



# Seattle Fault Earthquake Scenario

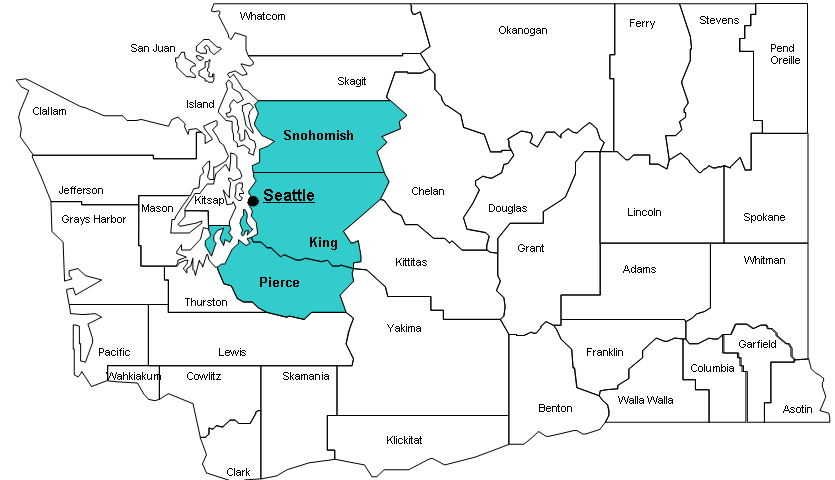
*Congressional Hazards Caucus  
October 11, 2007*



**Earthquake Engineering  
Research Institute**

# Scenario Study Area

King, Pierce,  
Snohomish  
Counties



More than half state's population.

- Six of the 10 largest cities in state.

Cornerstone of state's economy.

- King County has 44 percent all jobs statewide.
- Major Employers: Boeing, Ports of Seattle and Tacoma, Microsoft, WaMu, Starbucks, Alaska Air Group, University of Washington, Military.
- WA is fifth largest exporter in nation.
- Ports of Seattle, Tacoma handle \$52 billion waterborne international freight annually.



# Estimated Losses

- Property, economic loss – \$33 billion
- Deaths – 1,660
- Injuries – 24,000
- Buildings destroyed – 9,000
- Buildings unsafe to occupy – 29,700
- Buildings with restricted use – 154,500
- Property damaged by fire – \$500 million
- Households displaced – 46,000
- People seeking shelter – 11,000
- Recovery time – Many years.



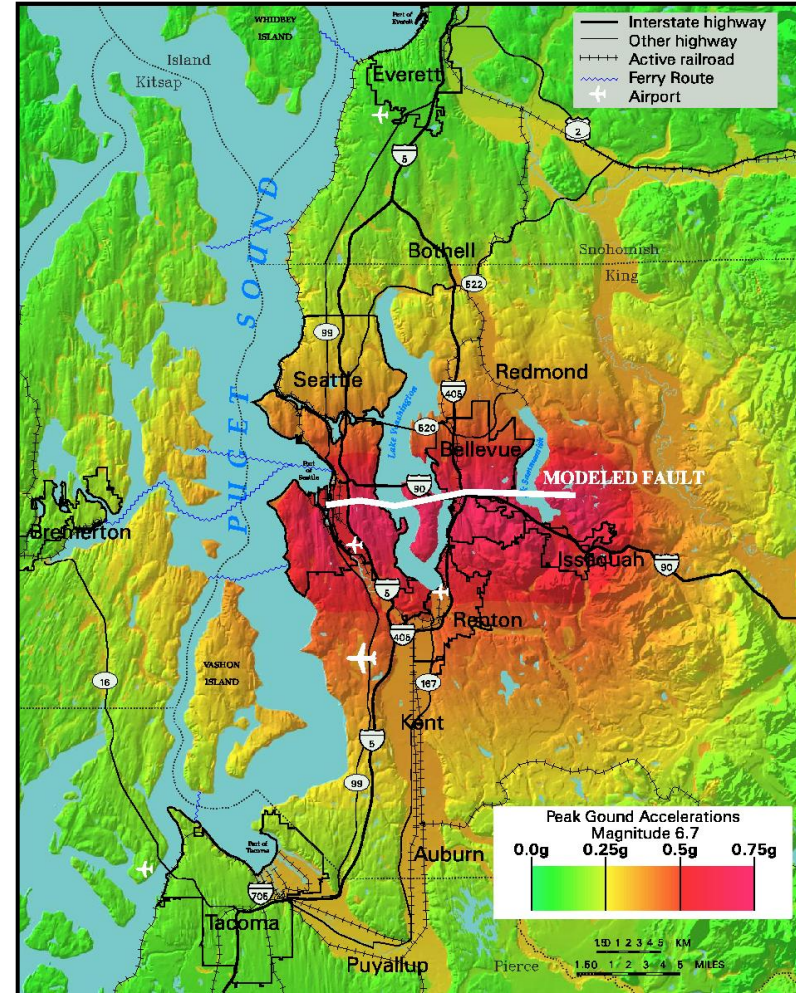
# Key Response Concerns

- Urban search and rescue help needed.
- Lack of water inhibits firefighting.
- Cleanup of numerous hazardous materials, sewage spills.
- Standards of care adjusted for injured.
- Thousands of displaced individuals need shelter.
- Caring for vulnerable populations.
  - Disabled, seniors, school children.
- Communicating with non-English speaking people, ethnic communities.



# Transportation and Recovery

- Correlation between transport damage & business disruption.
  - Northridge EQ, Great Midwest Flood: Transport disruption as costly as facility damage.
  - Kobe EQ: Transport, port damage slowed economic recovery of region.
- Port to Port study
  - Segments closed months to years.
  - Commerce movement difficult.



# Major Highways Near Seattle Fault

Route (red cross fault)	Vehicles per day
Interstate 5 (N-S through Seattle)	260,000+
<u>State Route 99 (N-S through Seattle)</u>	110,000+
Interstate 405 (N-S through Bellevue)	130,000+
Interstate 90 (Seattle east)	148,000+
State Route 520 (Seattle east)	100,000+
State Route 167 (north to Renton)	110,000+



**Alaskan Way Viaduct  
(SR 99)**

**Built in 1950s on poor soils, near now-failing seawall. Damaged in 2001 EQ.**

**Replacement will take 6+ years.**



# Likely Impacts to Roads

## Damages

- Parts of major highways experience major damage or bridge collapse.
- Local roads, bridges will experience damage.

## Immediate Impacts

- Emergency services will be limited.
- Severe traffic congestion.



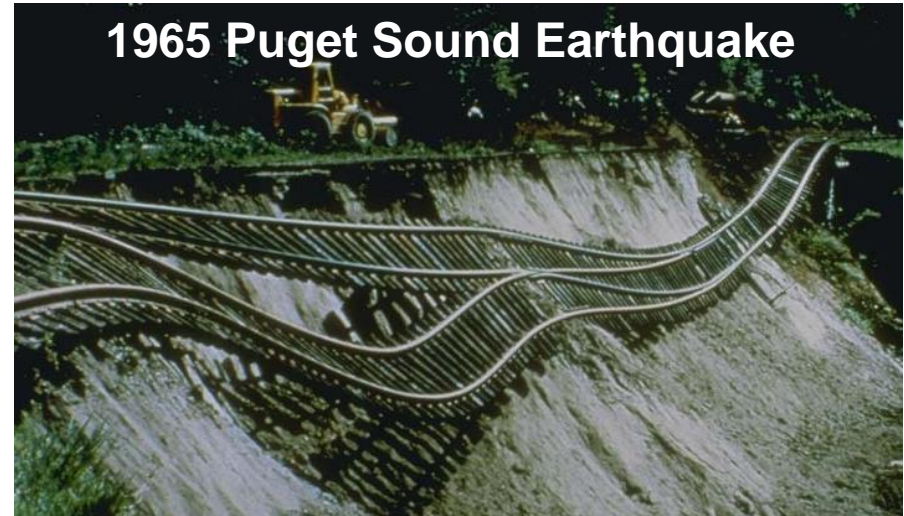
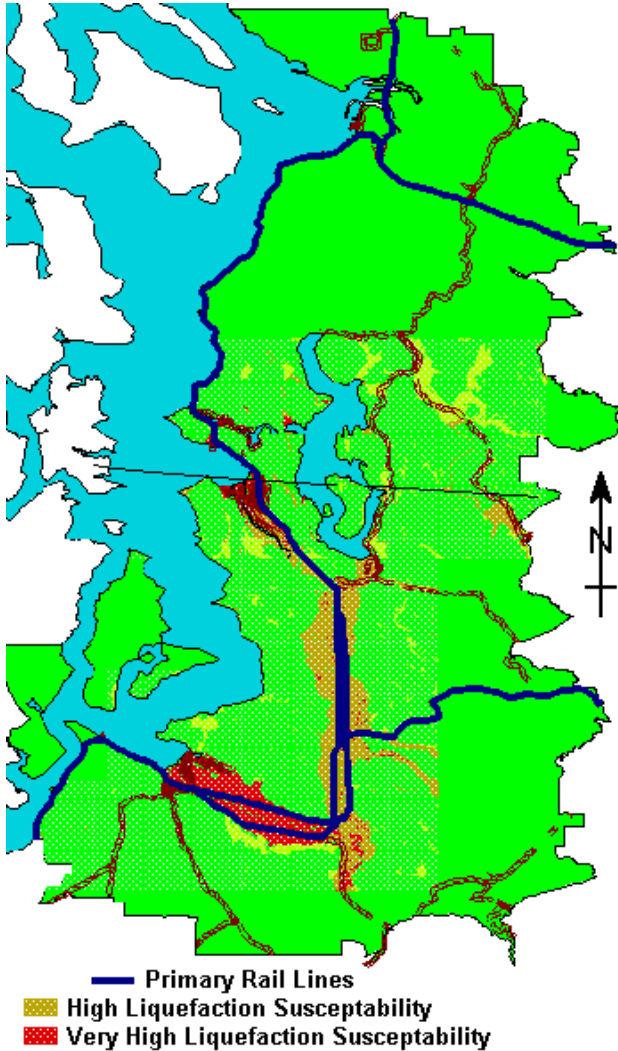
**US 101 west of Olympia, M6.7  
Nisqually Earthquake, 2001**







# Railroads



BNSF and UP handle about 200,000 tons/day, share a line south of Seattle.

Restoration of service may take much more than one week.

Loss of revenue is likely to exceed cost of repairs.



# Seaports



Port of Seattle, WA

Facilities on poor soils, fills.

Damage expected to:

- Pier, wharves, seawalls
- Containers yards
- Cranes and other structures
- Buried infrastructure

Recovery:

- Multi-billion impact on local economy.
- Full economic recovery may take years (Kobe).



Damage at Port of Kobe:  
Crane legs buckled, soils  
failed at container terminal

# Airports



- EQ closes all airports immediately.
- Possibly a month or more to restore full operations.
- SeaTac International
  - Structural and non-structural damage
- Boeing Field & Renton Airport
  - Liquefaction and runway damage
  - Older structures may collapse
- Paine Field – Everett
  - Limited damage expected

# Washington State Ferries

## Major Concerns

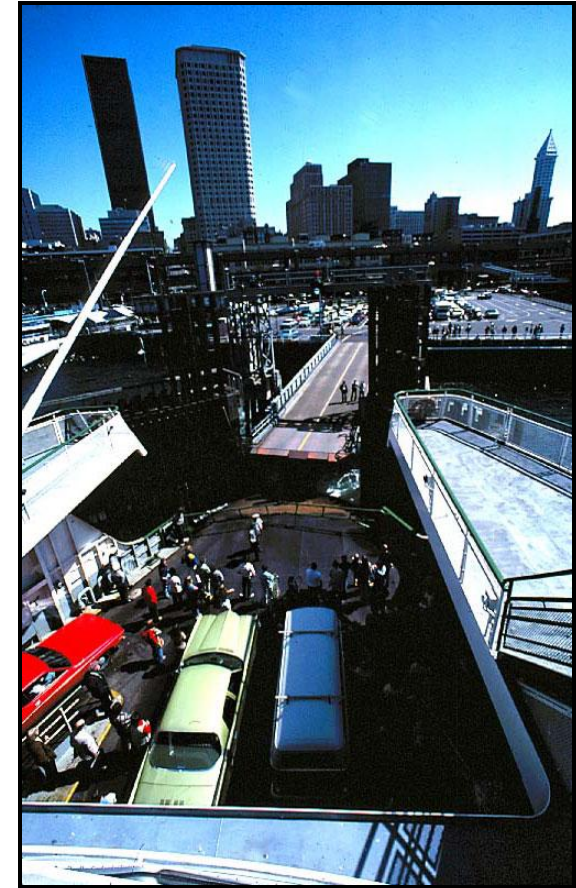
- Piers and Terminal structures vulnerable.
- Liquefaction / Lateral Spreading similar to port damage.

## Vulnerable Terminals

- Seattle/Colman Dock:  
Bremerton/Bainbridge routes
- Fauntleroy: Vashon/Southworth route

## Planning

- System has contingency plans that can be implemented post-EQ.
- Use of other ferry terminals, port facilities will increase.
- Ferries may be used as an alternative mode of transportation.

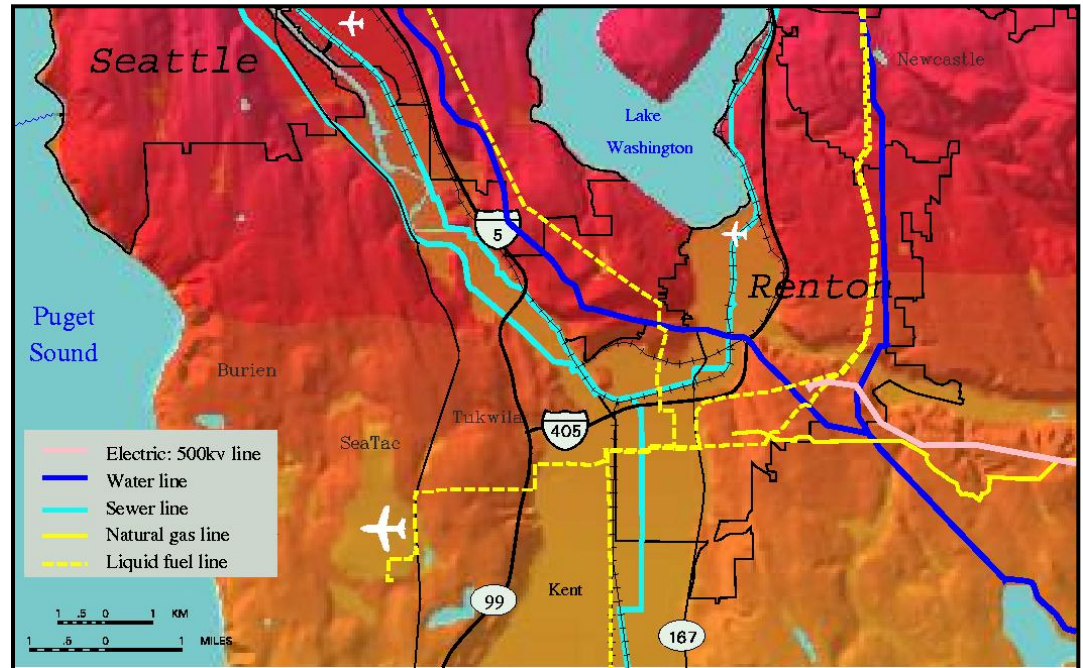


**Washington State Ferry  
approaching Colman Dock,  
Seattle**



# Lifelines

Water  
Wastewater  
Liquid Fuel  
Natural Gas  
Electric power  
Communications



Liquefaction will drive damage to underground pipelines.

Fault rupture will damage N-S trending pipelines.



# Building Performance Factors

- Type of system (tilt-up, pre-cast, shear wall)
- Primary material (steel, concrete, wood)
- Year designed/built (year and code)
- Type of soil (soft soil vs. rock)
- Layout (irregular, regular, soft-story, high-rise)
- Quality of design, construction



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# Building Damage Estimates

- Significant damage to structures on poor soils.
- 4,000+ commercial structures with extensive damage.
  - Pre 1970-vintage buildings.
  - Tilt-ups
  - Unreinforced masonry
- About 20 percent of housing stock at least moderately damaged.
  - 46,000 households displaced (est. 115,000 people)
- Long-term impact on industry and economy.



# School Damage Projections

## At least moderately damaged

- King County – 55 percent
- Snohomish County – 22 percent
- Pierce County – 17 percent

## Immediate concern

- Caring for thousands of children while parents try to reach them.

## Intermediate and long-term concerns

- Where, when to house students to continue education and allow parents to return to work.
- Potentially expanding use of online education, home schooling for some students.





# Hospital Damage Projections

**Table 6-1: Estimate of Number of Available Hospital Beds at Various Time Periods Following Event**

Time After Event	King County (4,400 Total Beds)		Pierce County (1,400 Total Beds)		Snohomish County (500 Total Beds)	
	# Beds Available	% Beds Available	# Beds Available	% Beds Available	# Beds Available	% Beds Available
1 Day	1,100	25%	1,110	79%	380	76%
3 Days	1,370	31%	1,160	83%	400	80%
7 Days	1,720	39%	1,230	88%	420	84%
30 Days	2,910	66%	1,340	96%	480	96%
90 Days	3,470	79%	1,390	99%	490	99%



# Fire Station Damage Projections

**Table 6-2: Projected Damage to Fire Stations**

<b>Peak Ground Acceleration</b>	<b>% of Stations with Reduced Functionality</b>	<b>% of Stations Not Useable</b>
Greater than 0.75g	More than 70%	20% to 30%
Between 0.45g and 0.75g	60% to 70%	10% to 20%
Between 0.30g and 0.45g	30% to 40%	Less than 10%
Between 0.15g and 0.30g	10% to 20%	Less than 5%
Less than 0.15g	Less than 10%	0%

Some stations are in unreinforced masonry buildings in areas of poor soils.

Undamaged stations may find their garage doors jammed shut by the ground shaking.



# Community Recovery Issues

- Restoring damaged transportation systems critical to recovery.
- Returning people to their homes.
- Federal (Stafford Act) disaster aid is limited.
  - Public Agencies face 25 percent match for repairs.
- Debris disposal.
- Economic revitalization:
  - Timing, funding of rebuilding, redevelopment.
  - Maintaining business viability.
  - Some businesses will fail, some will relocate.
- Restoring historic resources will be challenging.
  - Pioneer Square → poor soils
- Land-use: how best to protect and/or develop critical areas.



# Individuals – The Bottom Line

- Those with fewest social, economic resources will have greatest difficulty recovering.
- Potential recovery, rebuilding resources:
  - Personal finances.
  - Insurance proceeds (State of Washington):
    - 10-20% covered for earthquake.
    - 25-30% covered for flood.
  - Government assistance is *limited*:
    - SBA Emergency Loans (credit worthy).
    - \$28,800 FEMA grants (not credit worthy).
- Expect increased foreclosures, bankruptcies.
- Expect increased problems resulting from stress.
- Expect many will relocate outside the affected area.



# Preparing for next disaster

- SoundShake '08 earthquake exercise.
- Increasing involvement with private industry.
- Expanding outreach, communication with different cultures, in different languages.
- Establishing state-wide logistics and resource management framework.
- Updating state emergency plans to include catastrophic events.
- Developing scalable template for evacuations.
- WSDOT increasing pace of bridge retrofit program.



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# Questions?

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Scenario website

<http://seattlescenario.eeri.org/documents.php>



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