Sound Shake '08

Breakout Session 2: Seattle Fault Ground Motions and Geologic Effects

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(see last slide for contact info)

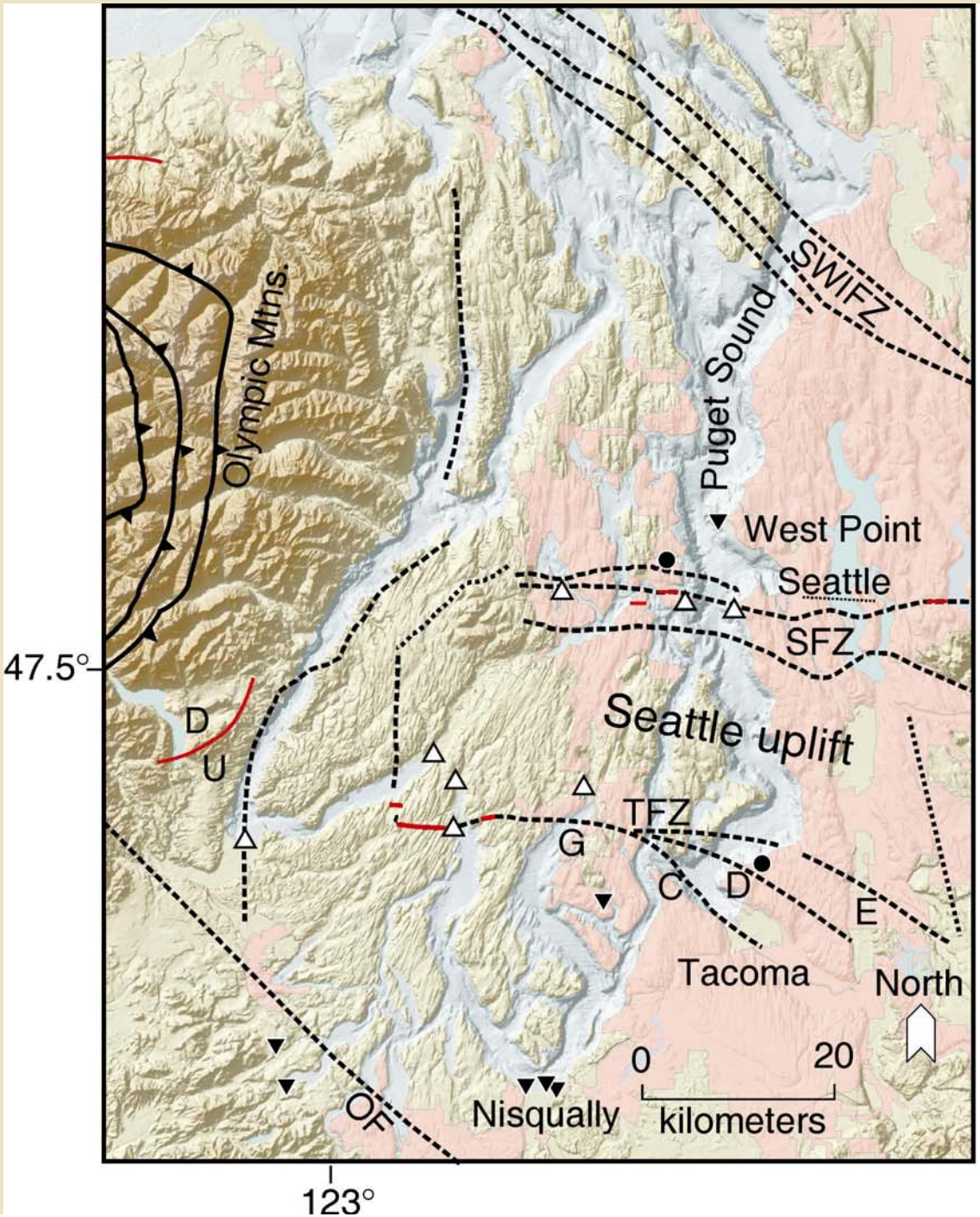
How often do earthquakes bother us?

Approximate 50 year probabilities

- Cascadia M9: 10-14%
- Seattle Fault M $\geq$ 6.5: 5% (from slip rate, GR model; 1000 yr return time) ???
- Deep M $\geq$ 6.5: 84% (from 1949, 1965, 2001)
- Random shallow M $\geq$ 6.5 in entire Puget Sound area: 15% (mostly from rate of M $\geq$ 4 since 1963, b=0.8) ???

Probabilities from Art Frankel

USGS
science for a changing world

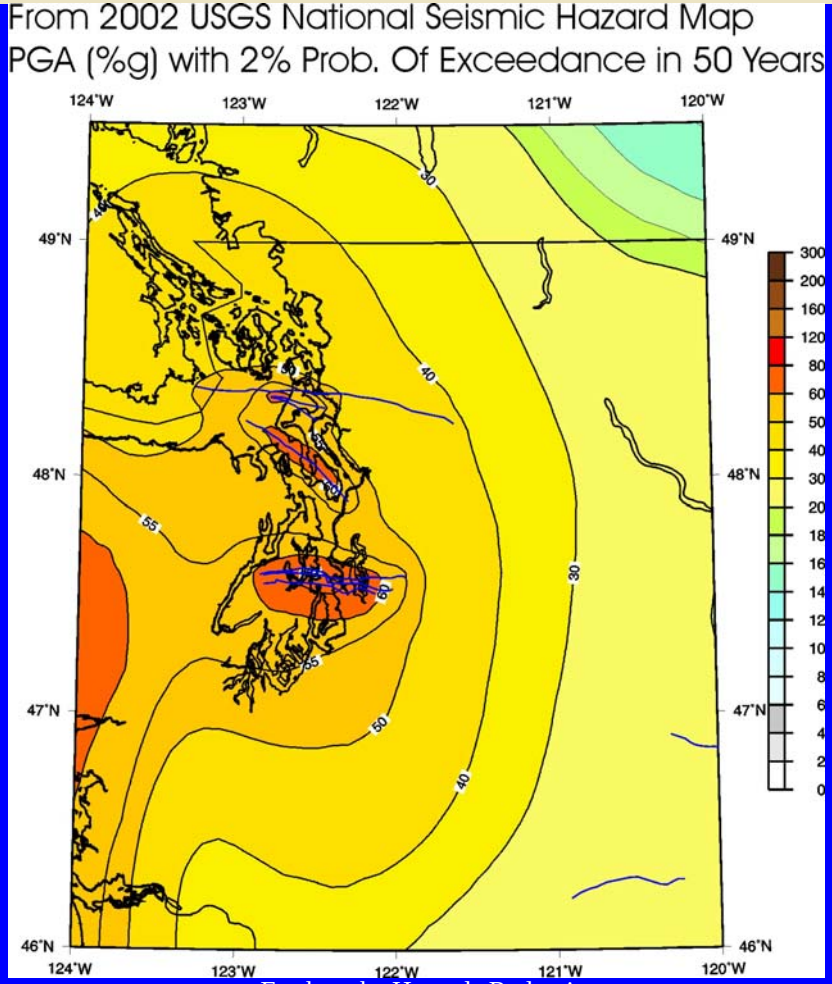


The Seattle fault zone is one of a series of major faults that cut across the Puget Sound basin

- △ Uplifted site
- ▼ Subsided site
- ● Site with no change
- Thrust fault, barb on upthrown block
- Geophysical anomaly
- Holocene scarp
- Urban areas

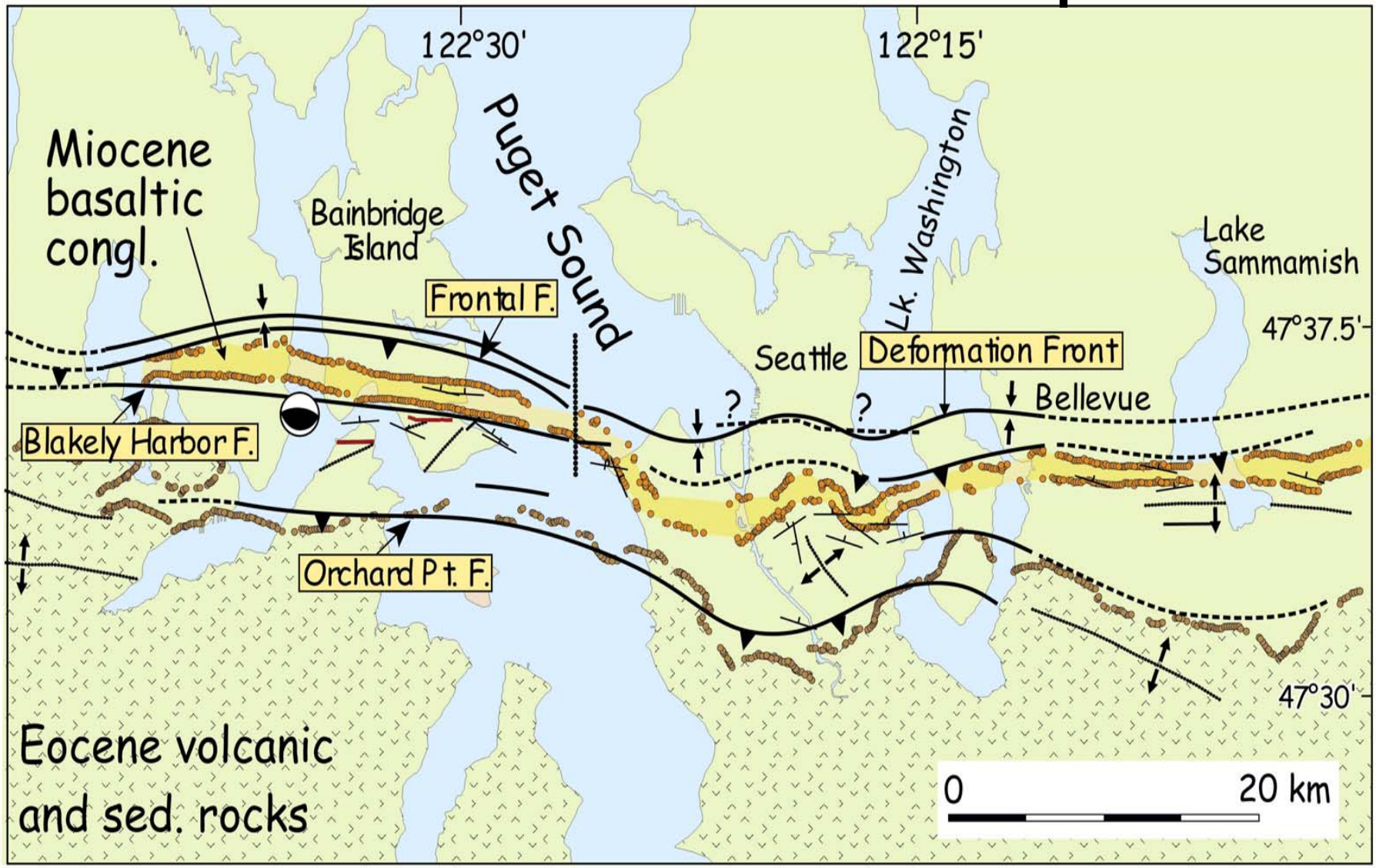
The Seattle fault uplifted the beach on Bainbridge Island 7 meters 1100 years ago

Seattle fault prominent in hazard maps



Earthquake Hazards Reduction Program

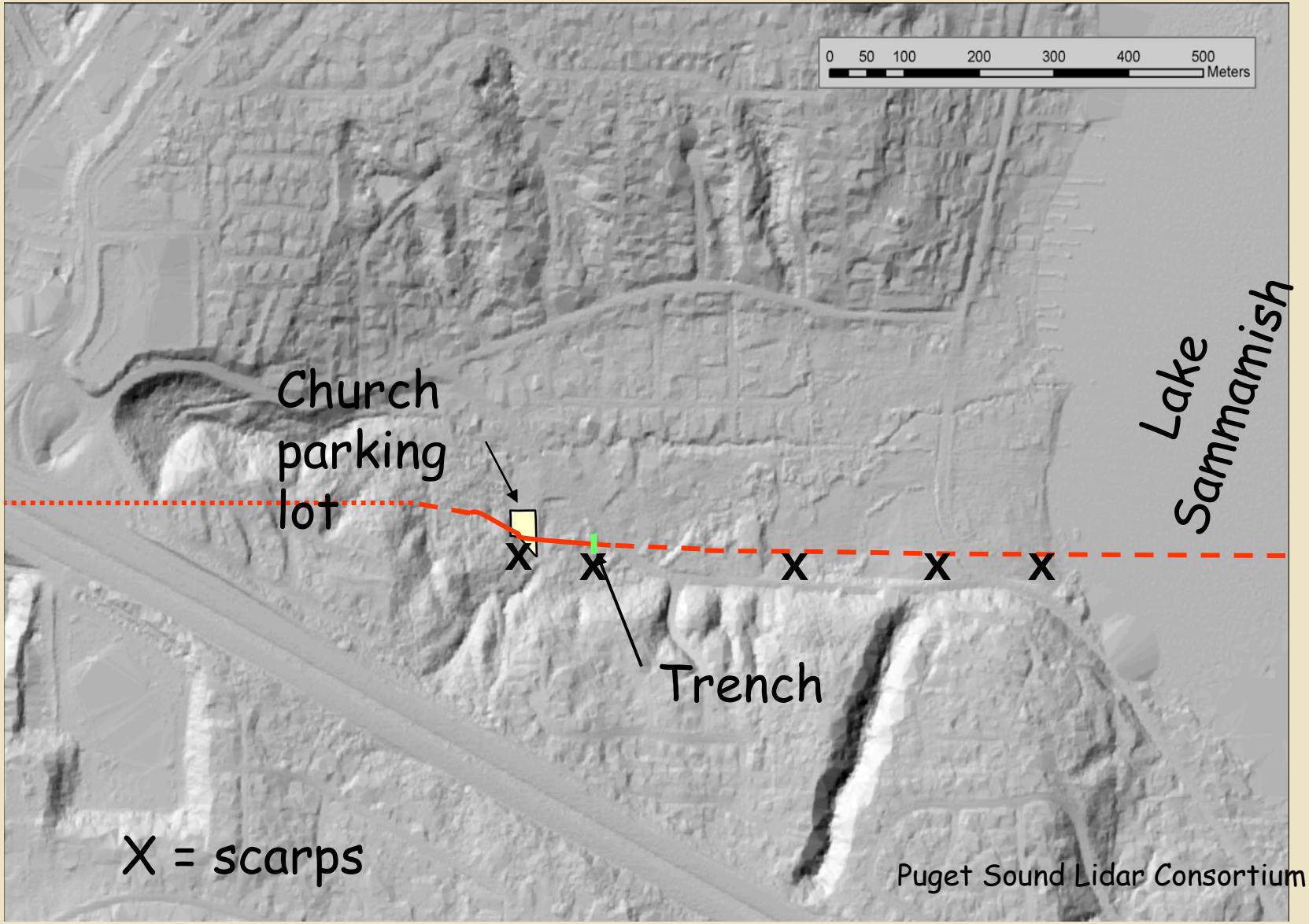
In detail—Seattle fault is complex



Interpreted Aeromagnetic Map of the Seattle Fault Zone

Epicenter, M 4.9 Bainbridge Island earthquake

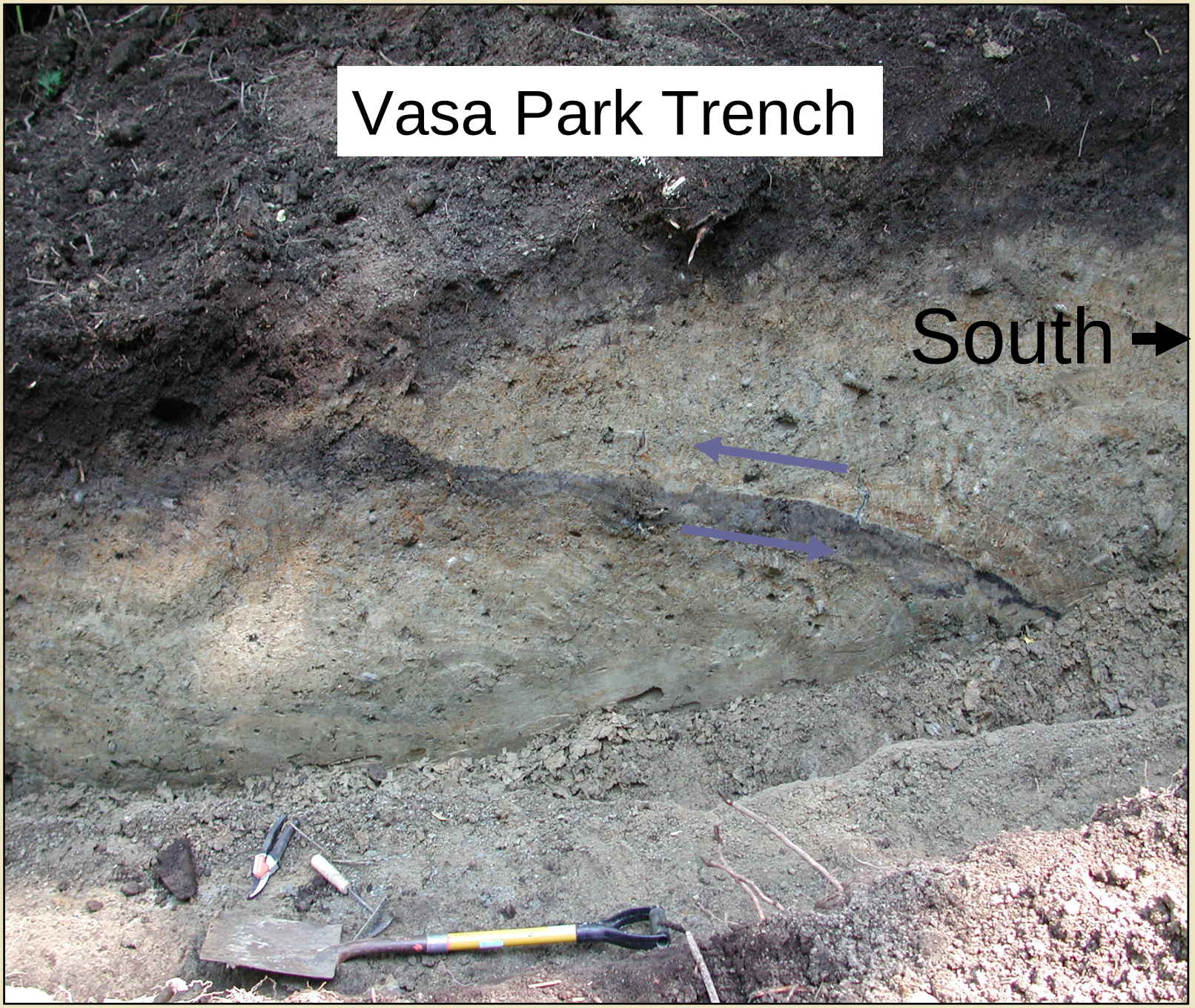
Surface faulting found in Bellevue



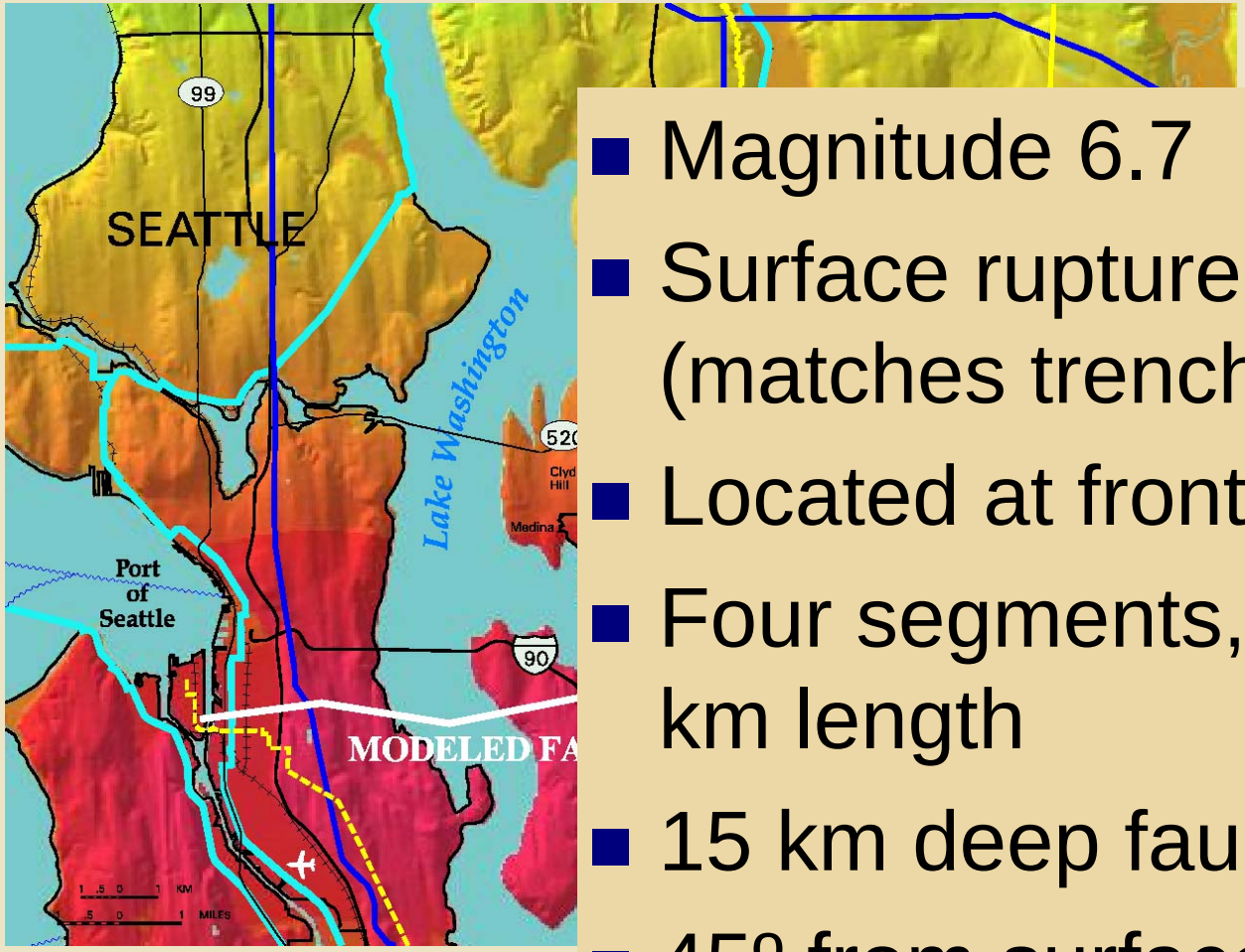
USGS
Church Parking Lot
Bedrock
Sediments
2000 8 26 18:31

Before the Vasa Park Trench

Why we need lidar!!

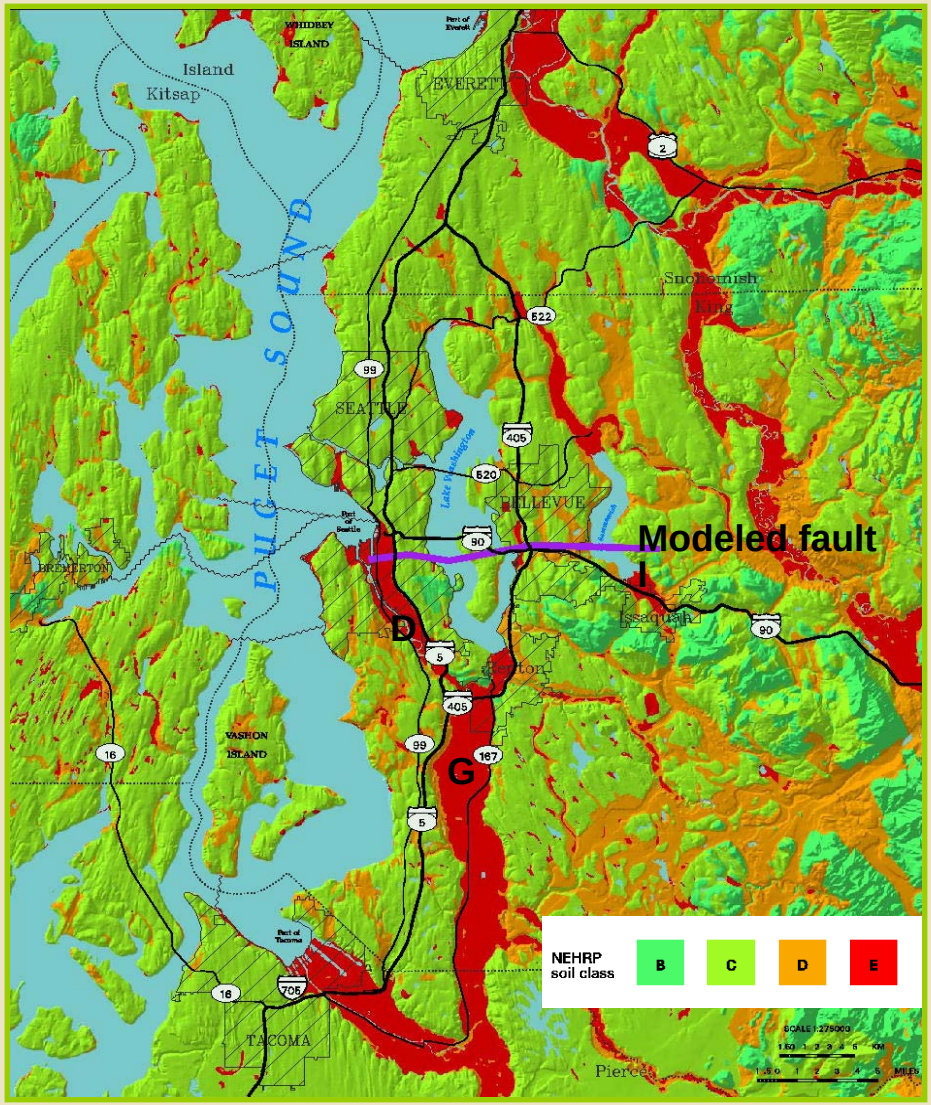

Vasa Park Trench
South

Modeled fault cuts major infrastructure, highly developed areas

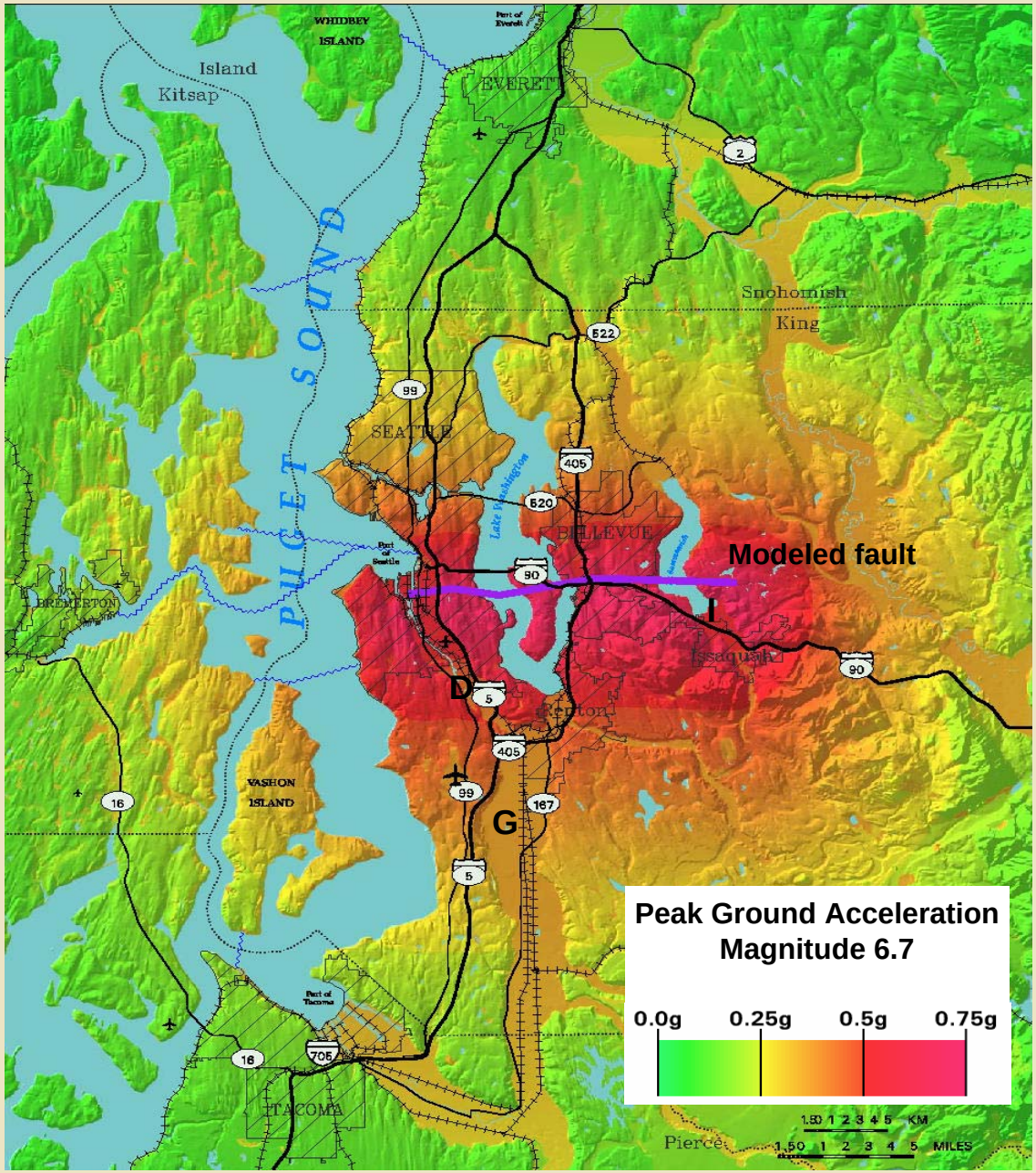


- Magnitude 6.7
- Surface rupture = 2 meters (matches trench)
- Located at frontal fault
- Four segments, about 22 km length
- 15 km deep fault
- 45º from surface
- Breaks from depth up

Local site conditions are important

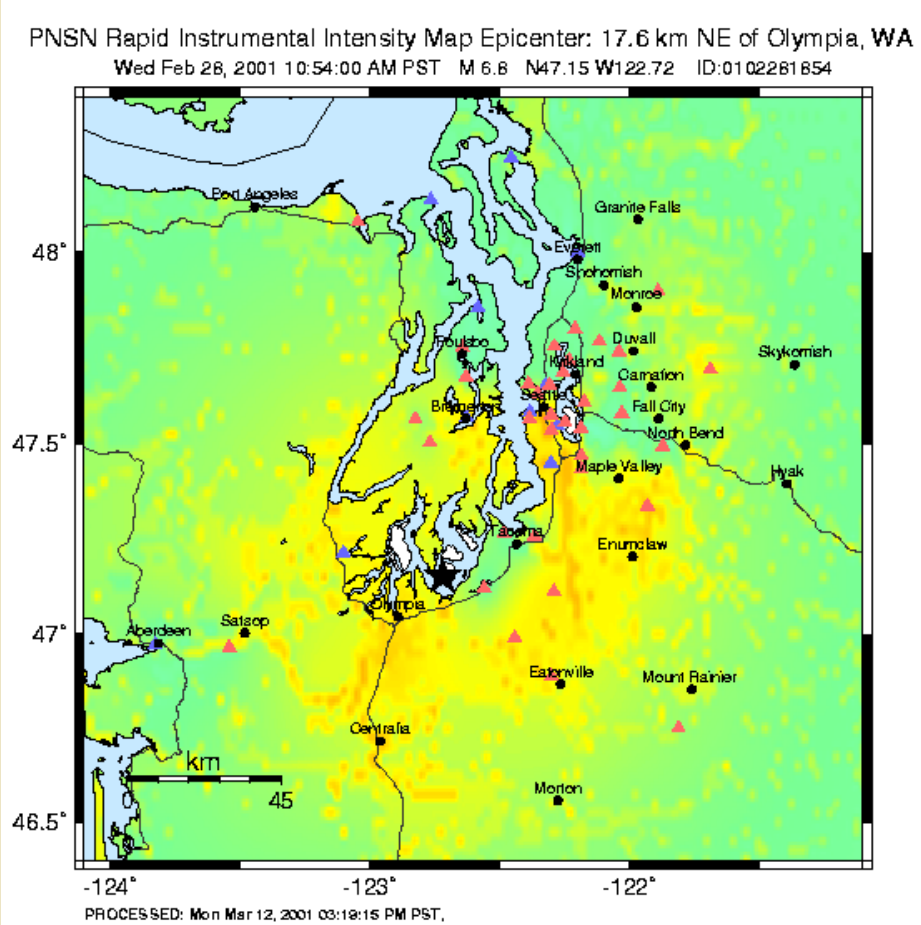


E soils are expected to cause problems



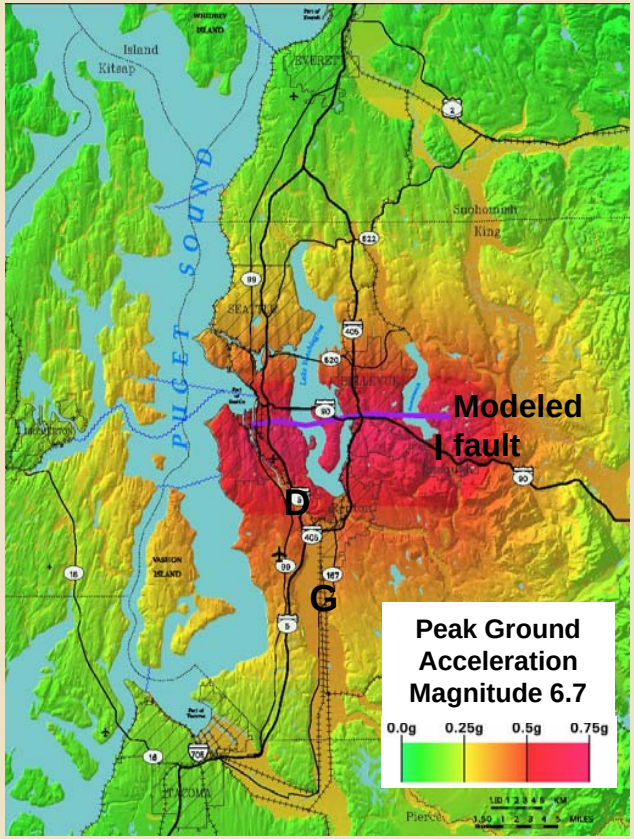
The scenario earthquake produces very strong ground motions. The highest ground shaking in the Nisqually earthquake was about 0.3 g.

Ground Motions Comparison



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+

Nisqually



Scenario

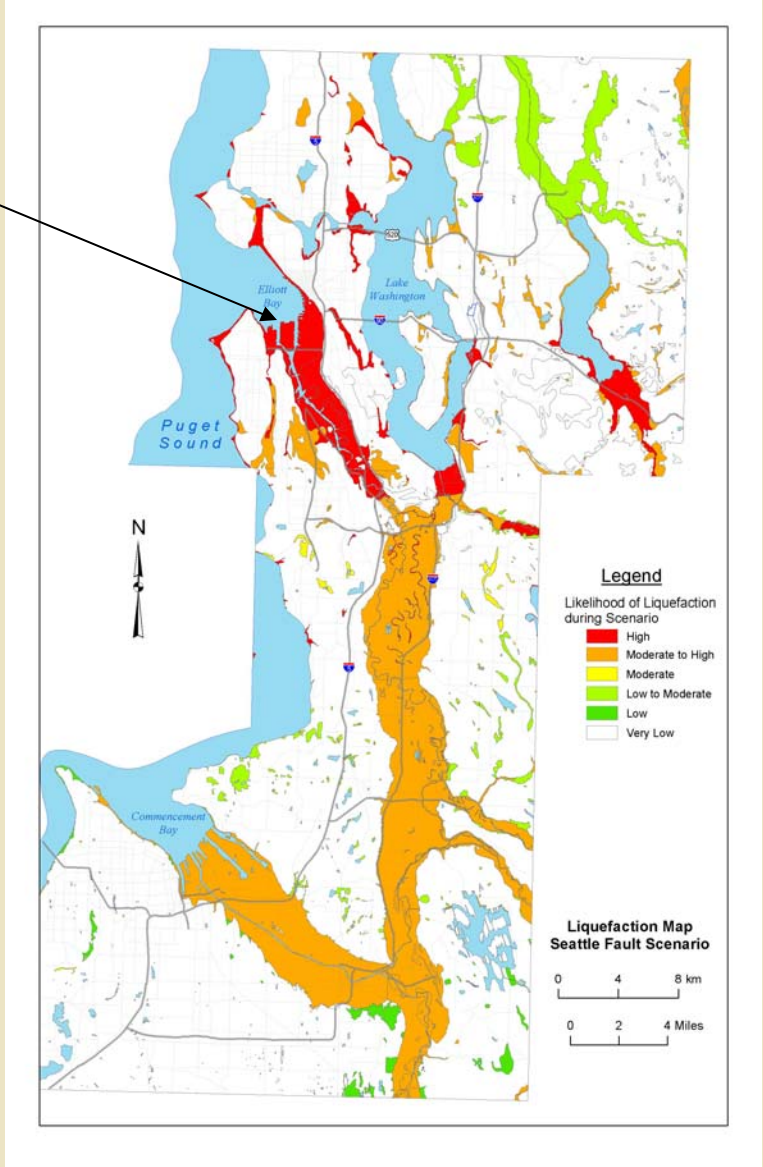
Liquefaction is expected over wide areas

3 events in 56 years

Liquefaction

Much of industrial area is artificial fill

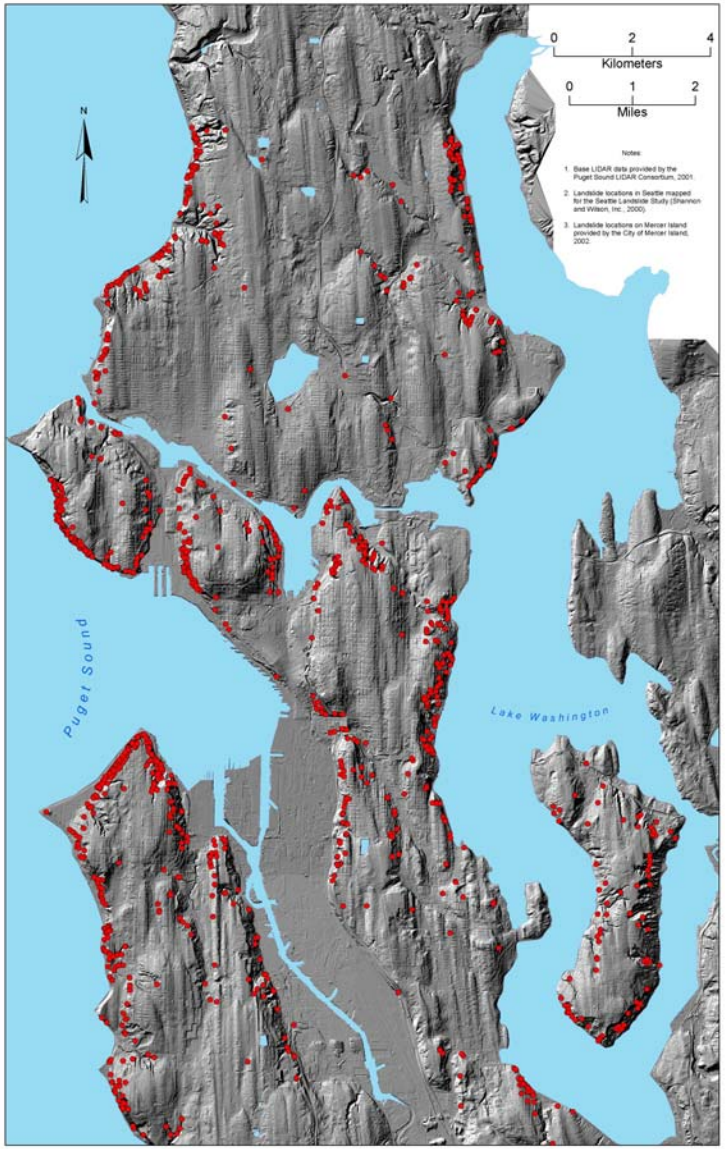
Groundwater flooding & stream reversal is possible



Landsliding

2001 M6.8 Nisqually Earthquake

Seattle's shorelines are expected to have major landslides at locations similar to the long-term record (100+ years)



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