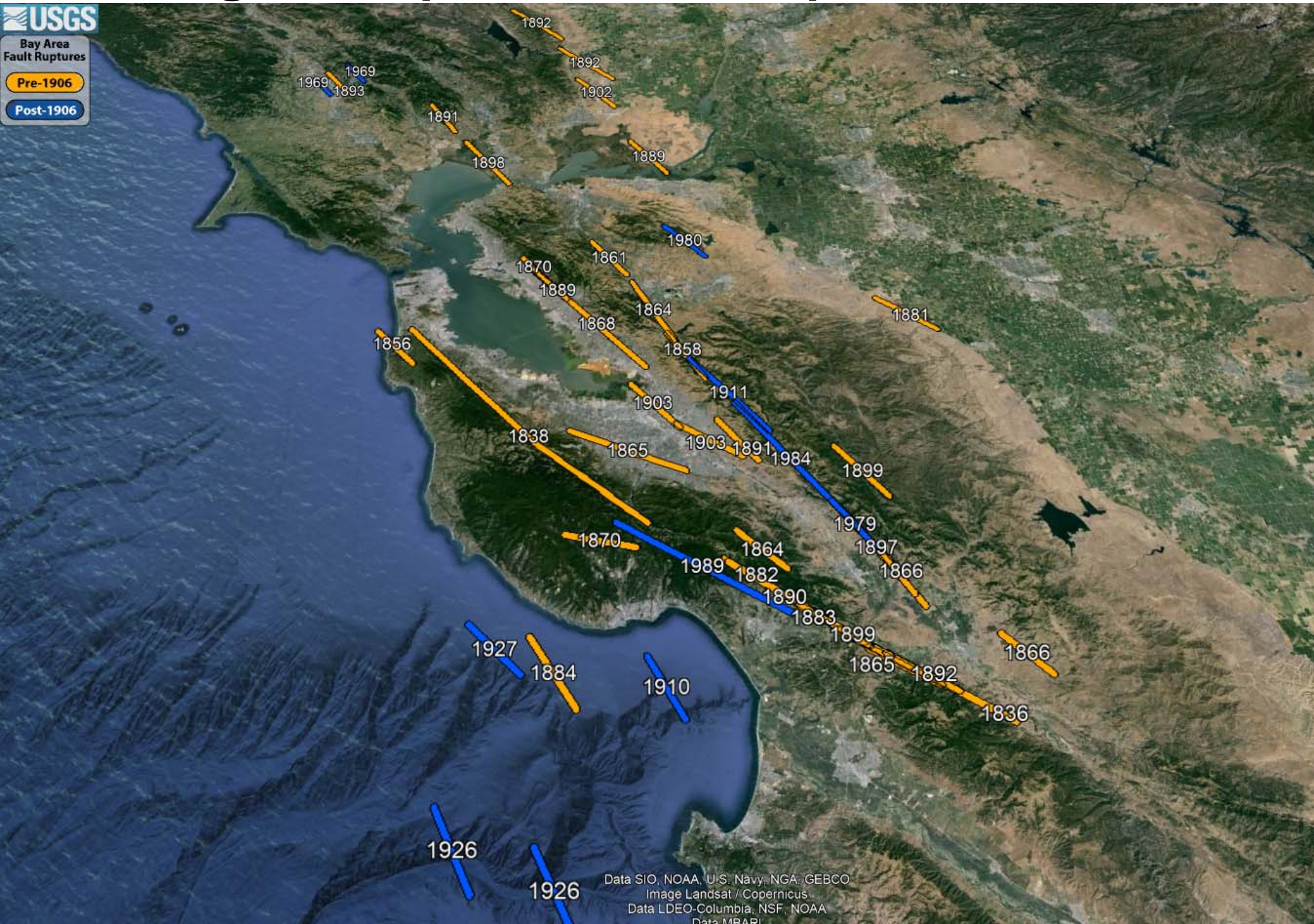
2024 Earthquake Risks



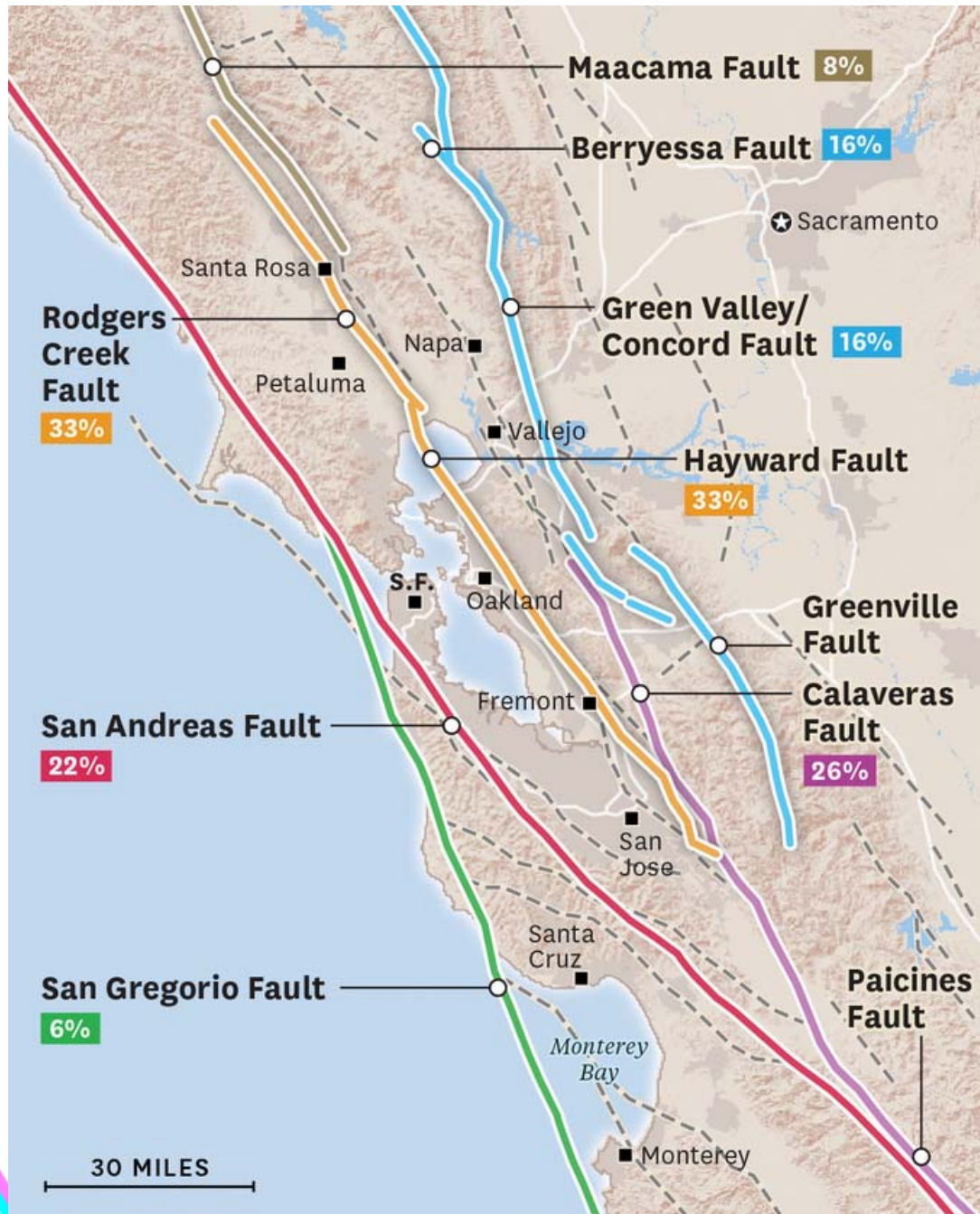
Post 1906 Earthquakes



Adding in the pre-1906 Earthquakes



Overall Risks



72%


Overall probability of a quake of magnitude 6.7 or greater striking somewhere in the Bay Area by the year 2043

The likelihood for individual faults in the Bay Area is shown on this USGS map of known active geological faults.





Figure 8-4.

100-Year Probabilistic Earthquake Scenario Peak Ground Acceleration

-  Santa Clara County Boundary
-  County Boundaries
-  Water Bodies & Channels

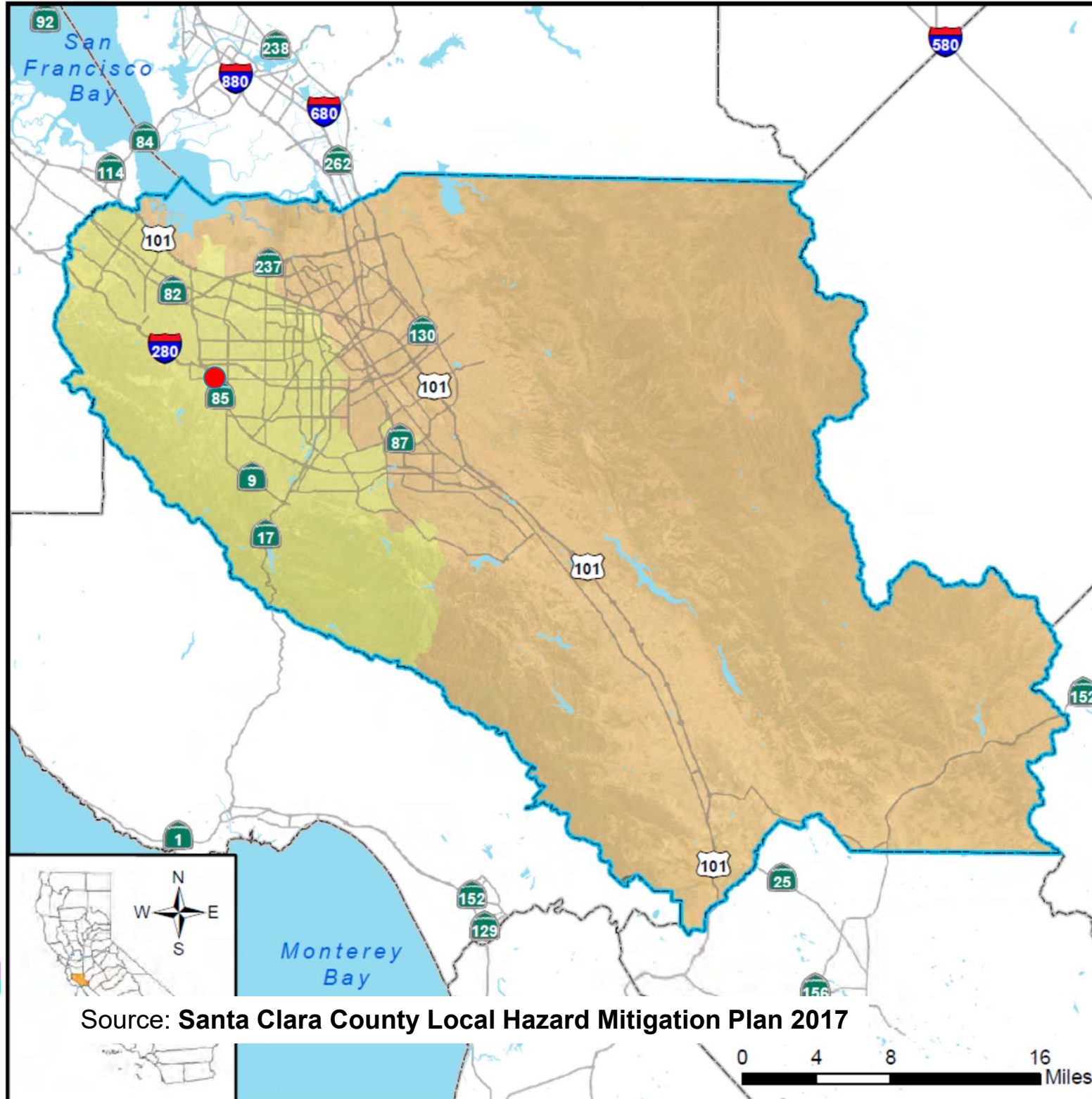
Modified Mercalli Scale, Potential Shaking

-  I (Not Felt)
-  II-III (Weak)
-  IV (Light)
-  V (Moderate)
-  VI (Strong)
-  VII (Very Strong)
-  VIII (Severe)
-  IX (Violent)
-  X+ (Extreme)

↑
↓
Range of Model Results Inside Planning Area



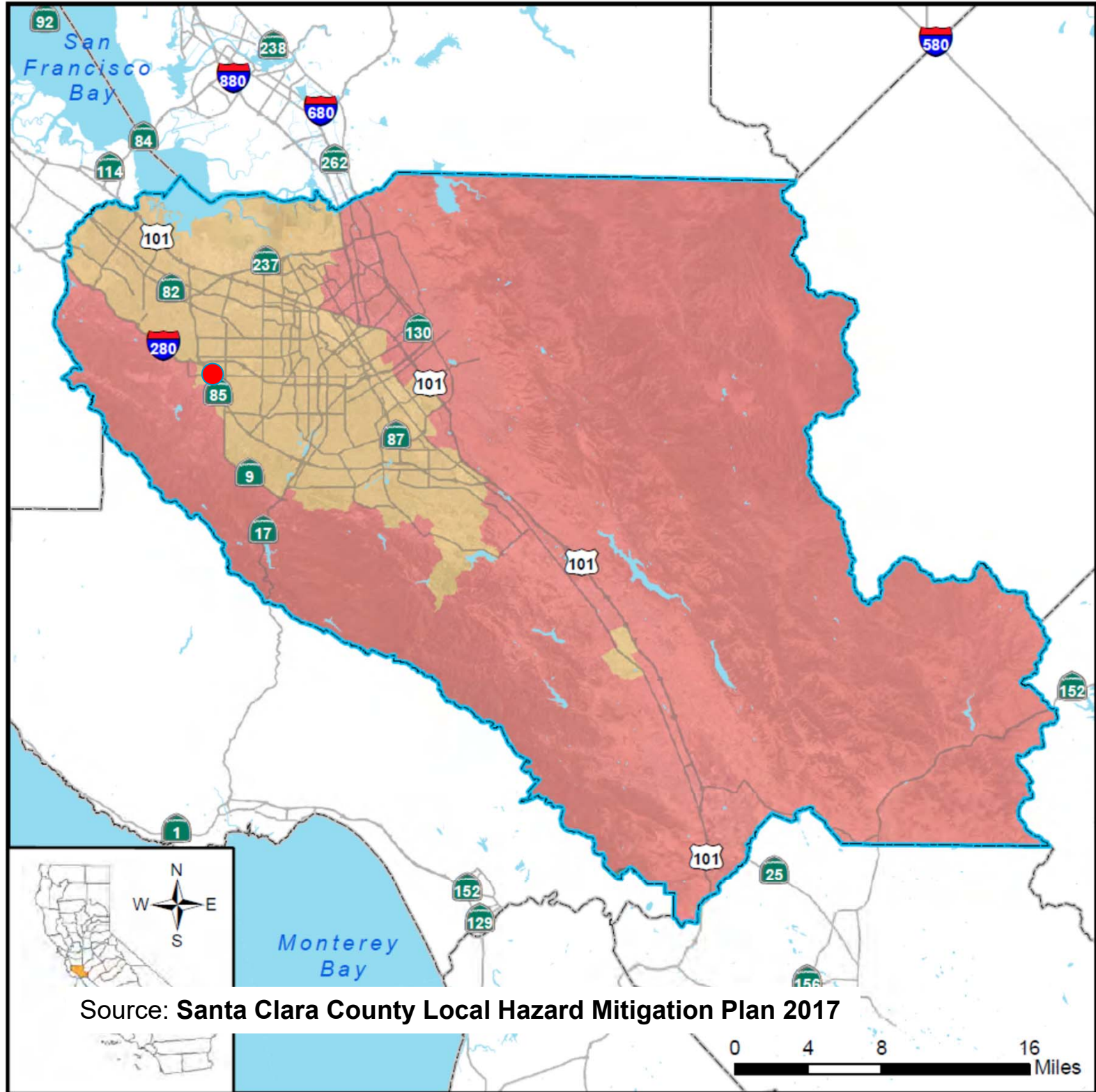
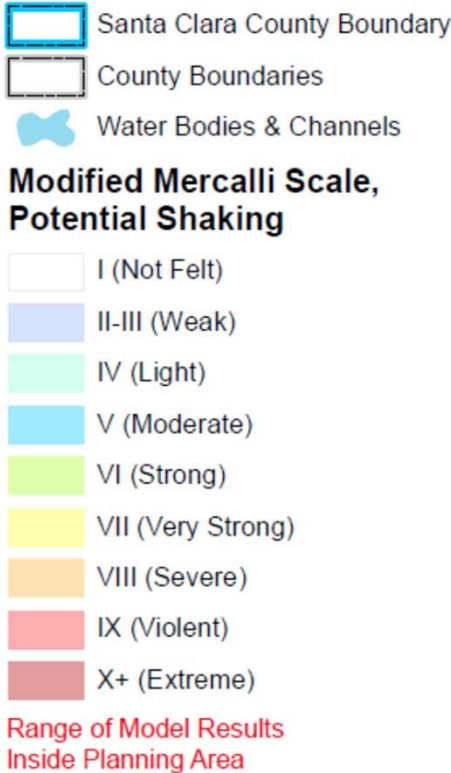
Map Data Sources: Santa Clara County, CalTrans, USDA, Hazus-MH 3.1



Source: Santa Clara County Local Hazard Mitigation Plan 2017

Figure 8-5.

500-Year Probabilistic Earthquake Scenario Peak Ground Acceleration

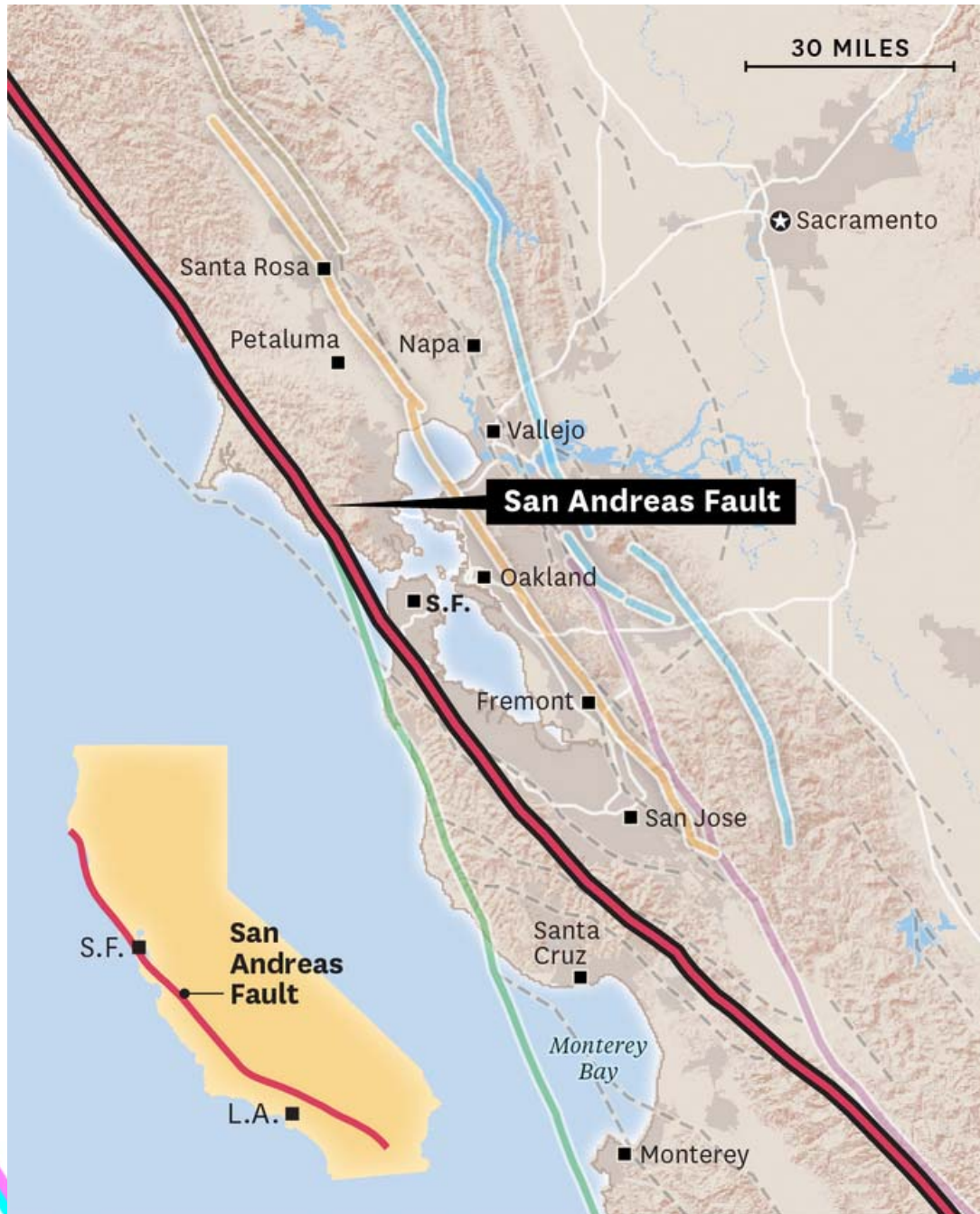


Source: Santa Clara County Local Hazard Mitigation Plan 2017



Map Data Sources: Santa Clara County, CalTrans, USDA, Hazus-MH 3.1

San Andreas Fault



22%




Probability of magnitude 6.7 quake or greater on the San Andreas Fault by 2043.

The San Andreas Fault runs most of the length of California, from the Salton Sea in Southern California to Cape Mendocino. Because of its size, it's the only fault in the Bay Area capable of producing a 7.8 earthquake, according to geologists.



Figure 8-8.

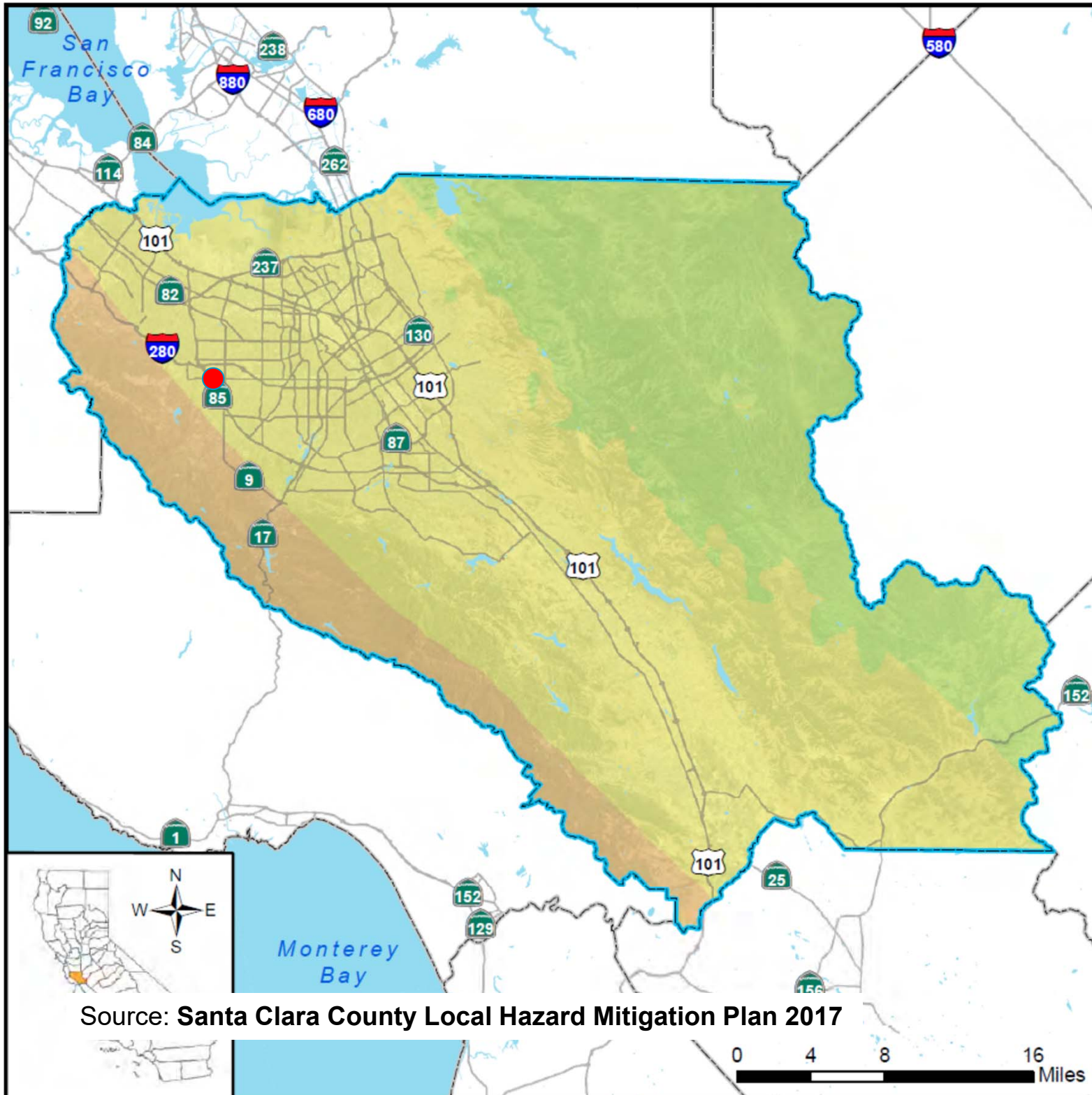
San Andreas M7.8 Fault Scenario Peak Ground Acceleration

-  Santa Clara County Boundary
-  County Boundaries
-  Water Bodies & Channels

Modified Mercalli Scale, Potential Shaking

-  I (Not Felt)
-  II-III (Weak)
-  IV (Light)
-  V (Moderate)
-  VI (Strong)
-  VII (Very Strong)
-  VIII (Severe)
-  IX (Violent)
-  X+ (Extreme)

 Range of Model Results Inside Planning Area



Source: Santa Clara County Local Hazard Mitigation Plan 2017



Map Data Sources: Santa Clara County, CalTrans, USDA, USGS

Hayward-Rodgers Creek Fault



33%

Probability of a quake of magnitude 6.7 or greater on the Hayward-Rodgers Creek fault system by 2043.

The most likely source of the Bay Area's next devastating earthquake is this connected fault system. A quake on the heavily urbanized Hayward Fault, which stretches along the foot of the East Bay hills, would be more destructive than Loma Prieta.



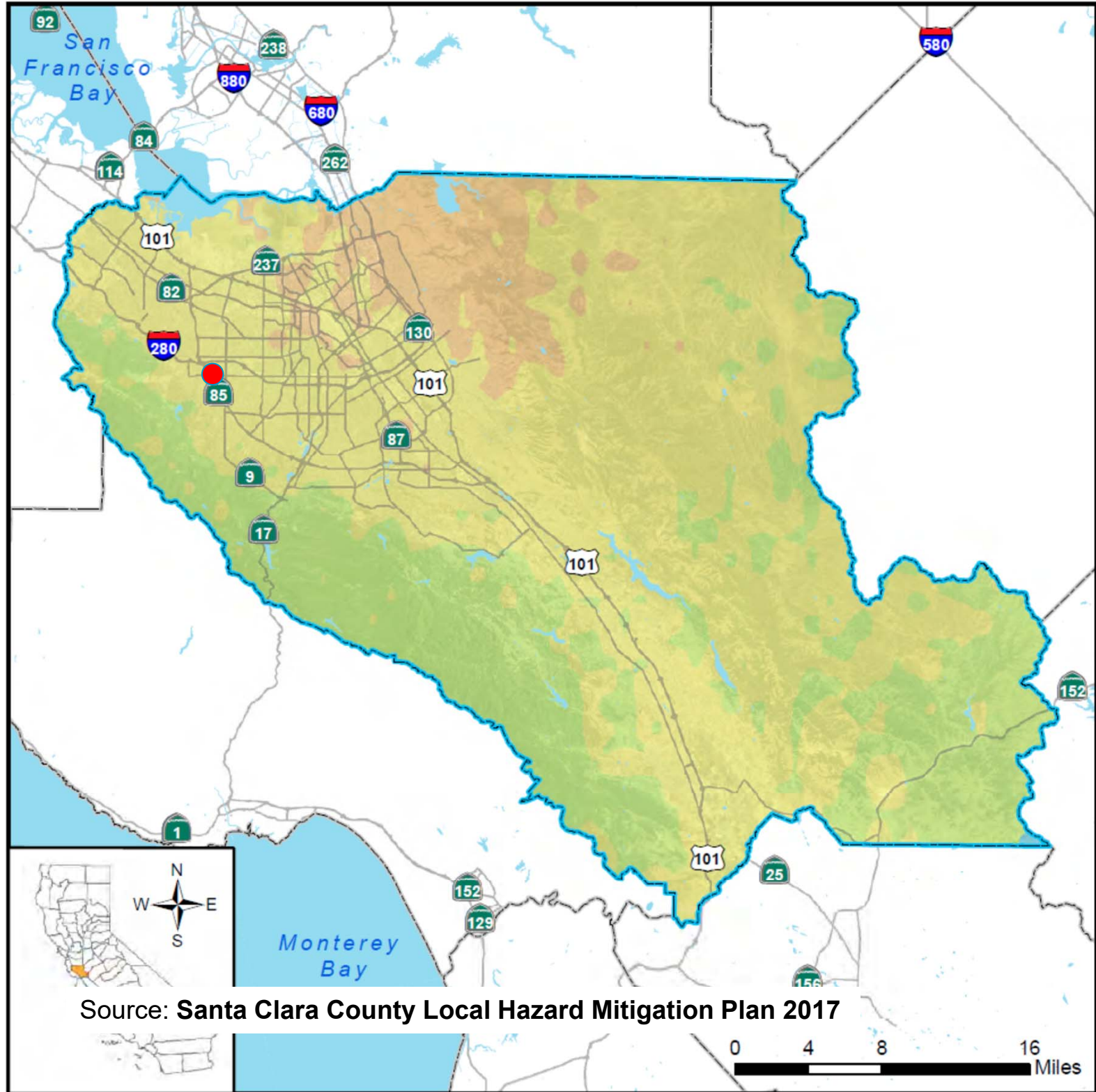
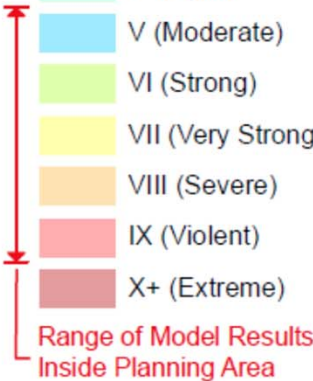
Figure 8-6.

Hayward M7.0 Fault Scenario Peak Ground Acceleration

-  Santa Clara County Boundary
-  County Boundaries
-  Water Bodies & Channels

Modified Mercalli Scale, Potential Shaking

-  I (Not Felt)
-  II-III (Weak)
-  IV (Light)
-  V (Moderate)
-  VI (Strong)
-  VII (Very Strong)
-  VIII (Severe)
-  IX (Violent)
-  X+ (Extreme)






Map Data Sources: Santa Clara County, CalTrans, USDA, USGS

Source: Santa Clara County Local Hazard Mitigation Plan 2017

Figure 8-7.

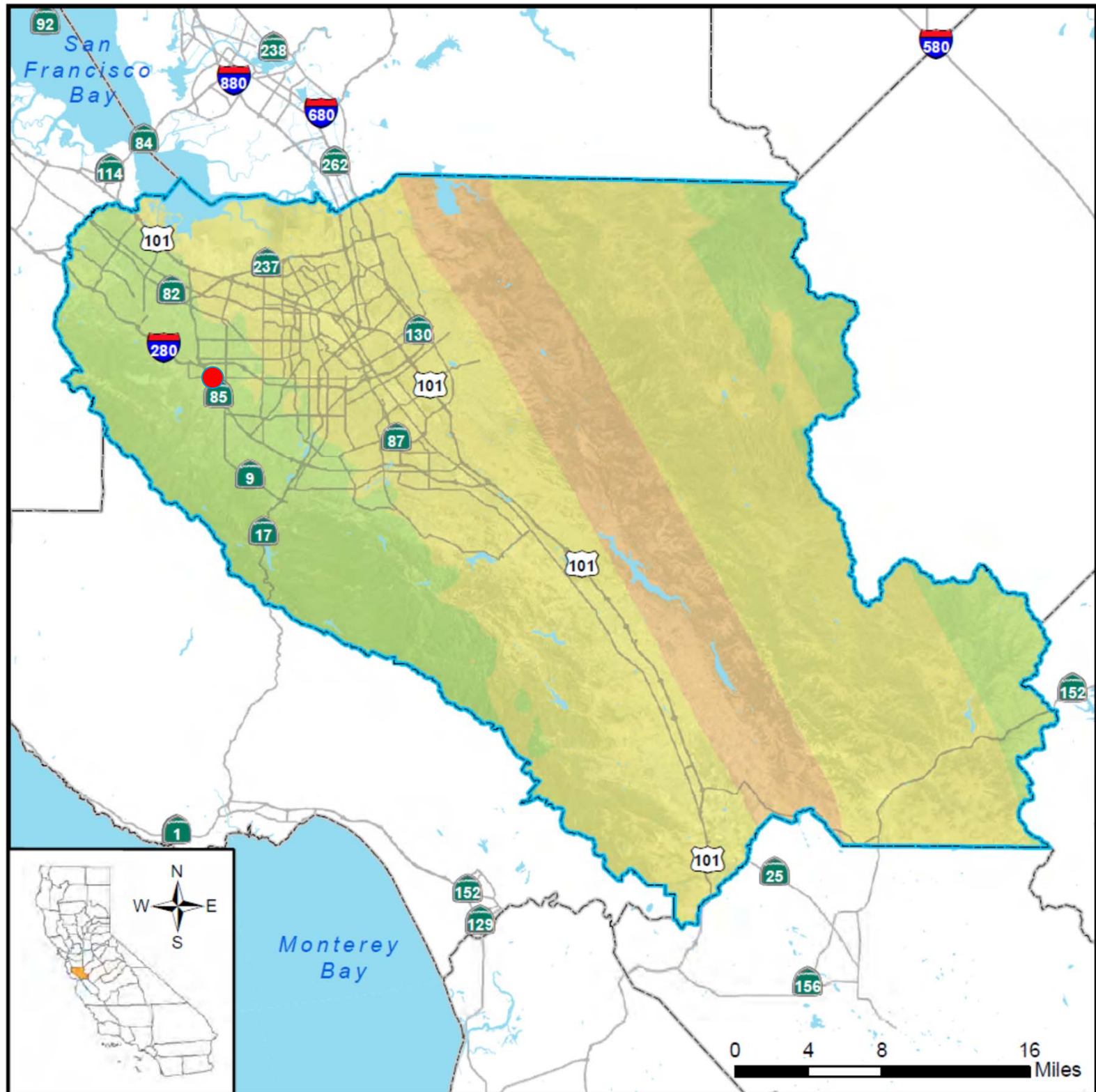
Calaveras M7.0 Fault Scenario Peak Ground Acceleration

-  Santa Clara County Boundary
-  County Boundaries
-  Water Bodies & Channels

Modified Mercalli Scale, Potential Shaking

-  I (Not Felt)
-  II-III (Weak)
-  IV (Light)
-  V (Moderate)
-  VI (Strong)
-  VII (Very Strong)
-  VIII (Severe)
-  IX (Violent)
-  X+ (Extreme)

 Range of Model Results Inside Planning Area



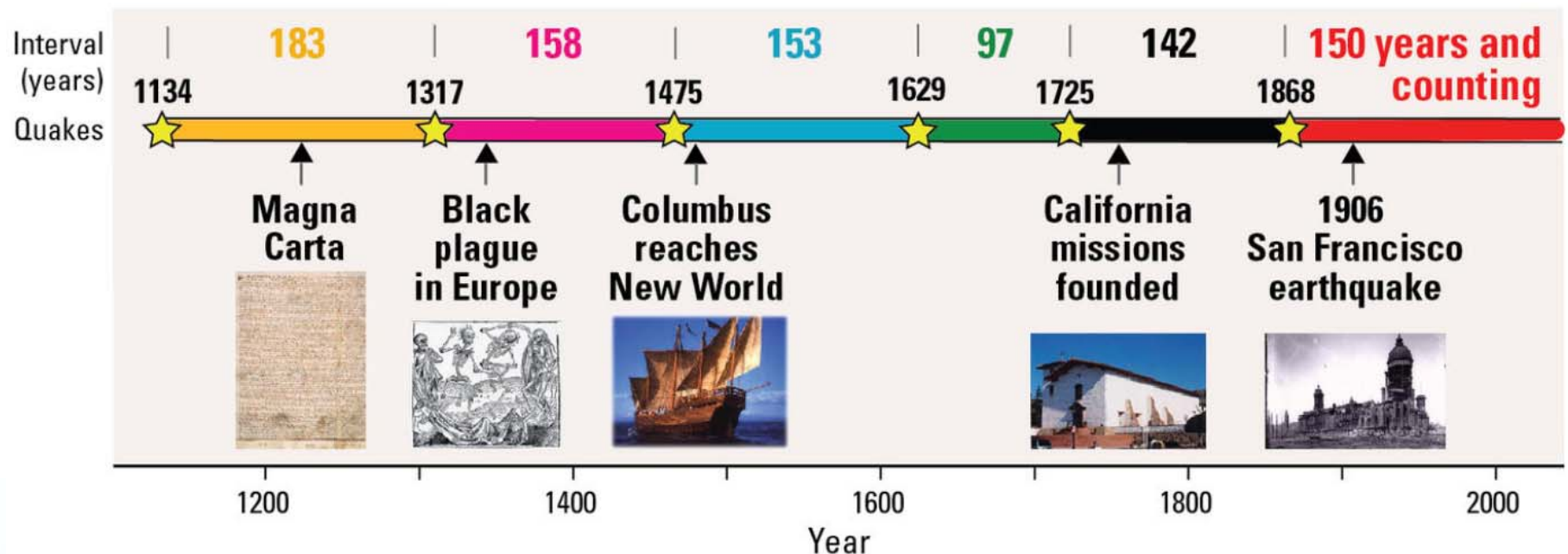
Map Data Sources: Santa Clara County, CalTrans, USDA, USGS

Who's next?

<https://www.usgs.gov/news/featured-story/hayward-fault-it-due-a-repeat-powerful-1868-earthquake>

Per the USGS,

- The last six quakes on the Hayward fault occurred at intervals of 97 to 183 years, with an average interval of about 150 years.
- The 150th anniversary of the 1868 quake was in 2018; scientists are convinced that the Hayward Fault has reached the point where a powerful, damaging earthquake can be expected at any time.



Cupertino ARES/RACES

The situation in Cupertino

5 May 2024

2024 Earthquake Risks

Cupertino ARES/RACES



Cupertino Geology

We are not without 'faults'

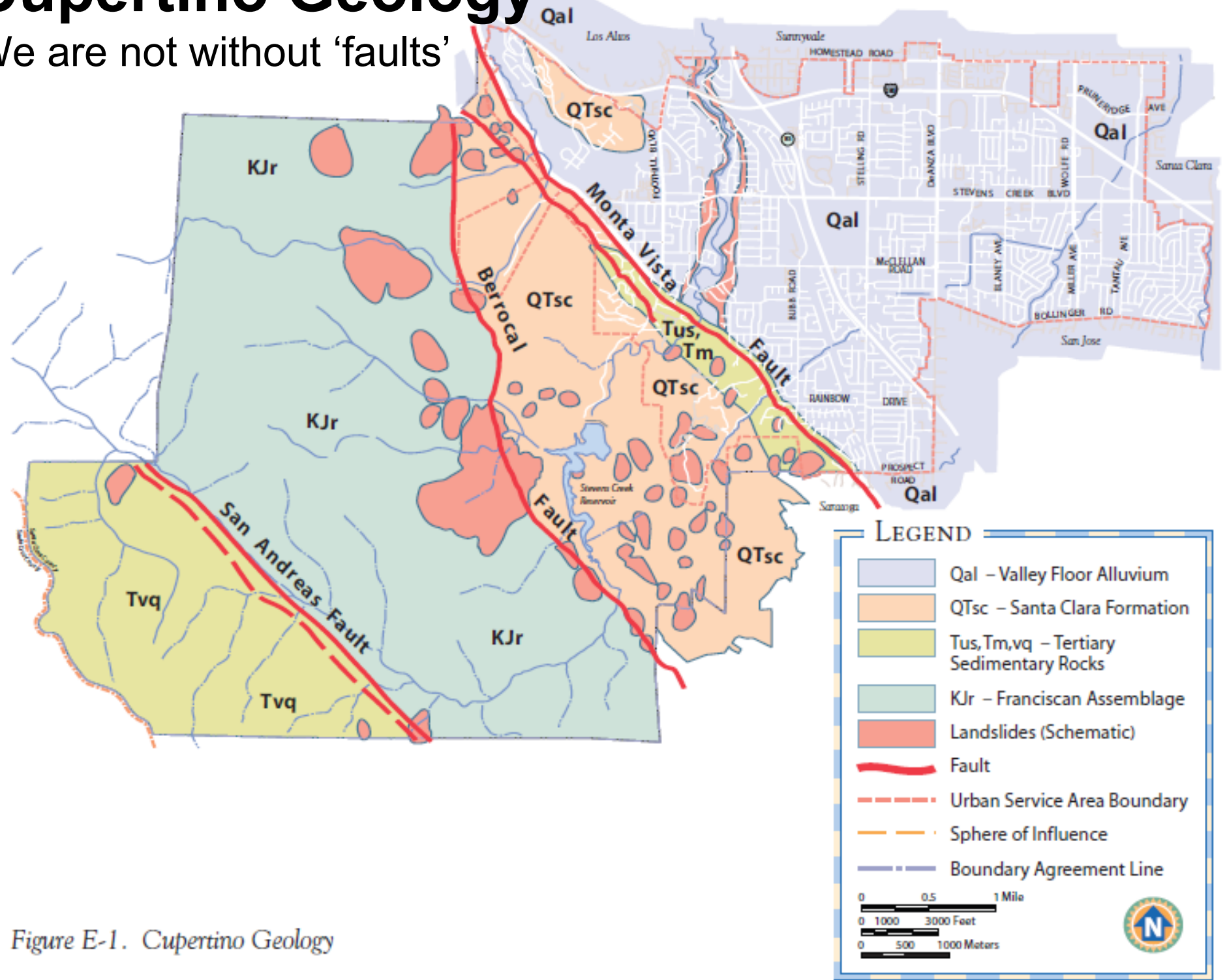


Figure E-1. Cupertino Geology



Local and small earthquakes

4 km WSW of Cupertino CA

Sep 21 2023 00:14	2.9	Monta Vista Fault
Sep 22 2023 11:03	2.8	Monta Vista Fault
Sep 22 2023 23:59	2.1	Monta Vista Fault
Oct 22 2023 22:49	1.9	Monta Vista Fault
Nov 4 2023 19:10	1.4	Monta Vista Fault
Nov 4 2023 19:24	1.0	Berrocal Fault
Nov 20 2023 18:59	1.2	Monta Vista Fault
Dec 2 2023 03:08	2.2	Monta Vista Fault
Jan 1 2024 04:39	1.4	Monta Vista Fault
Apr 20 2024 03:09	0.8	Valco?

Regional and large earthquakes

https://ia.cpuc.ca.gov/Environment/info/esa/monta/monta_geo.htm

- The San Andreas is an active fault.
- The Monta Vista and Berrocal faults are considered potentially active.

Fault	Last Activity Year	Dist, Direction from Cupertino	Max Probable Magnitude
San Andreas (Loma Prieta segment)	1989	4.5mi, Southeast	7.25
San Andreas (San Francisco segment)	1906	30mi, Northwest	8.00
Hayward (southern segment)	1836, 1868	16mi, East	7.50
Calaveras (southern segment)	1861	18mi, East	7.25
Sargent	< 10,000	16mi, South	6.75
San Gregorio/Hosgri	< 11,000	20mi, West	7.75
Monta Vista	< 700,000	2mi, West	6.50
Berrocal	< 1.6 million	2mi, Southwest	6.00

- We likely will experience severe shaking from the Hayward or San Andreas faults.

Source: **California Public Utilities Commission**



Summary of Earthquake Risks

the bottom line...

By 2043...

1. >99% chance of a M6.7 or greater earthquake somewhere in California
2. 98% chance of one or more magnitude-6.0 or greater quakes hitting the Bay Area.
3. 76% chance of a M7.0 or greater earthquakes will strike No. California
4. 75% chance of a M7.0 or greater earthquakes will strike So. California
5. 72% overall probability of a M6.7 or greater earthquake striking somewhere in the Bay Area.
6. 51% chance of a magnitude-7.0 or greater quakes hitting the Bay Area.
7. The Hayward Fault is likely to be the next to go, with a 33% probability of a magnitude 6.7 or greater



Hayward-Rodgers Creek Fault

<https://earthquake.usgs.gov/education/shakingsimulations/hayward/>

Hayward Fault Scenarios

- The most recent large earthquake on the [Hayward fault](#) was in 1868, 156 years ago.
- The Hayward and Rodgers Creek faults are the most likely faults to produce a large earthquake in the Bay Area.
- Computer simulations of large, anticipated earthquakes on the Hayward and Rodgers Creek faults:
 - Note how long it takes before the heaving shaking reaches San Jose
 - [M6.8 Earthquake Scenarios](#)
 - [M7.0 Earthquake Scenarios](#)
 - [M7.2 Earthquake Scenarios](#)



So, what does this mean?

<https://www.ready.gov/earthquakes>

- **The next earthquake is a matter of “when”**
- **Get Alerts.** MyShake App: Free smartphone app for iPhone and Android users with audio and visual warnings [magnitude 4.5 or higher and Modified Mercalli Intensity III (weak) shaking].

The Hayward Earthquake simulations tell us the shaking story in Cupertino.

- **Have a plan.** Sheltering, communications, evacuation, etc.
- **Build a kit.** Food, water, first aid, batteries, radios, etc.
- **Prepare your home.** Family, structure, furnishings, transportation, etc.

Source: **Ready.gov**

<https://www.ready.gov/earthquakes>

Cupertino ARES/RACES



Thank you
Any Questions?

