Tsunami Threats to Water & Wastewater Utilities in Pacific Northwest

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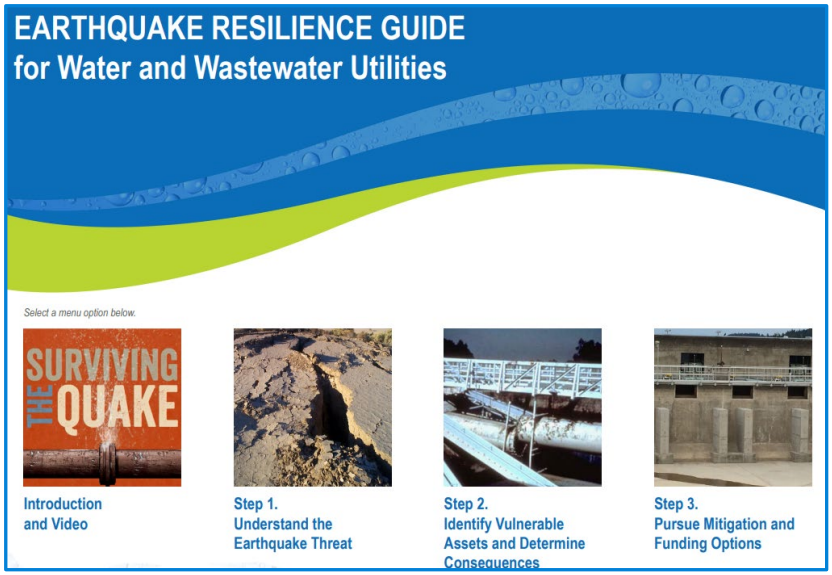
Agenda

1) EPA Background
2) Earthquakes and Tsunamis
3) Coastal Tsunami Threats in OR/WA/CA
4) Inland Tsunami Threats in WA
5) Mitigation

1. EPA Background

- Water Infrastructure and Cyber Resilience Division
  - *Mission*: Help water/wastewater utilities prepare, respond, recover from disasters (natural, terrorism)
  - *Policy*: Outline Fed/State/Local roles, hazard mitigation, codes/standards
  - *Voluntary*: Provide guides, trainings, funding, outreach
  - *Regulatory*: Comply America's Water Infrastructure Act
    - ✓ requiring risk assessment and emergency response plan
  - *Funding:* EPA State Revolving Funds, USDA Rural Water, FEMA BRIC Program

2. Earthquakes and Water Sector



Guide

Video

Interactive Maps

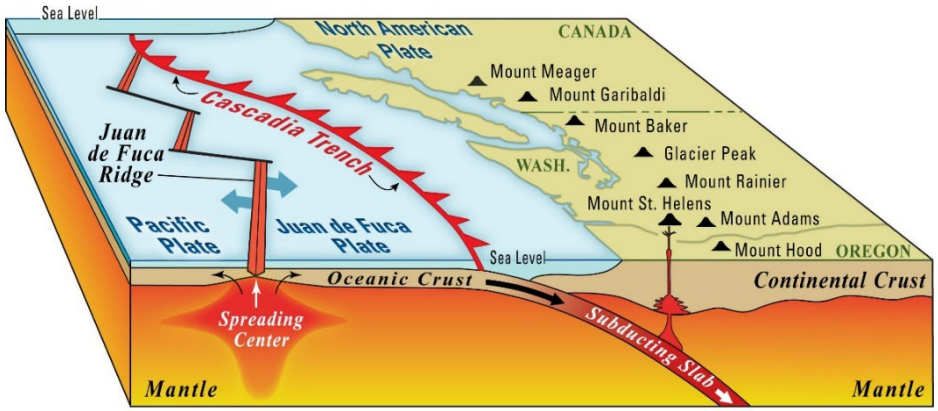
https://www.epa.gov/waterutilityresponse/build-earthquake-resilience-your-water-or-wastewater-utility

2. Tsunamis and Water Sector

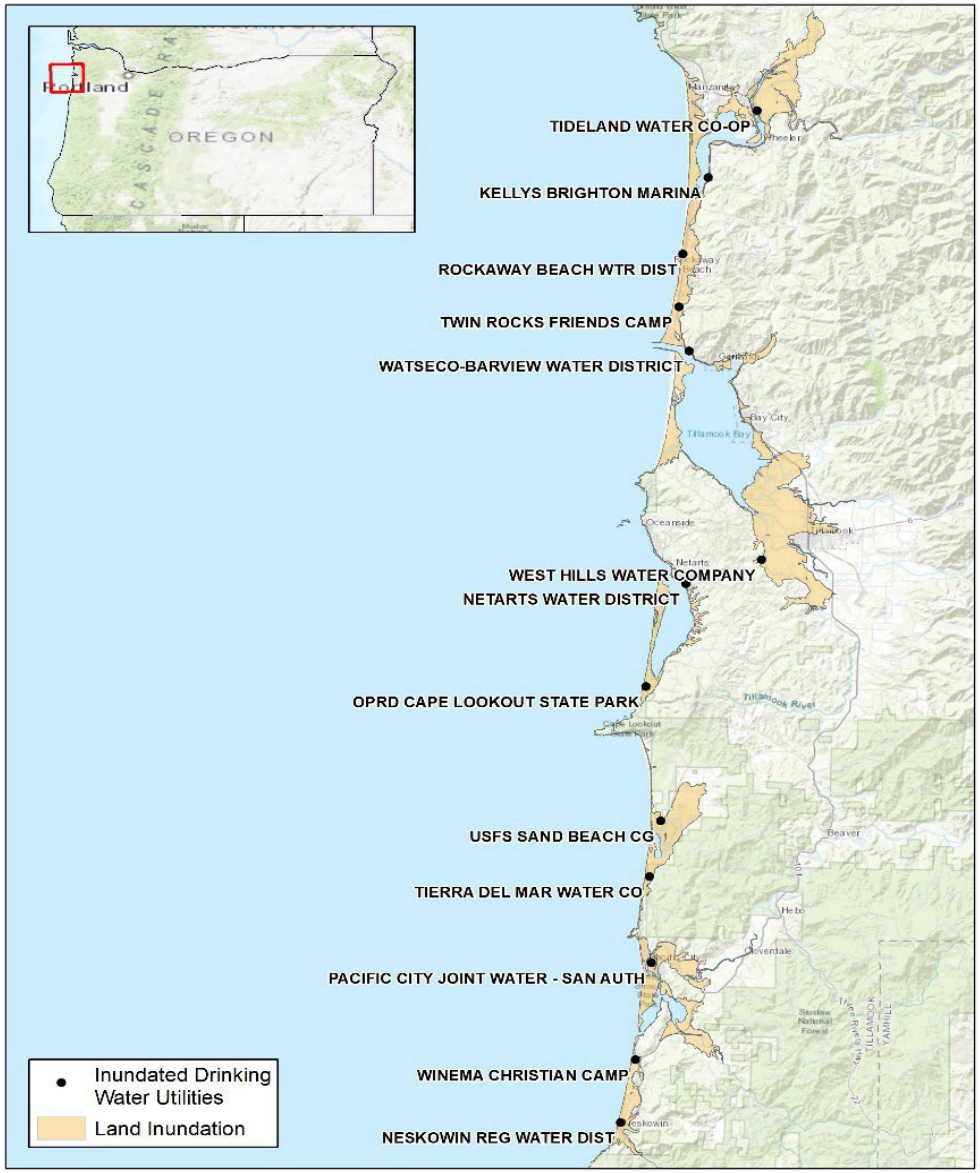
2. Coastal Tsunamis

Cascadia Subduction Zone

- 9.0 M earthquake & subsequent tsunami 10 to 17% within next 50 years
- Projected 40-100 foot waves
- Inundation of 5-10km
- Estimated 10,000+ fatalities



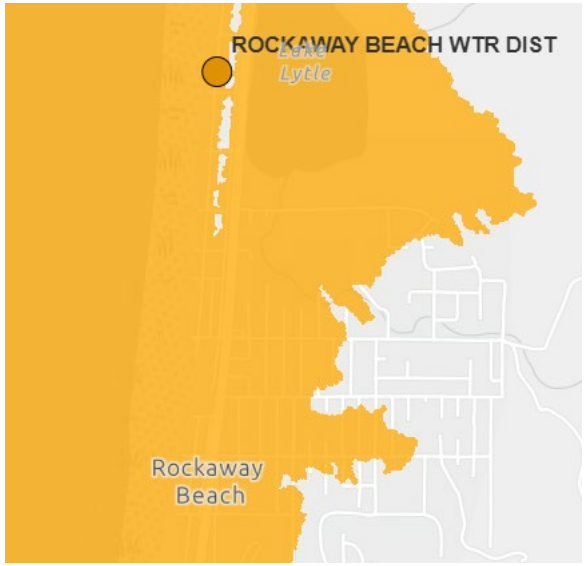
Threat Analysis: Oregon



Population and Number of Drinking Water Utilities in Oregon Impacted by M 9.0 Triggered Tsunami

Utility Population Served	# of Inundated Utilities in M 9.0 Scenario	Predicted Population Impacted
<= 500	33	3,123
>500 to 3,300	12	20,080
>3,300 to 10,000	3	20,968
Total	48	44,171

Small, Medium, Large Inundation Scenarios in Rockaway Beach



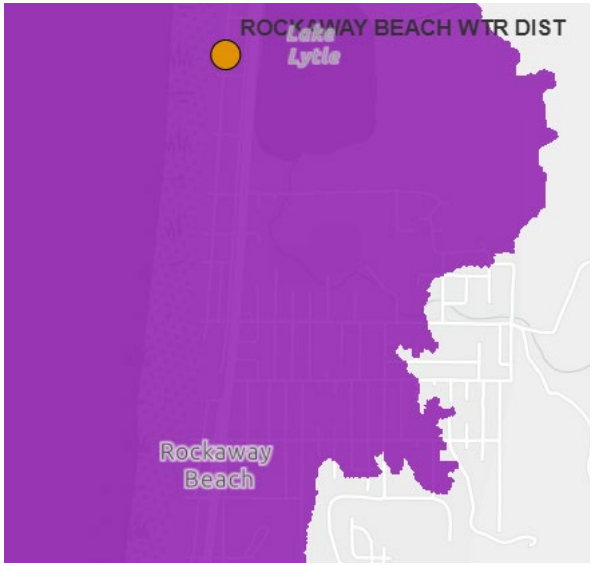
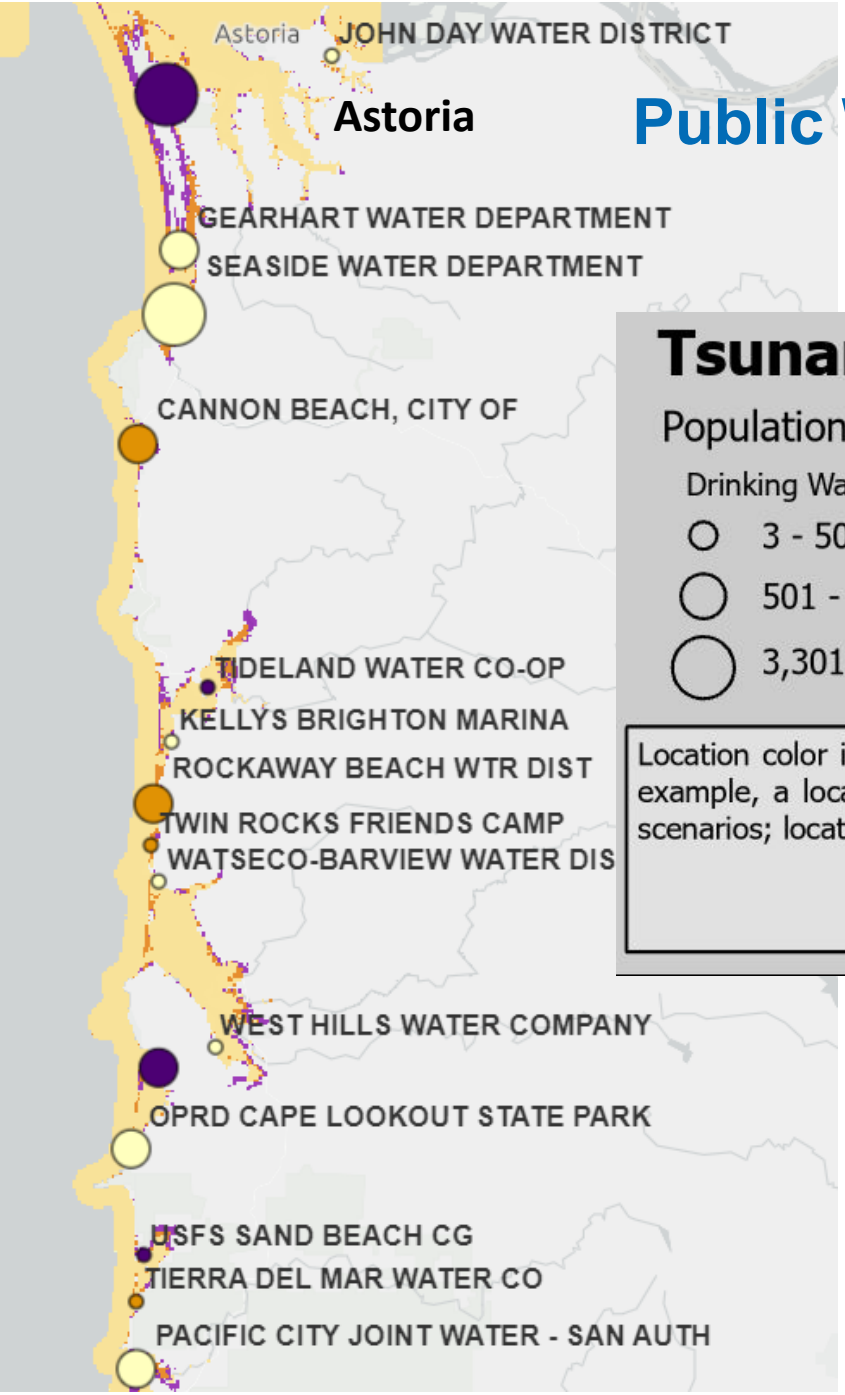


Table 1. Estimated earthquake parameters for tsunami source scenarios used in Oregon tsunami inundation maps (TIM series).

Rupture Scenario (Witter and others, 2011)	Tsunami Inundation Map (TIM Series) Scenario	Length (km)	Width (km)[a]	Slip Deficit Time (years)	Maximum Slip (m)[b]	Average Slip (m)[c]	Moment Magnitude (M_w)[d]
L1	L	1,000	83	650–800	27	13	9.0
M1	M	1,000	83	425–525	18	9	8.9
Sm1	S	1,000	83	300	10	5	8.7

Public Water Systems Affected: Northern Oregon



Tsunami Inundation Scenario Data

Population Served

Drinking Water
- 3 - 500
- 501 - 3,300
- 3,301 - 9,100

Wastewater (MGD)
- 0.0 - 0.9
- 1.0 - 5.0

Inundation Scenarios
- Small
- Medium
- Large

Location color is symbolized by identifying smallest intersecting inundation scenario. For example, a location symbolized as small, is inundated in S, M, & L tsunami inundation scenarios; locations symbolized as large, are only within L scenarios.

Small Medium Large

Public Water Systems
Southern Oregon

Tsunami Inundation Scenario Data

Population Served

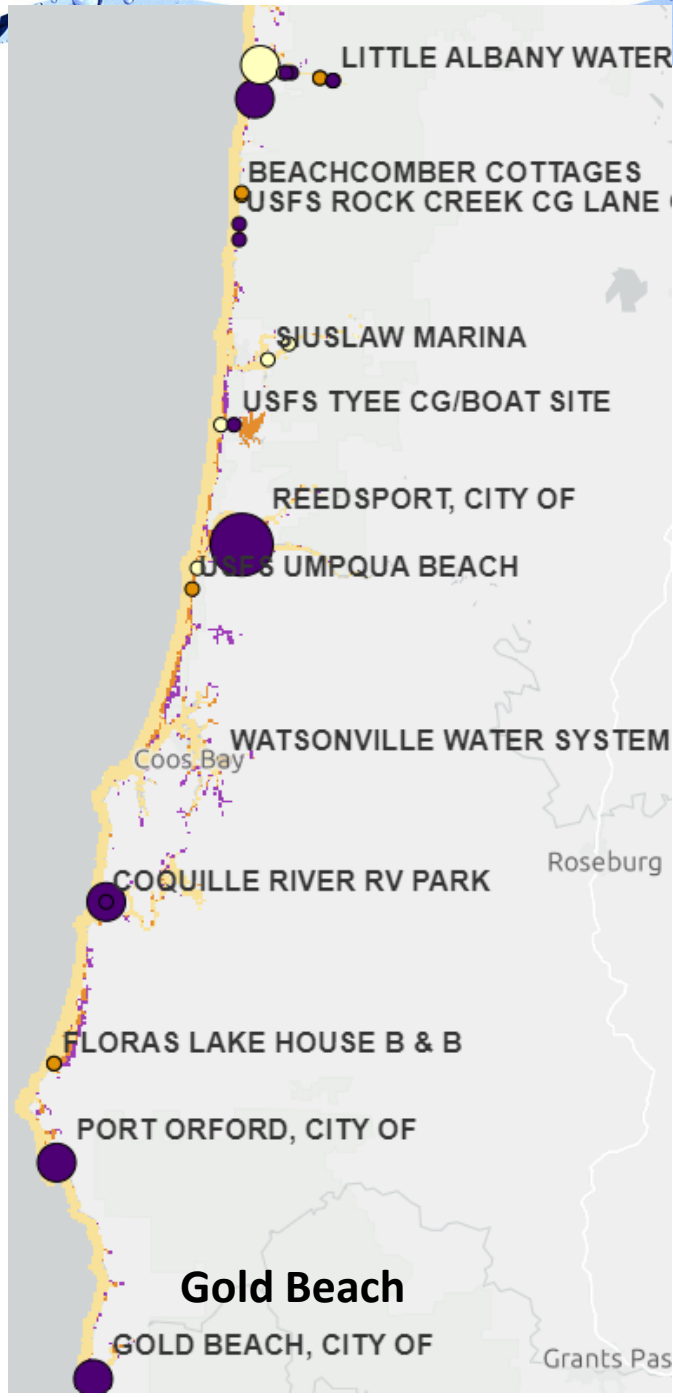
Drinking Water
- 3 - 500
- 501 - 3,300
- 3,301 - 9,100

Wastewater (MGD)
- 0.0 - 0.9
- 1.0 - 5.0

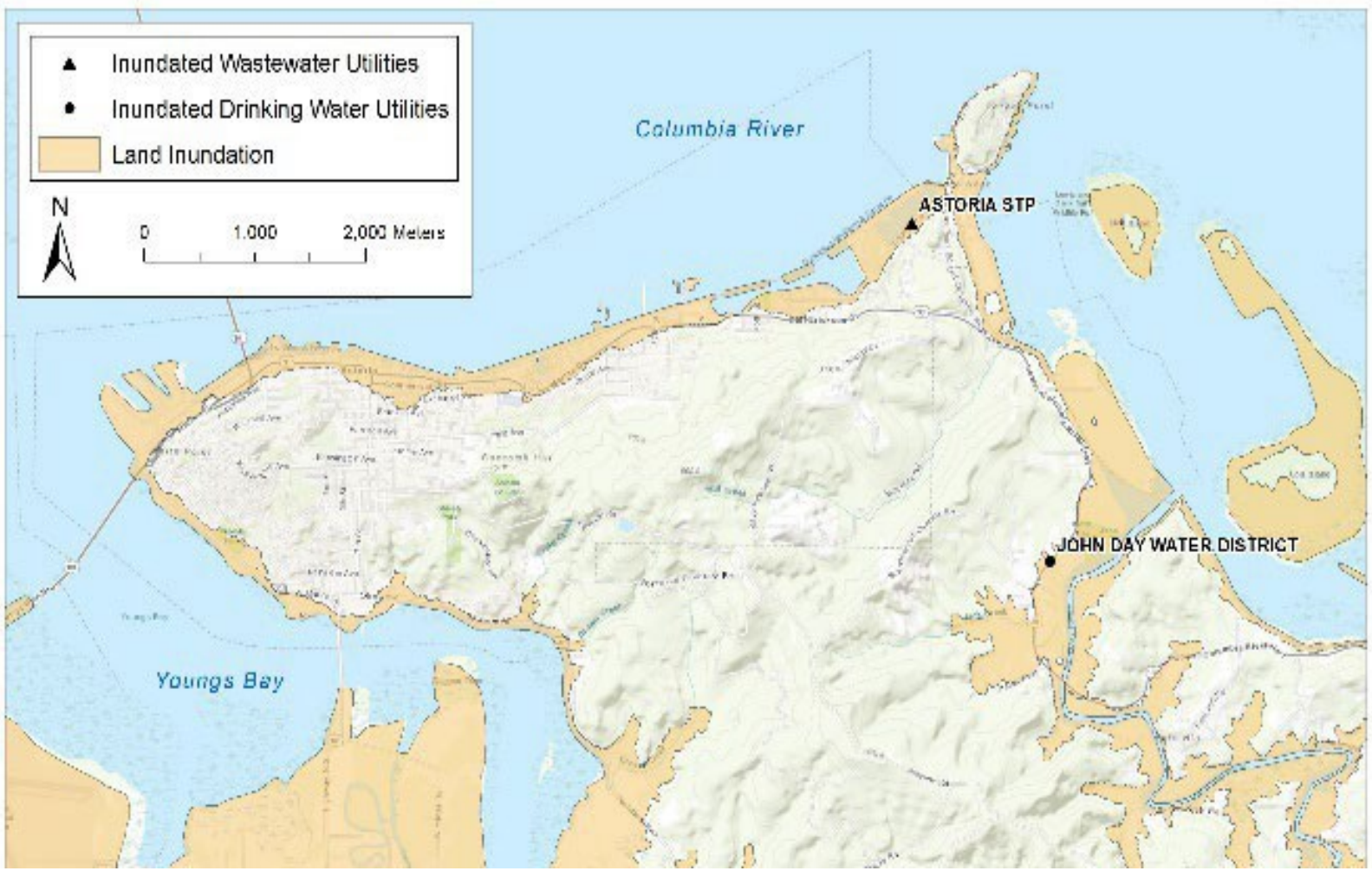
Inundation Scenarios
- Small
- Medium
- Large

Location color is symbolized by identifying smallest intersecting inundation scenario. For example, a location symbolized as small, is inundated in S, M, & L tsunami inundation scenarios; locations symbolized as large, are only within L scenarios.

Small Medium Large



Tsunamis affect bays and inlets – Case of Astoria



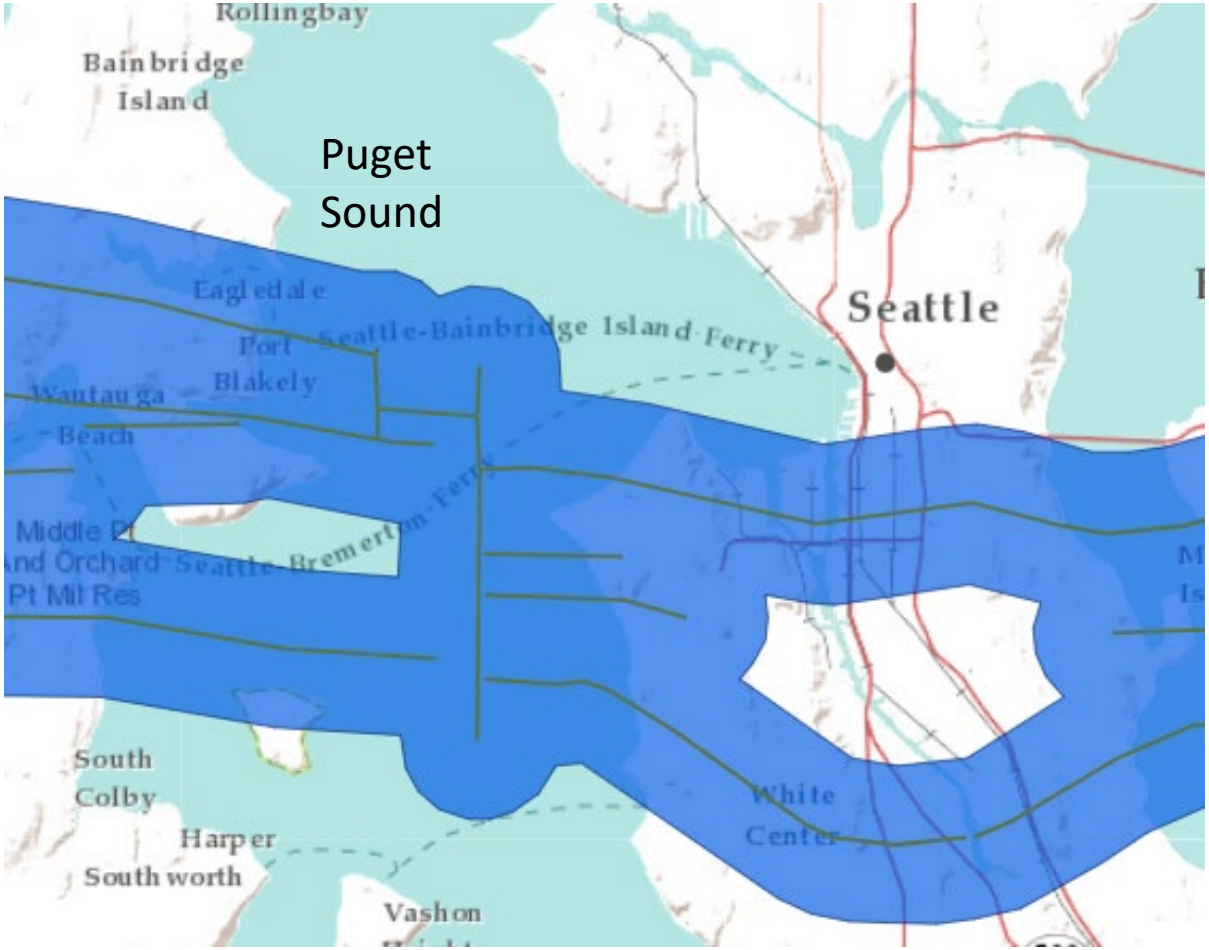
Washington and California in M9 Earthquake

- Along Washington Coast,
  - 62 drinking water utilities serving 45,495 residents affected (similar to Oregon)
- In northern California,
  - six wastewater treatment plants, ranging 0.1 to 15 mgd in tsunami zone

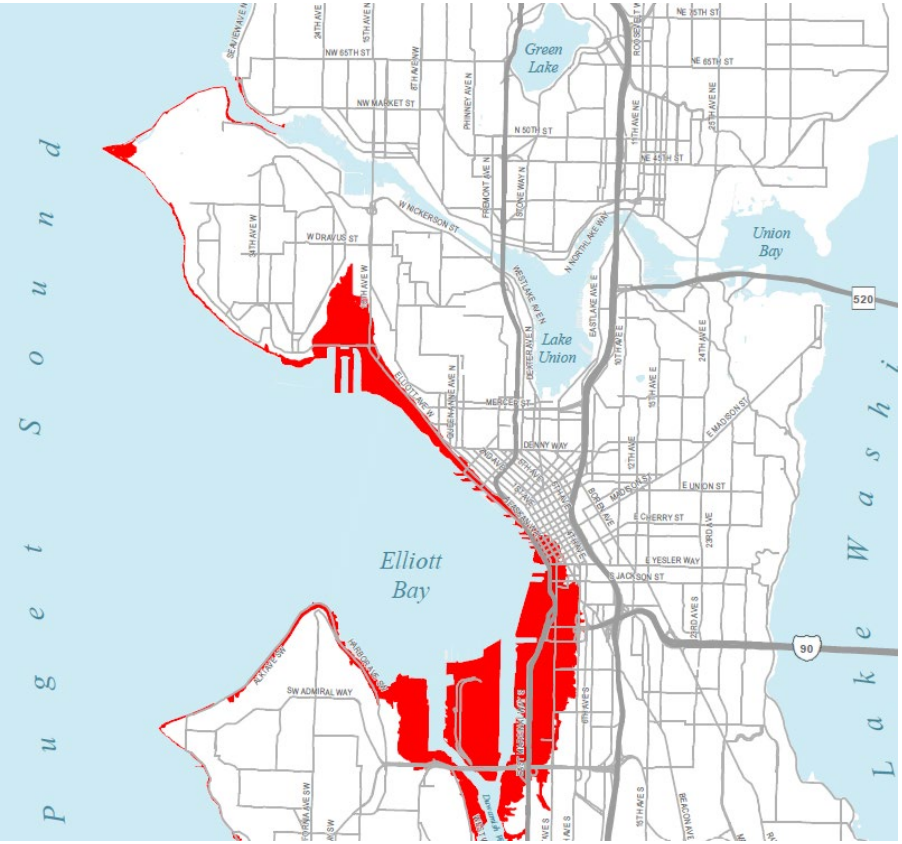
3) Inland Tsunami Threats in WA

Earthquake faults across body of water

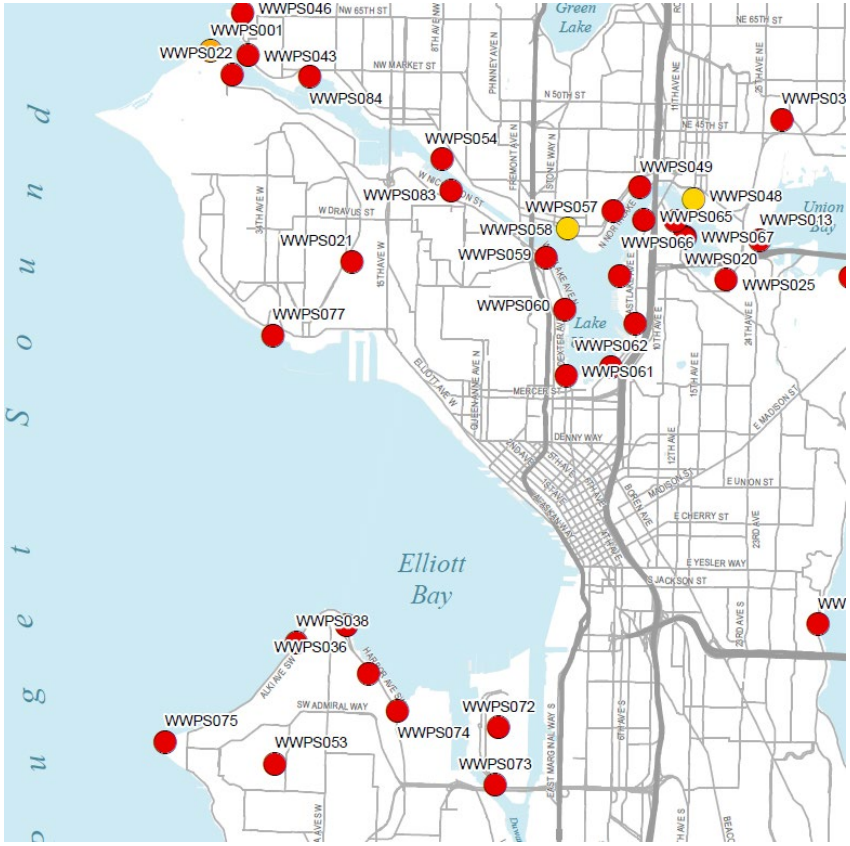
Seattle Tsunami Threat



Seattle Public Utilities (SPU) Seismic Analysis

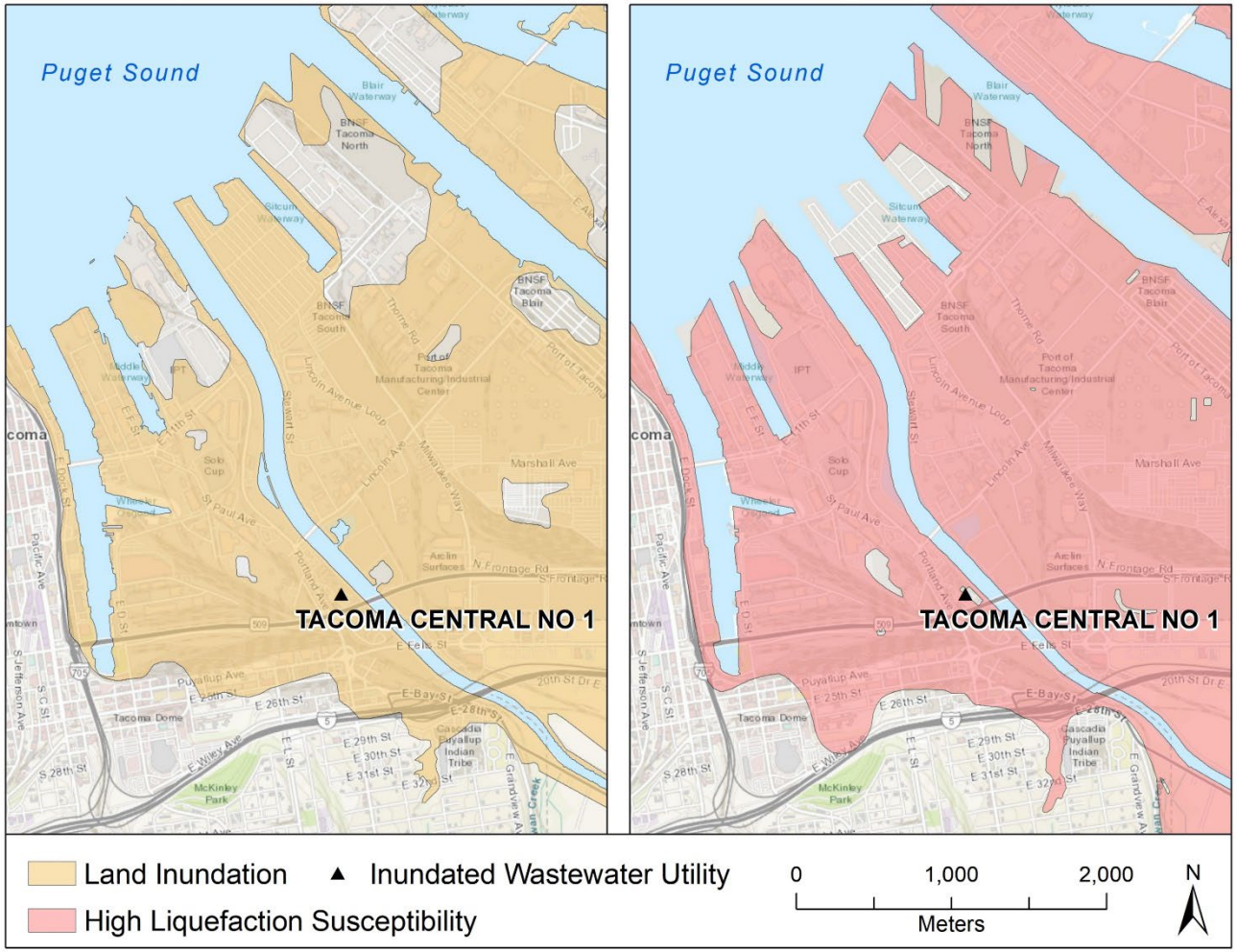


Tsunami Inundation

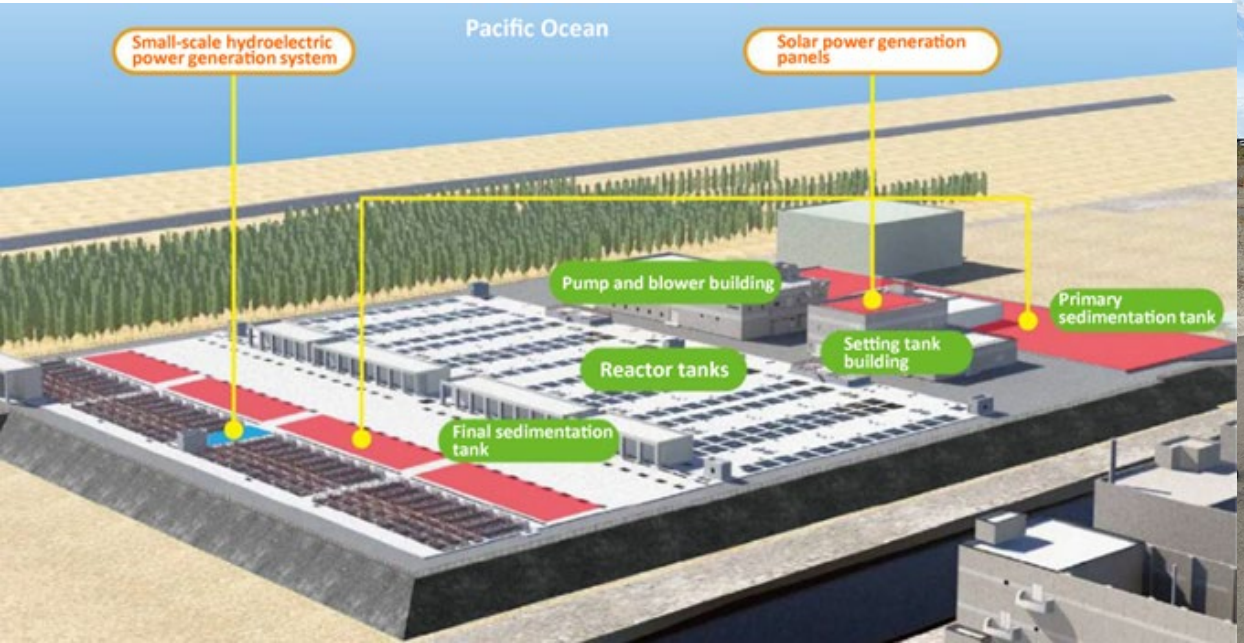


Pumps receiving high failure scores from tsunami, shaking, liquefaction, etc

City of Tacoma WWTP: Central No 1 Facility
Tsunami Inundation and Liquefaction



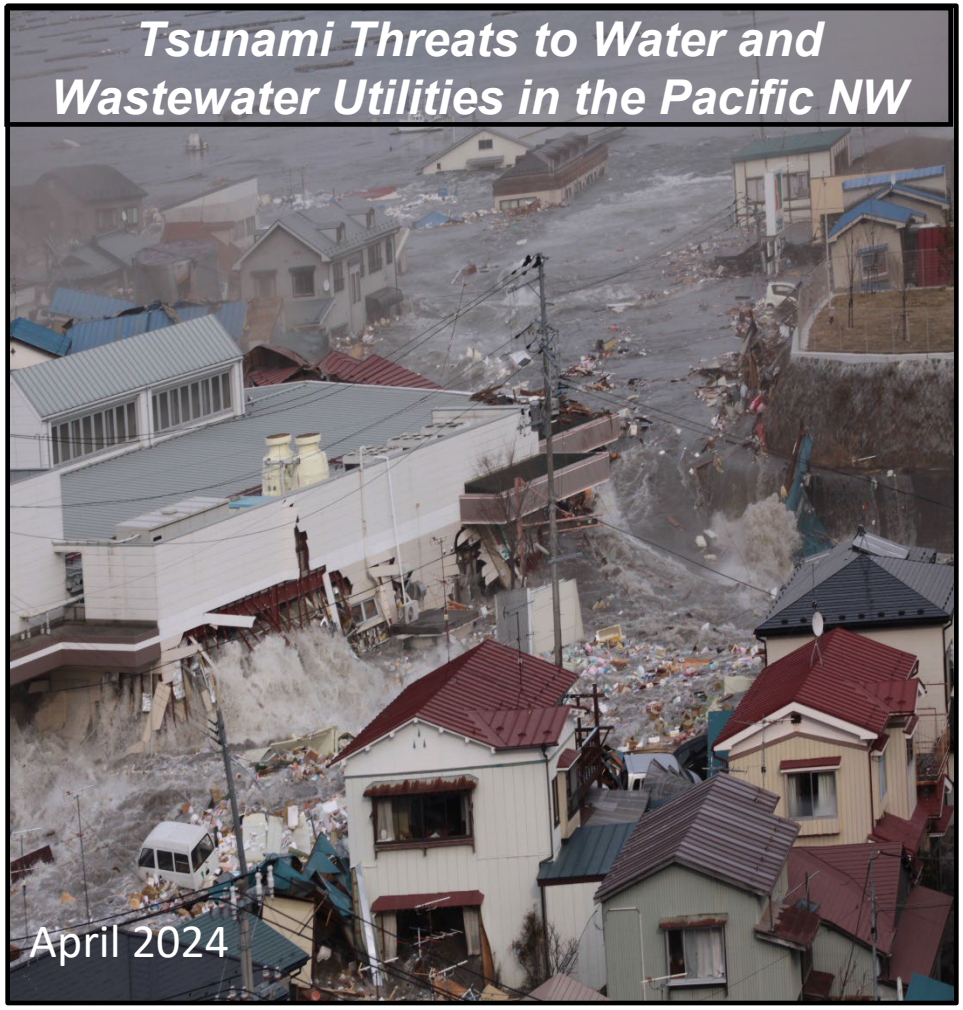
4. Tsunami Mitigation



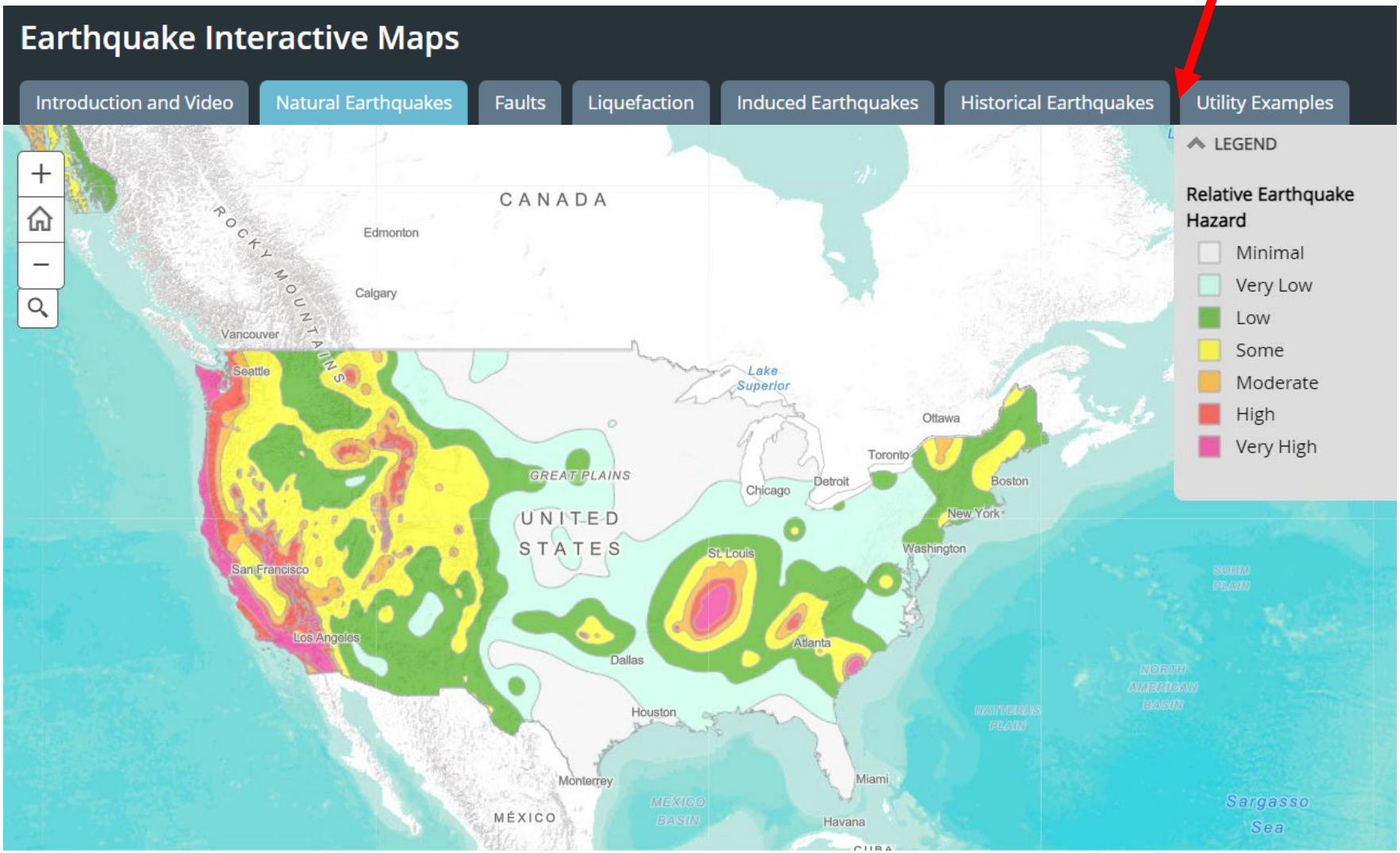
4. Tsunami Mitigation – U.S.

- Water and wastewater utilities assess site-specific tsunami threats
  - Hawaii/Alaska: coastal tsunamis
  - Salt Lake City/Tahoe: inland tsunamis
- Vertical evacuation towers (Shoalwater Tribe, WA)
- Elevating plant and installing concrete barrier designs (Japan)
- *Designing for Tsunamis* guide (NOAA)
- Early warning tsunamis & earthquakes
- EPA's Earthquake Resilience Products (video, guide, and interactive maps)

Opflow Article:



Tsunami


Earthquake Interactive Maps
Introduction and Video
Natural Earthquakes
Faults
Liquefaction
Induced Earthquakes
Historical Earthquakes
Utility Examples
LEGEND
Relative Earthquake Hazard
Minimal
Very Low
Low
Some
Moderate
High
Very High
CANADA
Edmonton
Calgary
Vancouver
Seattle
ROCKY MOUNTAINS
Lake Superior
Ottawa
Toronto
Boston
Chicago
Detroit
GREAT PLAINS
UNITED STATES
New York
Washington
St. Louis
San Francisco
Los Angeles
Dallas
Atlanta
Houston
Monterrey
Miami
MÉXICO
MEXICO BASIN
Havana
Sargasso Sea
NORTH AMERICAN BASIN
HATTERAS PLAIN

Questions/Comments

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