State & National Tsunami Hazard Mitigation Programs... **Increasing our Nation’s Overall Resilience to Tsunamis**

**From Education**  
John D. Schelling  
Washington Emergency Management

**To Application**
Why Vertical Evacuation? & Why Now?
Because **TODAY**, our Estimated Population at Risk in Cascadia-related Tsunami Hazard Zones is...

<table>
<thead>
<tr>
<th>Population Counts</th>
<th>Washington</th>
<th>Oregon</th>
<th>Northern California</th>
<th>Regional Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Residents</td>
<td>44,710</td>
<td>22,201</td>
<td>10,344</td>
<td>77,255</td>
</tr>
<tr>
<td>Number of Employees</td>
<td>17,021</td>
<td>14,857</td>
<td>9,389</td>
<td>41,267</td>
</tr>
<tr>
<td>Average Daily State Park Visitors</td>
<td>17,029</td>
<td>53,714</td>
<td>2,889</td>
<td>73,632</td>
</tr>
<tr>
<td>Totals</td>
<td>78,760</td>
<td>90,772</td>
<td>22,622</td>
<td>192,154</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Number of Visitor Facilities</th>
<th>Washington</th>
<th>Oregon</th>
<th>Northern California</th>
<th>Regional Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Public Venues</td>
<td>135</td>
<td>60</td>
<td>67</td>
<td>262</td>
</tr>
<tr>
<td>Number of Dependent-care Facilities</td>
<td>149</td>
<td>43</td>
<td>32</td>
<td>224</td>
</tr>
<tr>
<td>Totals</td>
<td>284</td>
<td>103</td>
<td>99</td>
<td>486</td>
</tr>
</tbody>
</table>

* Assuming there are 100 people at a public venue and 50 people at a dependent-care facility, then there are approximately another 37,400 people in tsunami-prone areas.

** Numbers compiled from various USGS reports on community exposure to tsunamis (Oregon is based on 2000 data; Washington and California are based on 2010 data)

N. Wood, 2012
Because we know it is only a matter of time...

- **DISTANT Tsunamis:**
  - Events with 2+ hours arrival time from around Pacific Rim
  - Time & capability to issue ‘official’ warnings
  - Much smaller than local tsunamis
  - NOAA Tsunami Warning Centers (TWCs), Dart Buoys provide useful data

- **LOCAL Tsunamis:**
  - Events with 5-30 min. arrival time & most casualties occur w/in 45 min.
  - Massive tsunamis with large inland penetration possible
  - People must be trained on life-safety protective actions & act immediately!
  - TWCs & buoys ineffective for initial life-safety actions

- **“The time’s, they are a changin’?”**
  - M8+ EQ in the next 50-years:
    - 10 – 14 % Northern CSZ (USGS)
    - 37 % Southern CSZ (C. Goldfinger)
Because, perhaps most importantly, for **90-95%** of coastal populations... **Local Tsunamis are Survivable.***

*Disclaimer: Provided, coastal residents, visitors, schools, etc:
1. Know the ‘natural warning signs’
2. Know what areas are at risk
3. Know where to escape
4. Practice evacuations
What about the Other 5-10% of Coastal Communities?
Current Situation:

Ah ha!

Local Earthquake!

High ground: You **CAN’T** get there from here!

Bummer!
Hotspots of Evacuation Challenges


Based on 1.1 m/s travel speed
Official Engineering/Planning Guidance

Guidelines for Design of Structures for Vertical Evacuation from Tsunamis

Vertical Evacuation from Tsunamis: A Guide for Community Officials

+ ASCE 7 DRAFT CODE LANGUAGE
Project Safe Haven:
Tsunami Vertical Evacuation in Washington State

www.facebook.com/projectsafehaven
Safe Haven Planning Process

1. Kick off Meeting with Local Emergency Manager
2. Community World Café Meeting (Gather initial community input)
3. Alternatives Analysis (SWOT) By Community Members
4. Community Development of Preferred Alternative
5. Urban Design Charrette with Architects
6. Community Ranking of Locations & Final Plan Development
Implementation!

- Phase IV (FY12 NHTMP funds) – Site Specific Vertical Evacuation Modeling Analysis Completed to support 2 projects
  - Long Beach Elementary School Berm
  - Ocosta Elementary School Gym

- Used Oregon’s L1 Source (~2,500 year recurrence) for consistency and based on FEMA/NOAA guidance and draft ASCE 7 recommendations.

- Iterative process for hazard assessments

- Funding Test Balloons (federal, state, local)

- In FEMA speak they may be considered... “Tsunami Safe Areas”

- Eligible but Not Funded...

- Ocosta School District is moving forward! First structure in U.S. purposefully built to new tsunami-design criteria.

- Long Beach Elementary School is in Environmental Review
Tsunami Hazard Assessment of the Ocosta School Site in Westport, WA

Final Report: September 11, 2013

Supersedes February 24, 2013 Report
Frank Gonzalez, Randy LeVeque and Loyce Adams
University of Washington

Westport, WA. Google Earth image. Blue rectangle is area of fine resolution GeoClaw tsunami model grid; white circle encompasses Ocosta School campus.

Study funded by Washington State Emergency Management Division
Grays Harbor County school to build first U.S. vertical-tsunami refuge

A new scenario for a Cascadia megaquake and tsunami warns that more than 10,000 could be killed and 30,000 injured. But a school district near Westport, Grays Harbor County, is doing everything it can to keep its students safe.

By Sandi Doughton
Seattle Times science reporter

A new scenario for a megaquake and tsunami off the Washington coast warns that the death toll could top 10,000 — but Paula Akerlund is doing everything she can to keep her kids safe. All 700 of them.

The Grays Harbor County school district Akerlund oversees on the Washington coast is preparing to build the nation’s first tsunami refuge.
Foundation Design

- Overturning
  - Buoyancy
  - Hydrodynamic
- Scour
  - Depth = 12 ft
- Liquefaction
Foundation Design

- 50 ft. deep piles
- Grade beams
- Structural slab
Structural Design

- Hydrostatic
- Hydrodynamic
- Impact
  - Logs
  - Vehicles
- Progressive collapse
Finished Design

image courtesy TCF Architecture
Finished Design

image courtesy TCF Architecture
Finished Design

image courtesy TCF Architecture
Long Beach Safe Haven Berm

- Funded through FEMA Hazard Mitigation Grant Program
- Received Phased Award
- Currently in 30% Design Phase and Detailed Environmental Review

<table>
<thead>
<tr>
<th>Table 1: Long Beach Berm</th>
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<tbody>
<tr>
<td>Scope</td>
</tr>
<tr>
<td>Site Utilities</td>
</tr>
<tr>
<td>Excavation-Backfill</td>
</tr>
<tr>
<td>Concrete</td>
</tr>
<tr>
<td>Landscaping</td>
</tr>
<tr>
<td><strong>Construction Totals</strong></td>
</tr>
<tr>
<td>Design Fees (8%)</td>
</tr>
<tr>
<td>General Conditions (10%)</td>
</tr>
<tr>
<td>Contractor Fees, O&amp;P (15%)</td>
</tr>
<tr>
<td>Construction Contingency (5%)</td>
</tr>
<tr>
<td>Estimate/Design Contingency (10%)</td>
</tr>
<tr>
<td><strong>Project Total</strong></td>
</tr>
</tbody>
</table>
If you build it, they will come.

Quinault tribe set to expand Quinault Beach Resort & Casino

Peninsula Daily News

OCEAN SHORES — The Quinault tribe expects to begin a $25 million expansion of the Quinault Beach Resort & Casino in March.

The expansion follows the completion of a 159-room remodel at the resort and will expand the property’s fast food services, add two additional bars and include a combined gift and coffee shop, according to Fawn Sharp, tribal president.

More space

The casino will have up to 70 percent more space to house new slot machines.

A new 500-car, four-story parking garage also can serve the area as a tsunami shelter, Sharp said.

The expansion project will employ more than 100 laborers during the construction as well as add to the resort’s current workforce upon completion.

Sharp said that the resort and casino “has been a major component of Quinault Nation’s employment and economic structure for the past 16 years.

“It is largely due to its success that we have been able to diversify.”

The tribe is the largest employer in Grays Harbor County, providing more than 1,200 jobs.

“I am excited that the Quinault Nation will continue to expand its properties,” said Don Kajans, general manager of Quinault Beach Resort & Casino.

“This expansion project not only allows us to employ more locals, it will also help us to bring more people to the area.”

Last modified: January 11, 2016 7:49PM
Questions?