

# **Surviving the Big One:**

## **Understanding and Preparing for a Major Earthquake in Western Oregon**

May 21, 2013

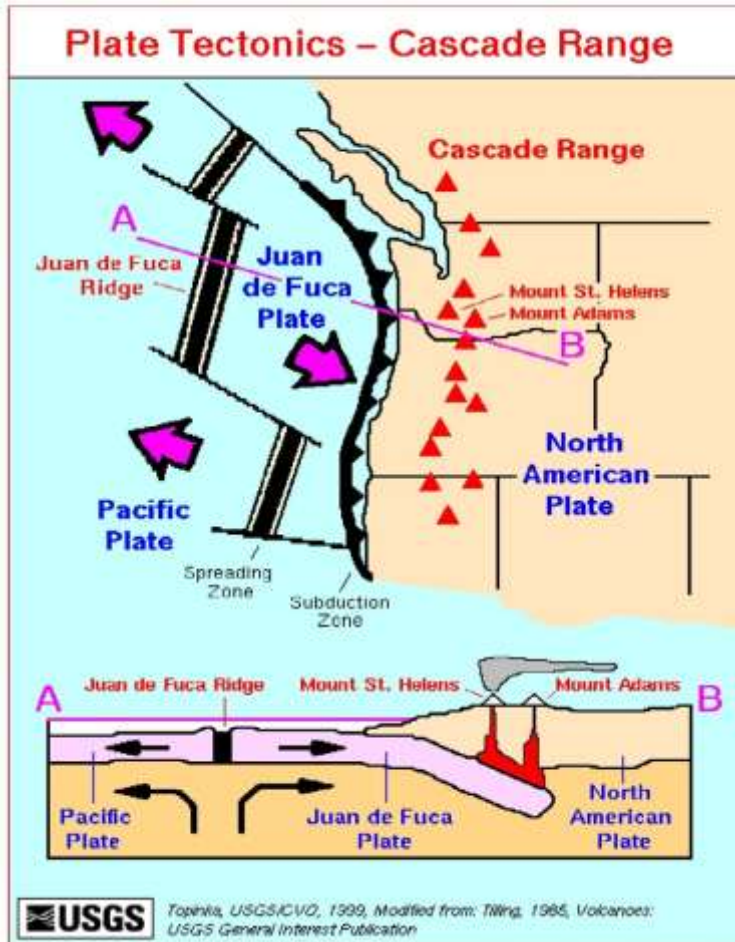
City of Salem

Salem Public Library

Althea Rizzo, Geological Hazards Program Coordinator  
Oregon Emergency Management



# Know your Cascadia Subduction Zone



- 600 miles long, from northern California to British Columbia
- Capable of producing very large earthquakes ( $M9+$ ) that impact a wide area
- Similar in size and impact to the 2004 Sumatra earthquake
- Can produce devastating tsunamis
- 37% chance of a mega-thrust earthquake in the next 50 years \*



# Know your Cascadia Subduction Zone

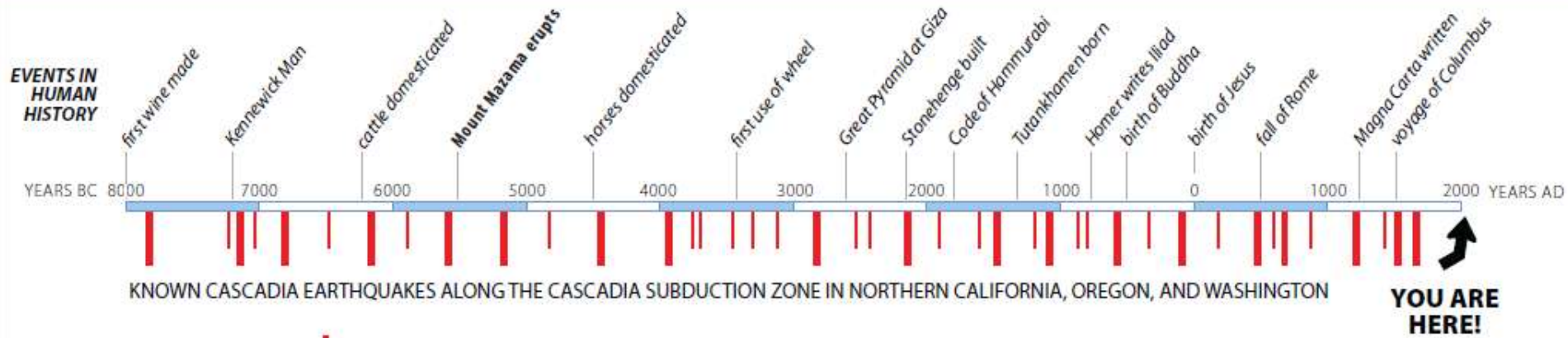


Ghost forest at Copalis River, WA

- Last Cascadia Subduction Zone earthquake occurred in 1700
- When will the next one occur?
  - We just don't know
- Average recurrence:
  - 240 years (south of Cape Blanco)
  - 5-600 years (entire length)
  - 190-1,200 years between EQ

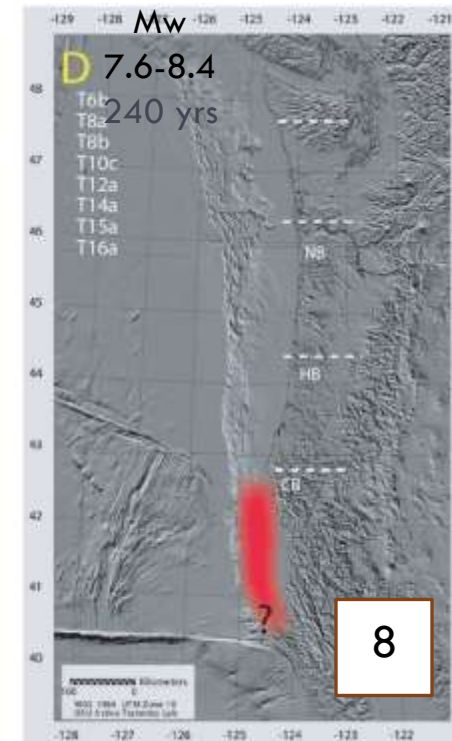
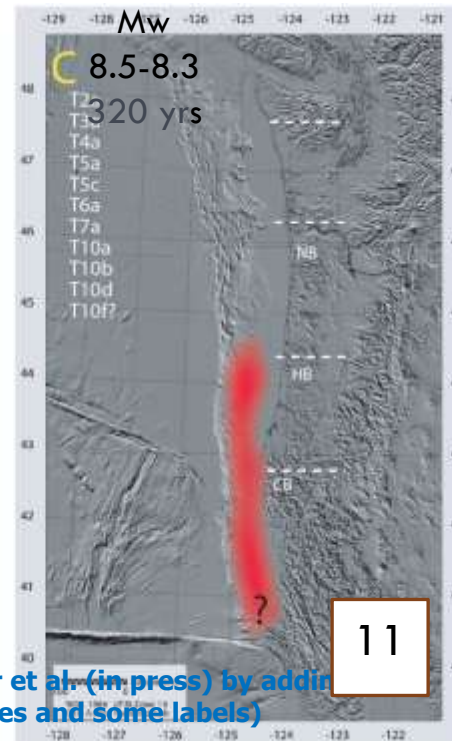
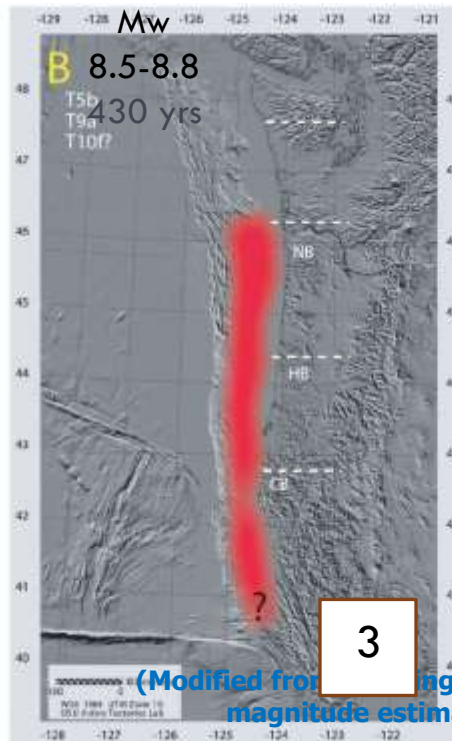
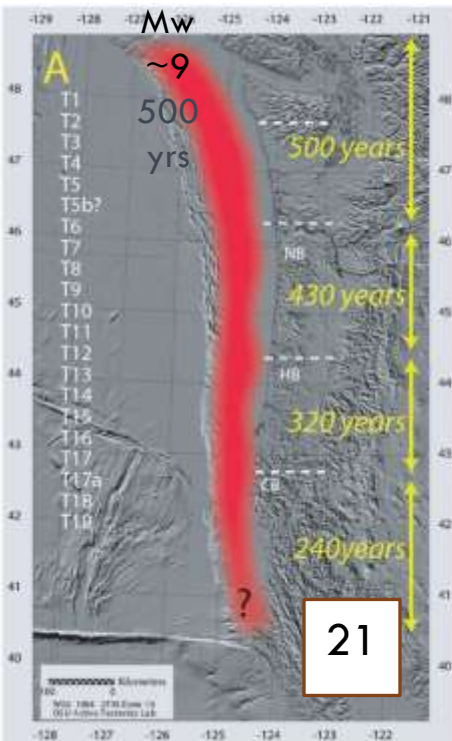


# Cascadia Subduction Zone Earthquakes



Earthquake of Magnitude 9+ (fault breaks along entire subduction zone)

Earthquake of Magnitude 8+ (fault breaks along southern half of subduction zone)



(Modified from [Finger et al. \(in press\)](#) by adding magnitude estimates and some labels)



- Past 10,000 years
  - 19 earthquakes that extended along most of the margin, stretching from southern Vancouver Island to the Oregon-California border
  - 8.7 to 9.2 – really huge earthquakes.
- 22 additional earthquakes that involved just the southern end of the fault
  - slightly smaller – more like 8.0 – 8.2

We're in the Zone  
And it WILL happen again

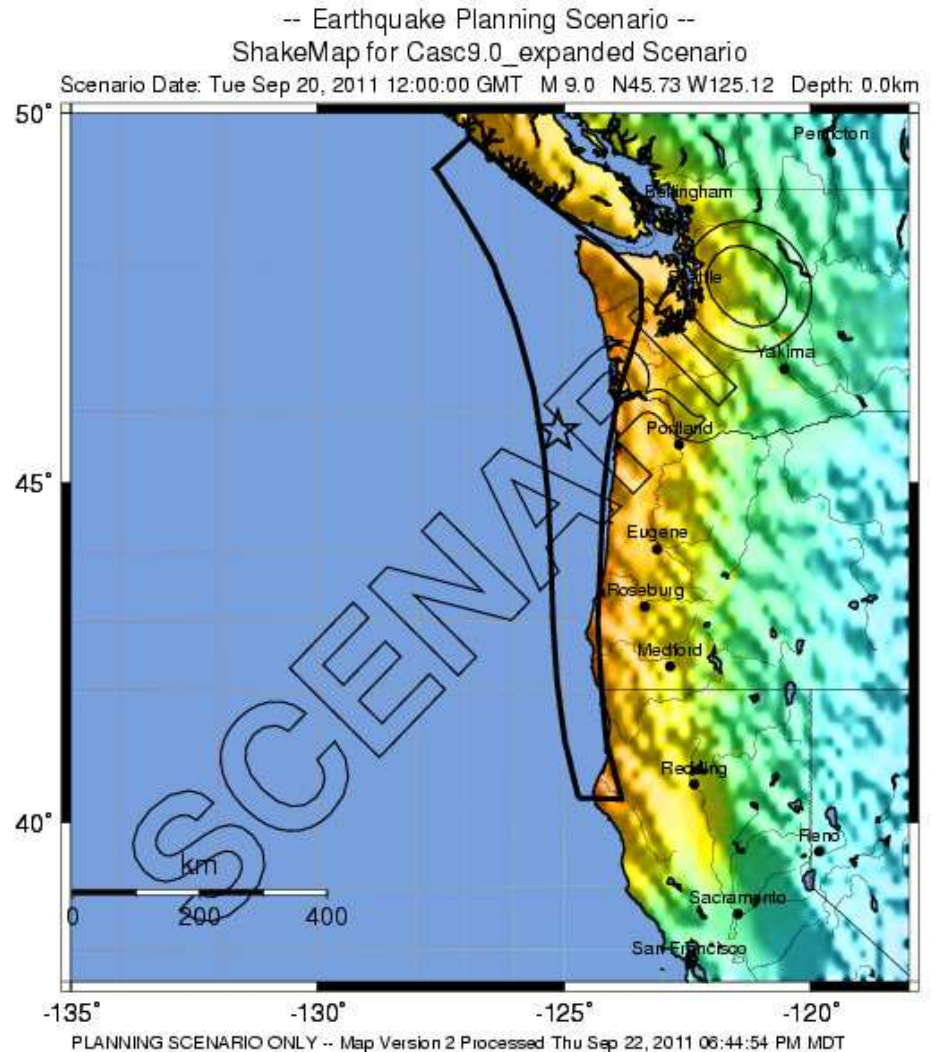


# Cascadia

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## Strong Shaking and Tsunami

- Strong Ground Shaking
  - M9 w/ 2 - 4 min shaking
- Tsunami
  - within 15 to 25 minutes



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	8.1-16	16-31	31-60	60-116	>116
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+



# What are the hazards?

## Strong ground shaking



2010 Haiti earthquake



2011 Tohoku earthquake



1993 Molalla High School



# What are the hazards?

## Coastal subsidence



2004 Sumatra



Mainichi Shimbun, Reuters





# What are the hazards?

## Landslides



Landslides in Ferndale, WA



2010 Taiwan



# What are the hazards?

## Liquefaction



1964 Alaska



2011 Christchurch, New Zealand



# What are the hazards?

## Tsunami



2004 Indonesian tsunami

2011 Tohoku tsunami



# Tsunami

- **Local** – Caused by a subduction zone earthquake near the Oregon shore
- **Distant** – Caused by a subduction zone earthquake far away from the Oregon shore



# Distant Tsunami

- **Arrives 4 + hours after the earthquake**
- Lower damage and flooding than local tsunamis
- National Tsunami Warning System can warn you
  - Warning and Advisory require protective action



# Local Tsunami

- **Arrives minutes after the earthquake**
- Much higher waves
- Much further inland penetration
- NOAA Tsunami Warning System ineffective
- **Earthquake = Only Warning**
  - **NO OFFICIAL WARNING!**
  - **Self Evacuation required**

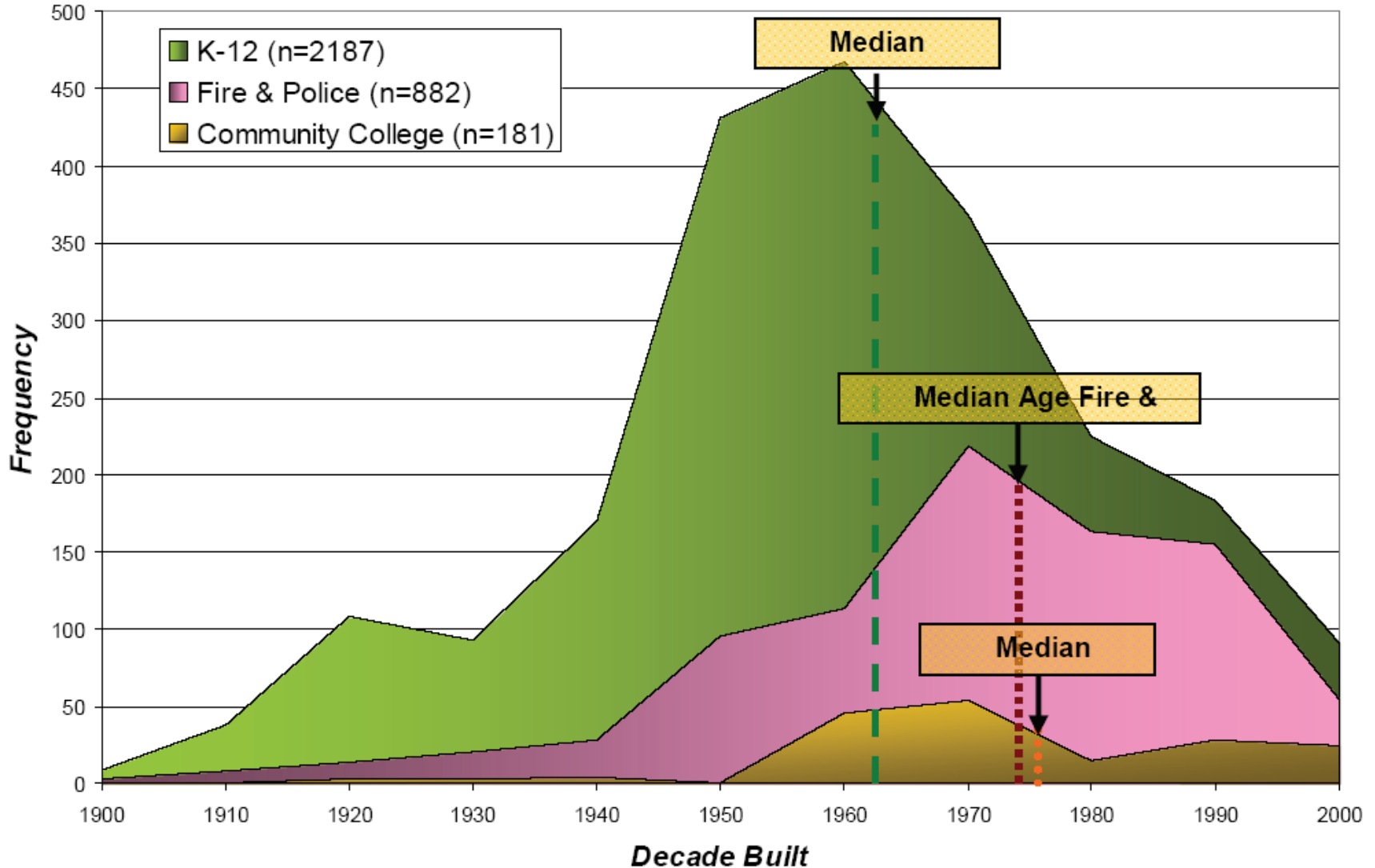


# Cascadia Planning Assumption

- Widely accepted that a very large, 9+ subduction zone earthquake is not just possible, but probable
- Strong to Very Strong shaking inland to Cascade mountains
- Three metropolitan cities in impact zone
  - Portland
  - Seattle
  - Vancouver, B.C.
- Heavy urbanization along the I-5 corridor
- Approximately 15 million people live in the hazard zone



# Oregon Education & Emergency Facilities



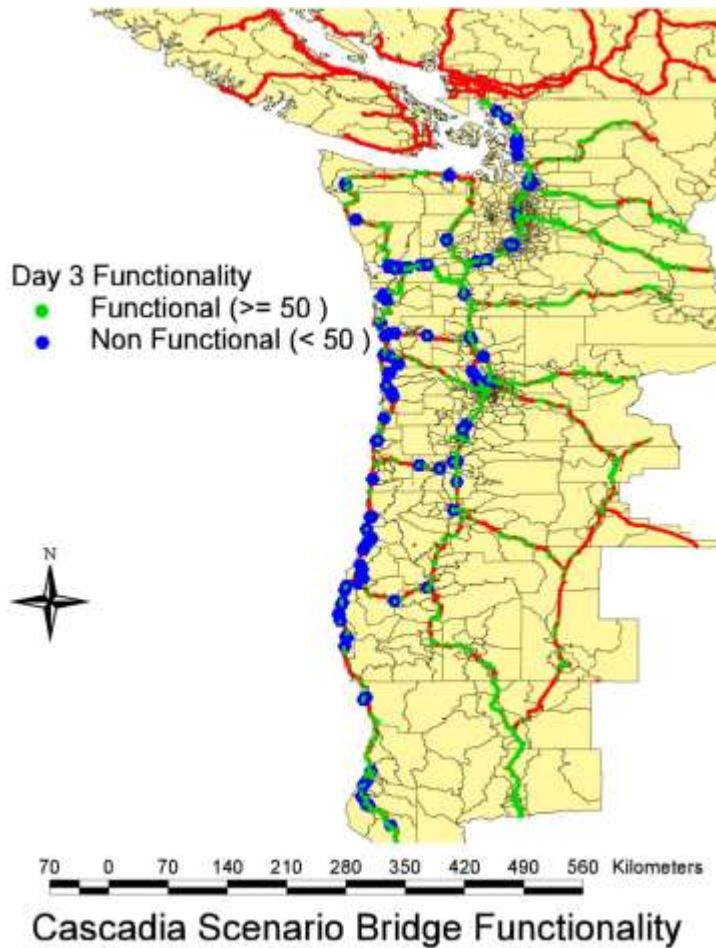


# Seismic Concerns

- Inadequate seismic knowledge + inadequate codes = widespread deficiencies
- Focus on Schools and Critical Facilities
- Disappointing performance of lifelines in 2007 Oregon Winter Storm



# What are the risks & impacts based on our assumptions?



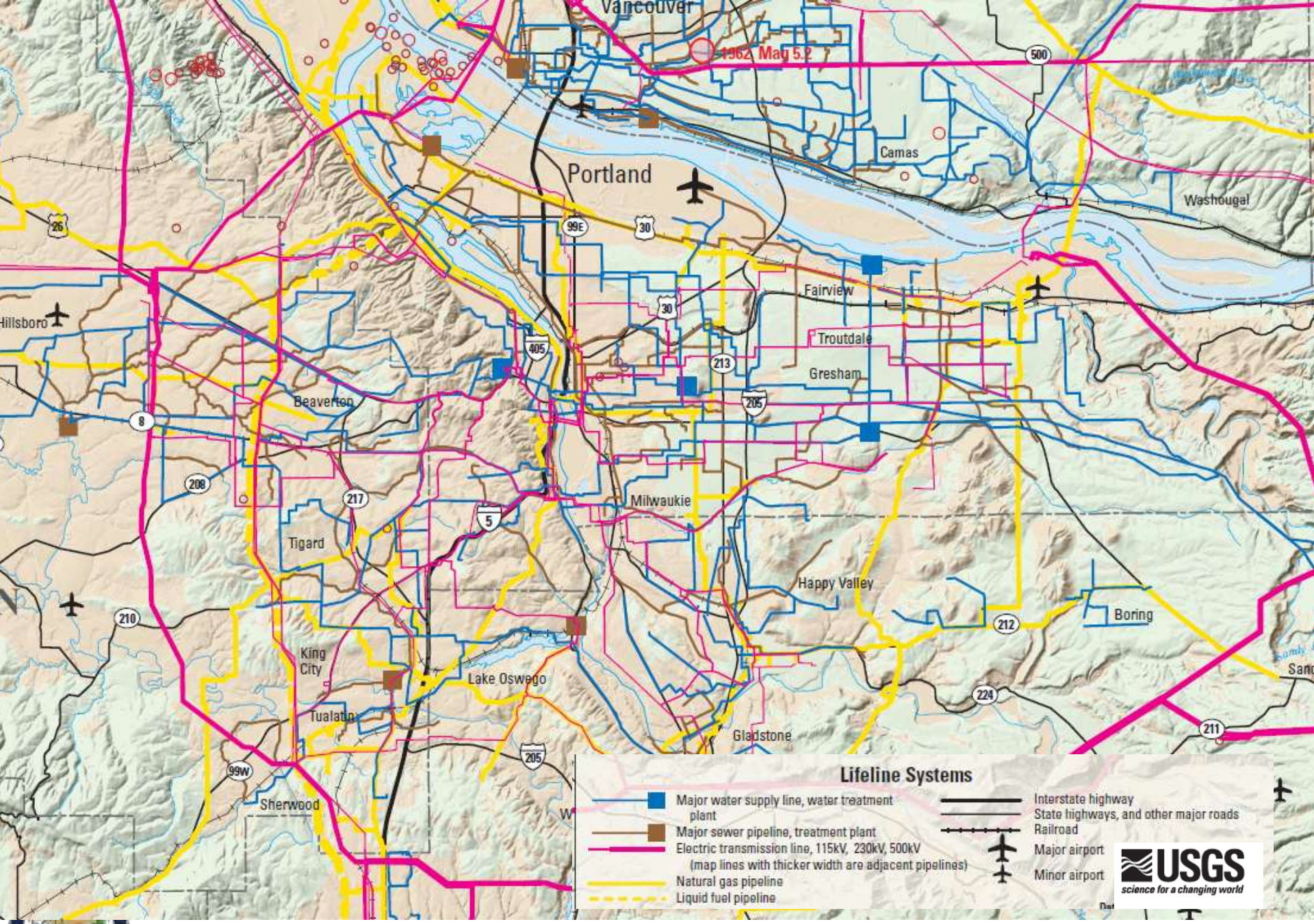
- Infrastructure and lifelines will be seriously damaged
  - In Oregon, 399 bridges would have totally or partially collapsed under an M 9.0 Cascadia Subduction Zone earthquake, and 621 bridges would have been heavily damaged.
  - Most state routes connecting Interstate I-5 with the Oregon Coast Highway would be closed. The estimated time of closure could be 3 to 12 months.
  - The restoration of the entire transportation network could take 3 to 5 years, and would require a nationwide effort.



# Key Findings

- Oregon is far from resilient to the impact of a great Cascadia earthquake today
  - Casualties (1,250 to more than 10,000)
  - Economic Loss (close to 20% state GDP)
  - More than one million truck loads of debris
- Liquid Fuel vulnerability





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# Slow and Frustrating Recovery



# From Awareness to Action



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# Resilience in Action - Coast

- ❖ Waldport High School is the first FEMA tsunami acquisition project in the country. Lincoln County School District secured a bond to rebuild a new high school on the hill above the city.
- ❖ As of December 19, 2012, the Seaside School Board approved a resolution to authorize the superintendent to hire an architect to begin designing a new school campus, which would be constructed above the tsunami inundation zone. A long-anticipated bond measure to support this effort is expected to be on the ballot in May 2013.
- ❖ As of December 12, 2012, the Cannon Beach City Council agreed to acquire 55 acres to expand the city limits for a new school site above the tsunami inundation zone.



# Resilience in Action - Schools

## ❖ State Seismic Rehabilitation Grant Program

- Funded 25 schools throughout the state
- Will save lives of more than 8000 students

## ❖ Portland Public Schools

## ❖ Oregon University Systems: Many universities buildings have been retrofitted or will be retrofitted in the near future.

## ❖ Private Universities: Some private university buildings have been renovated.





# Resilience in Action – Emergency Facilities

## ❖ State Seismic Rehabilitation Grant Program

- Funded 18 Facilities

<b>Emergency Services</b>	
<b><u>Entity</u></b>	<b><u>Project</u></b>
Tuality Healthcare	Tuality Hospital, Building A
City of Dallas Fire Department	Dallas Fire Station
City of Albany Fire Department	Station 12
City of Gresham Fire & Emergency Services	Stations 71 (Public Safety Building) & 72
Netarts Oceanside Fire District	Station 61
City of St. Helens Police Department	St. Helens Police Station
Klamath County Fire District No. 1	Station 6
City of Eugene	Danebo Fire Station Number 8
Silverton Fire District	Scotts Mills Station
Oregon Health & Science University	University Hospital South
City of Coos Bay	Coos Bay City Hall

Awarded in 2009  
to 2010

<b>Emergency Services</b>	
<b><u>Entity</u></b>	<b><u>Project</u></b>
Langlois RFPD	Langlois Fire Station
City of Garibaldi	Garibaldi Fire Station
City of Grants Pass	Hillcrest Public Safety Building
City of Astoria	Public Safety Building
Santa Clara Fire District	Station 1
City of Hood River	Hood River Fire Department
Woodburn RFPD	Station 22

Awarded in 2010  
to 2011

# Resilience in Action – Emergency Facilities

## ❖ City of Portland:

- Renovated nearly all of their fire stations
- Constructing a new Emergency Communication Center

## ❖ TVFR

- On going program to renovate their fire stations



# Resilience in Action – Transportation



Tsunami Resistant Bridge: US 101  
Spencer Creek Bridge



1947 original and 1999 detour

<http://www.slayden.com/us-101-spencer-creek-bridge/>



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# Resilience in Action – Water



50 MG Powell Butte Reservoir  
City of Portland PWB



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# After an earthquake happens ...

- Actions you take today, will make the difference
  - Choose to be able to recovery quickly by preparing your family, business, neighborhood, community
- Before you can do your job, you need to know that your family is safe.



# Post-earthquake checklist

## Immediate response

- Drop, cover, and hold on
  - Get to high ground, if you are on the beach or near the coast.
- Assess personal safety
  - Check on co-workers & family
- Leave the building and assemble at designated point
  - Follow your emergency procedures





A state-wide  
Drop, Cover and Hold On Earthquake drill.  
[Shakeout.org/Oregon](http://Shakeout.org/Oregon)



# You can't prevent an Earthquake, but you can prepare for one

Building a culture of prevention is not easy because the cost of prevention has to be paid in the present, while its benefits lie in the distant future. Moreover, the benefits are not tangible; they are the disasters that did not happen.

*(to paraphrase Kofi Annan)*

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