

# Project Safe Haven: Tsunami Vertical Evacuation in Washington State



National Tsunami Hazard  
Mitigation Program



NOAA



Washington Military Department  
Emergency Management Division



UNIVERSITY of  
WASHINGTON



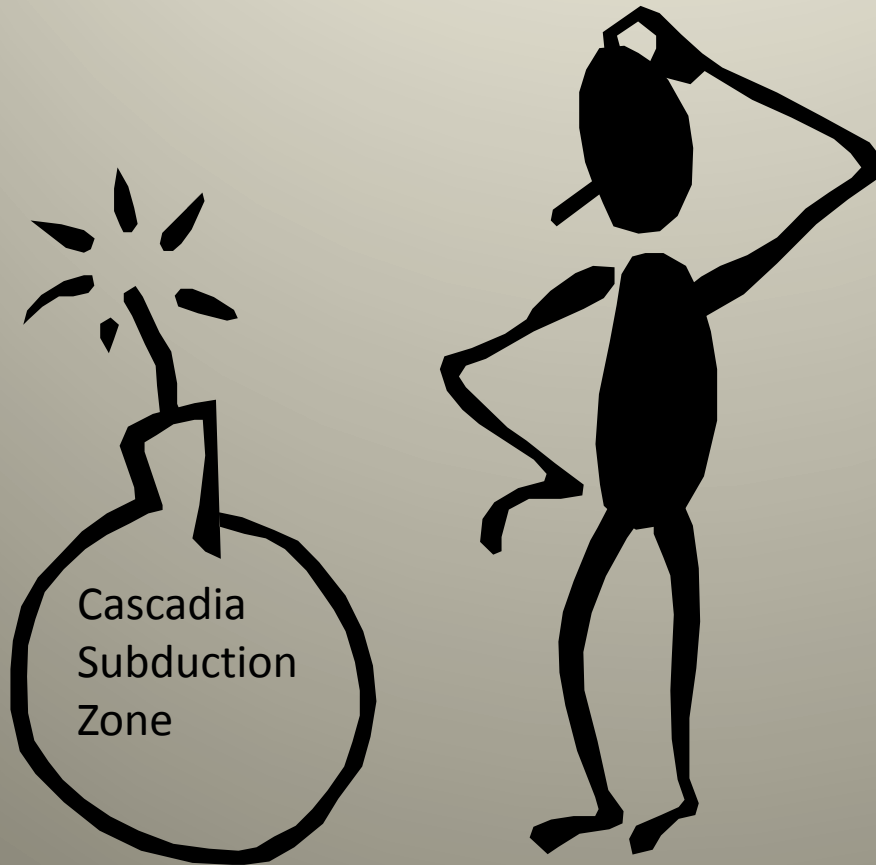
WASHINGTON STATE DEPARTMENT OF  
Natural Resources



USGS  
science for a changing world

ron kasprisk

# Tsunami Vertical Evacuation: Why Now?





Local  
Earthquake!

Ah ha!

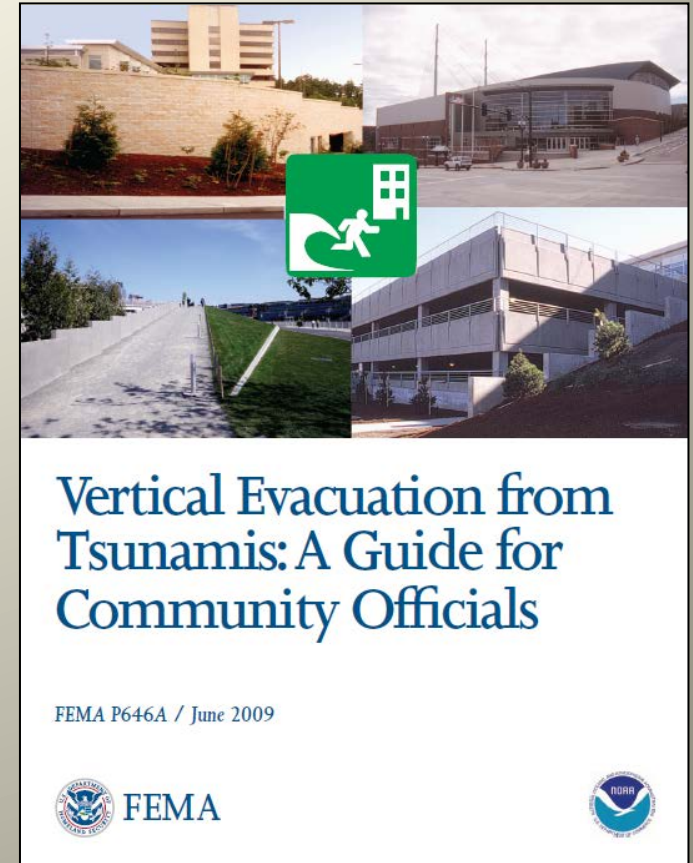
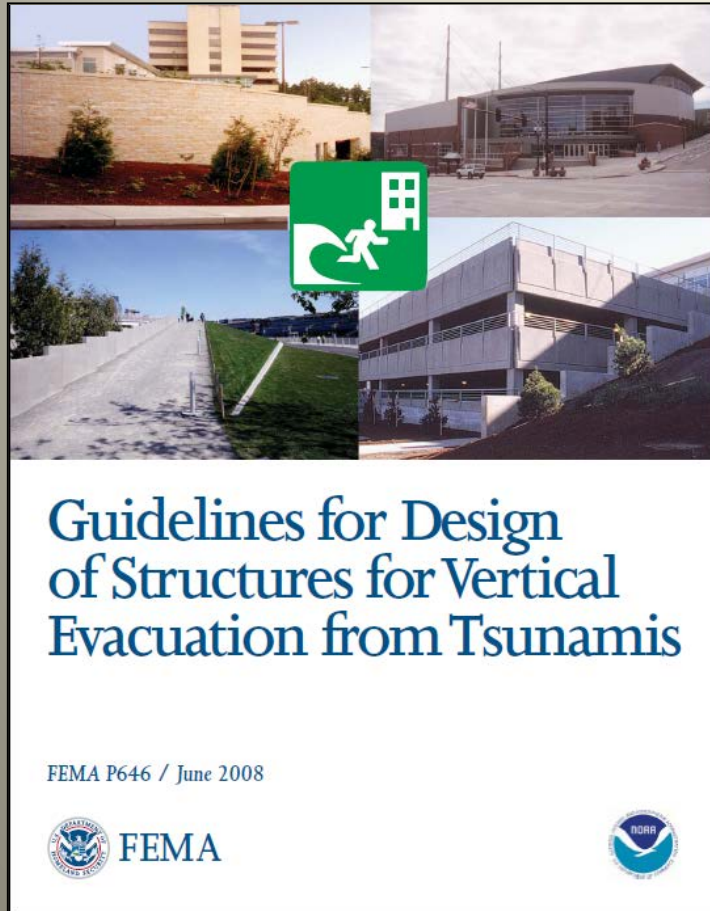


High ground:  
You **CAN'T** get  
there from  
here!

Bummer!



# Official Engineering/Planning Guidance



**+ ASCE 7 DRAFT  
CODE LANGUAGE**

# Washington Tsunami Hazard Profile:

- Local Source - Cascadia
- ~30-40 minutes before arrival of first wave
- Extremely flat coastal topography coupled with long peninsulas
- Majority of Coastal Communities Likely to be Flooded
- Vulnerable Populations at Risk
  - Seniors
  - Children
  - Etc.
- Untrained Tourist Population that reaches 100k+ during summer





# What's at Risk on the Outer Coast of Washington State?

## Populations:

- Residents: ~**42,972**
  - Most 65+ years in age, many renters
- Employees: ~**24,934**
- Tourists: **100K+** during summer months
- State Parks: ~**17,029** people (daily average)
- Other populations:
  - Public venues and hotels
  - Dependent-population facilities (schools, day cares, etc.)



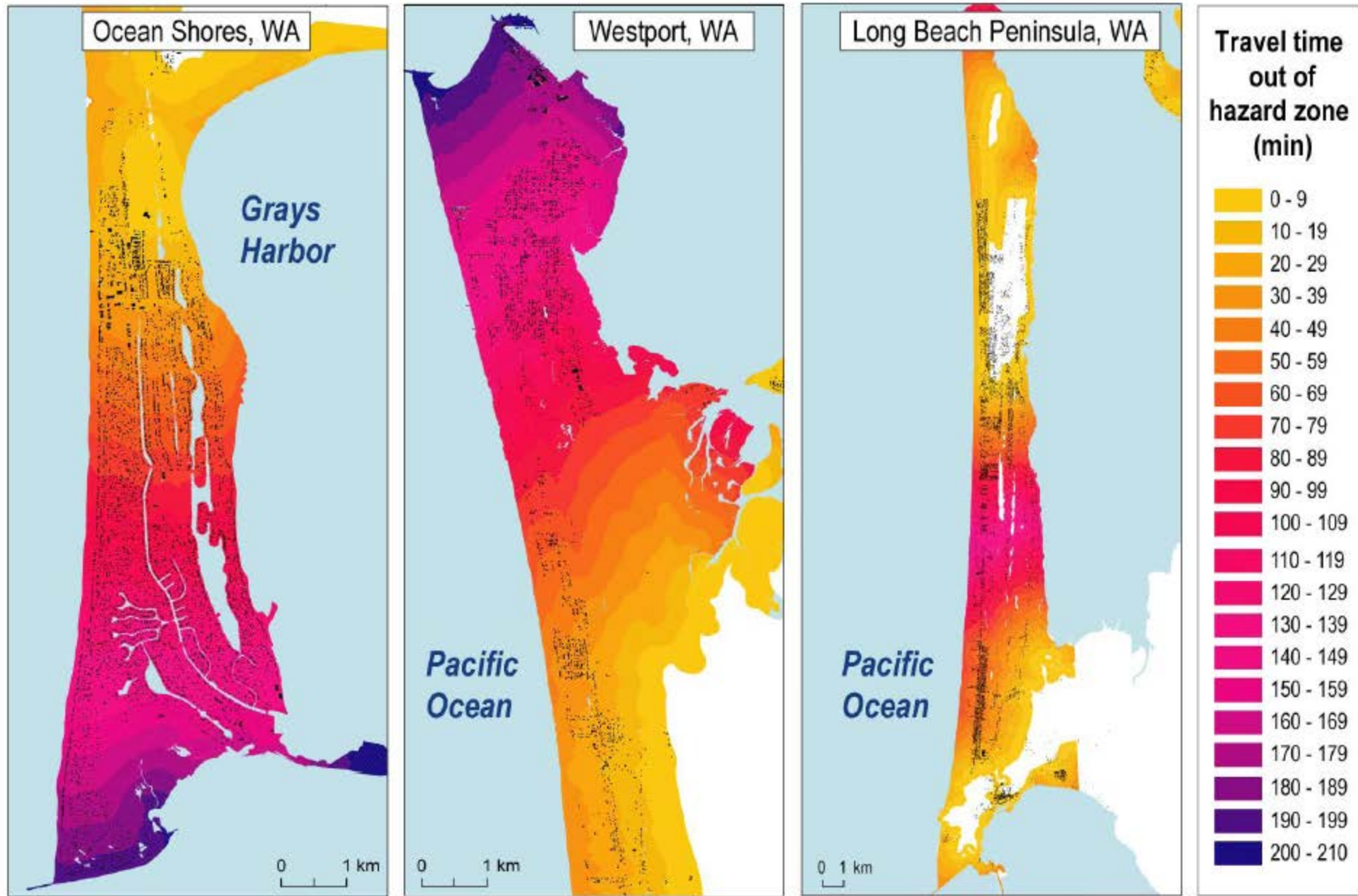
## Economy:

- **33%** of workforce in tsunami inundation zone
- Businesses focus on tourism, social services, and manufacturing

## Critical and Essential Facilities:

- High number of police stations, fire stations, public-work facilities
- High number of banks, government offices, and markets

# Hotspots of Evacuation Challenges



Source: Wood & Schmidlein, 2011

Based on 1.1 m/s travel speed



[illegible]

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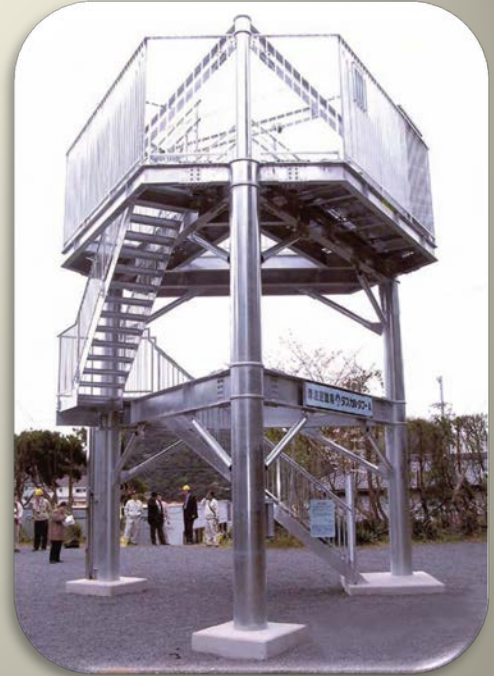
- School safety!!!
- Seniors and special needs populations
- More conservative travel times – 15 min. instead of 30 min.
- Requested more conservative estimates of elevations



# Project Safe Haven Options (from FEMA 646):

## Towers –

- Limited Space
- Blocks Views
- Few Options for Shelter



## Buildings –

- Expensive
  - Better get it right the first time!
- Very Large, Likely to Block Views
- May require Private Development
  - Incentives for Height?

## Berms –

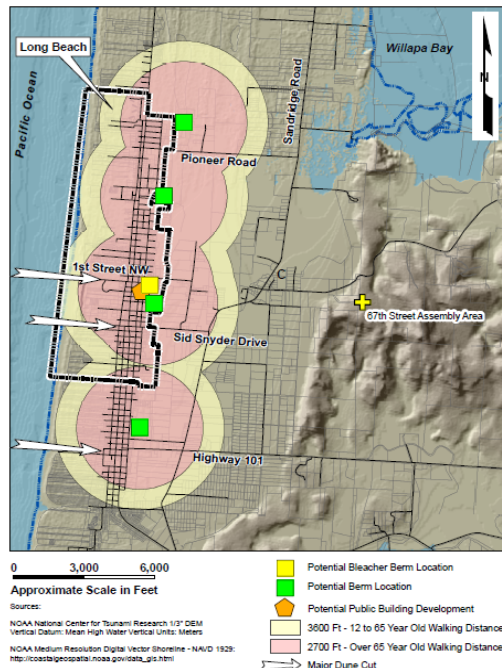
- A Less Expensive Option
- Can be Multi-Purpose
- May be Placed to Limit View Blocking



# Safe Haven Planning Process



Figure 2 - Preferred Strategy



Kick off Meeting with Local  
Emergency Manager

Community World Café Meeting  
(Gather initial community input)

Alternatives Analysis (SWOT )  
By Community Members

Community Development of  
Preferred Alternative

Urban Design Charrette with  
Architects

Community Ranking of Locations  
& Final Plan Development

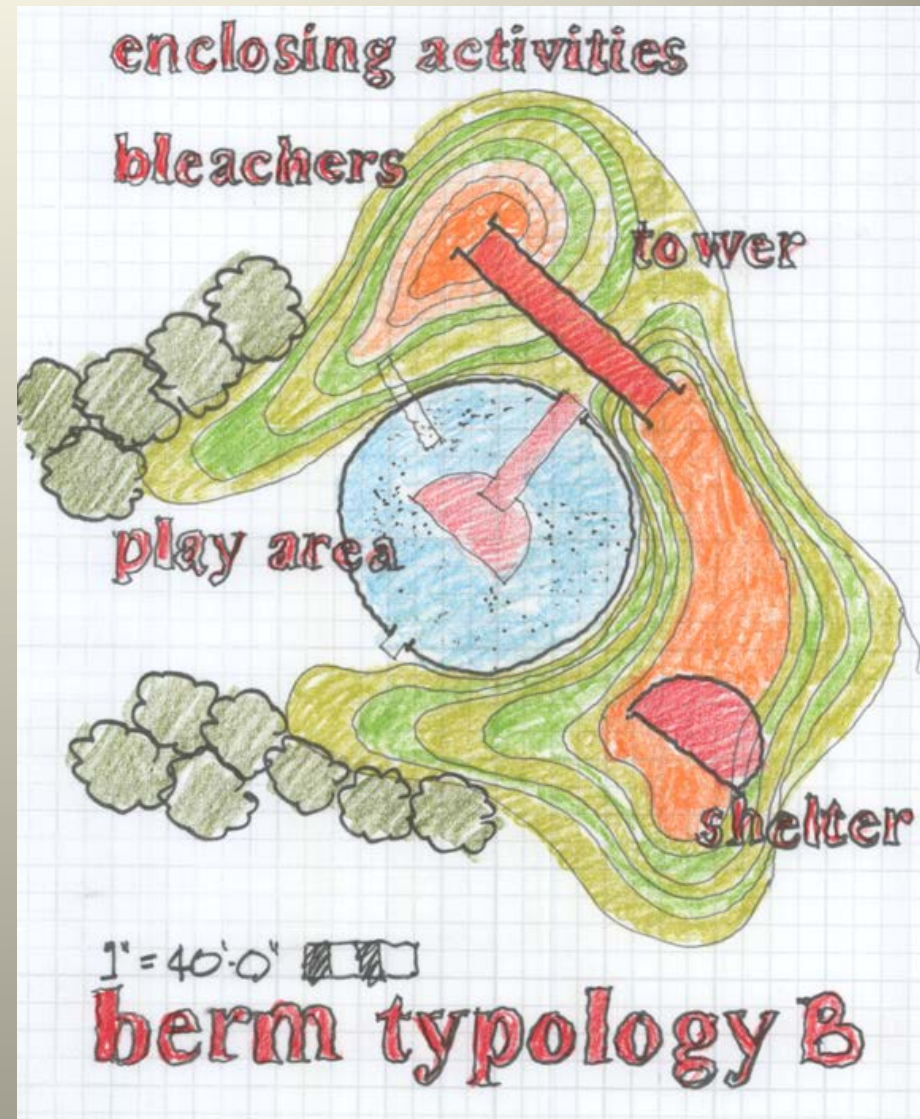
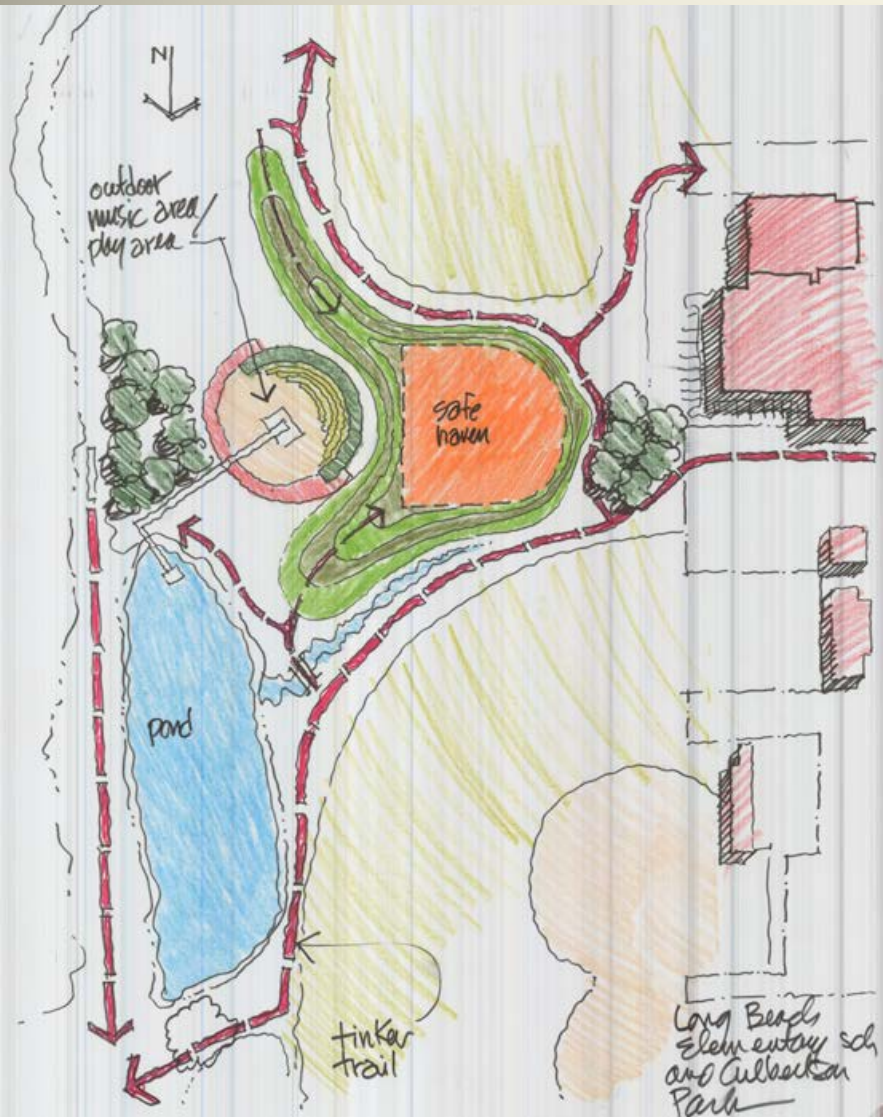




# Evacuation Capacity Analysis

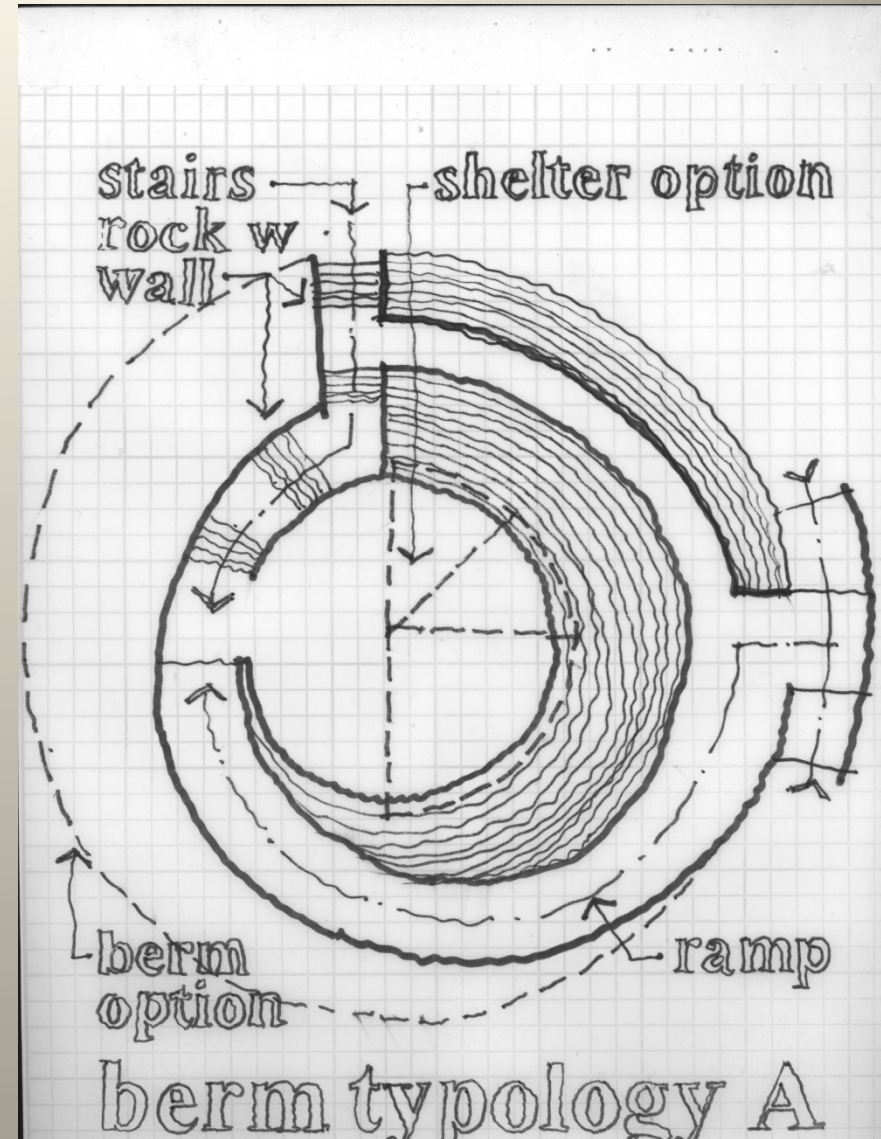
Map Number	Structure Type	Location	Structure Capacity
1	Tower	Ocean City	300
2	Tower	Quinault Beach Resort	500
3	Berm	North Beach Junior/Senior High School	800
4	Parking Structure	Downtown	1700
5	Tower or Berm	Golf Course	350
6	Tower	Ocean Shores Airport	350
7	Tower or Berm	Ocean Shores Elementary	350
8	Tower	Ocean Shores Blvd & Taurus Blvd SW	350
9	Tower or Berm	Blue Wing Loop SE & Duck Lake Drive SW	350
10	Tower	Cormorant St	350
11	Tower	Ocean Shores Blvd & Marine View Drive SW	350
12	Tower	Emeritus Senior Living	500
13	Tower	Wowona Ave SE & Tonquin Ave SW	350
14	Tower or Berm	Spinnaker Park	500
15	Tower or Berm	Ocean City State Park Campground	350
16	Tower	Between Lake Bay Loop SE & Pearsall Street on Duck Lake Dr	350
17	Tower	Trois Court & Inlet Avenue NW	350
18	Tower or Berm	Ocean Lake Way & N Port Loop	350
19	Tower or Berm	North Razor Clam Drive & Butterclam St SW	350
20	Tower	Mt. Olympus	350

# Safe Haven Berms





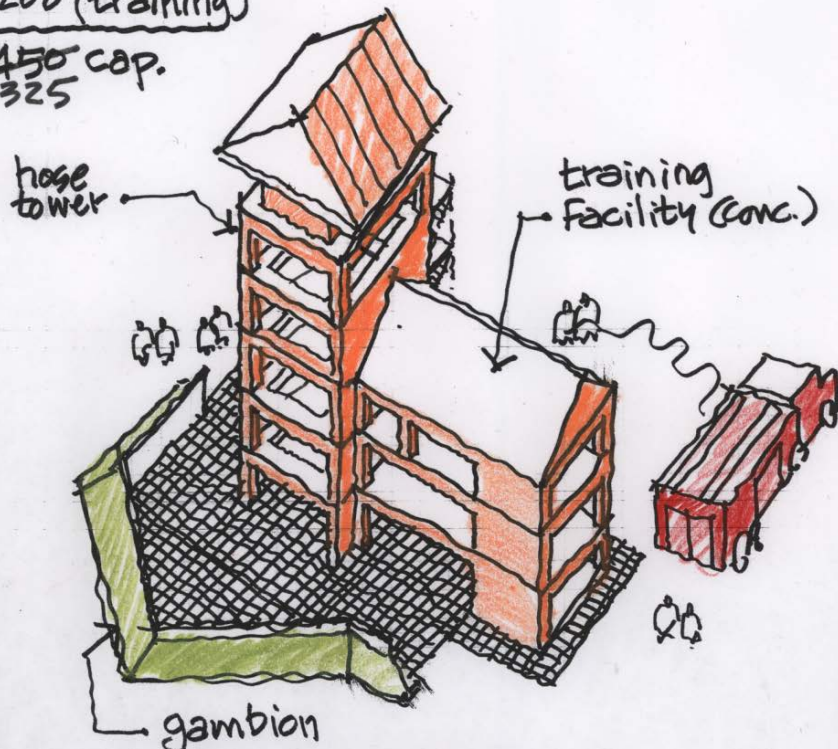
# Safe Haven Berms



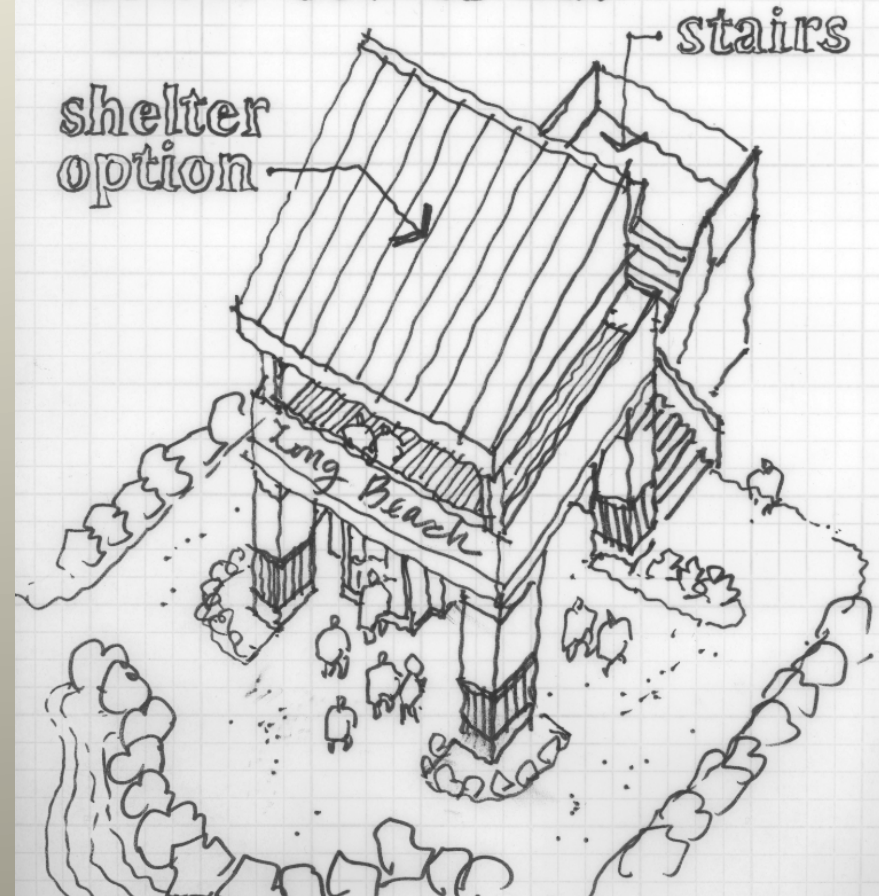
# Safe Haven Towers

## SAFE HAVEN FIRE HOSE/TOWER/ TRAINING FACILITY

250 (tower)  
125  
200 (training)  
450 cap.  
325

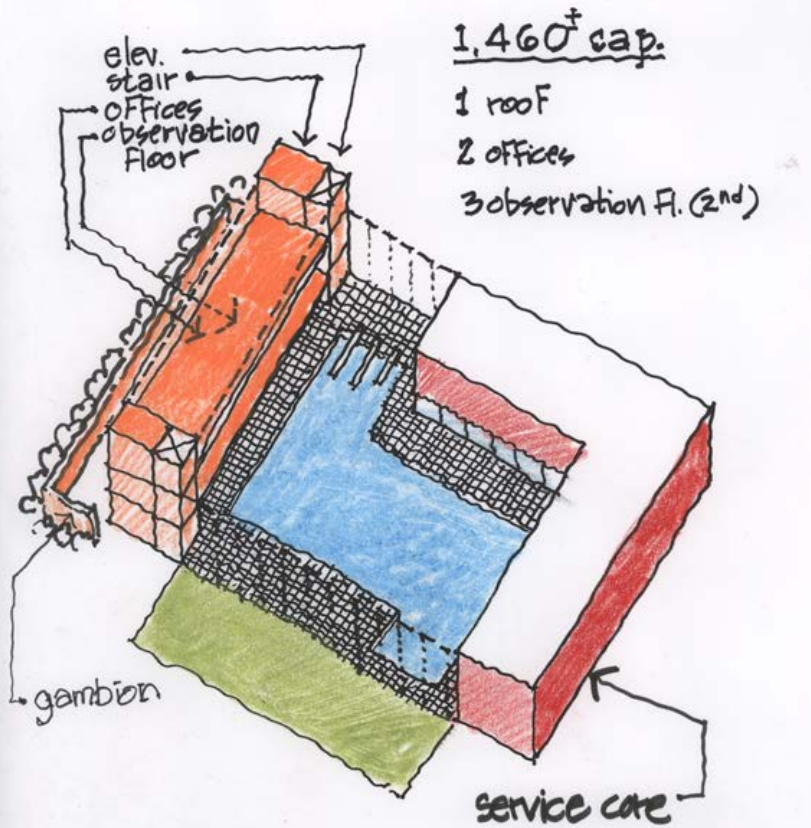


## tower typology A visitor center ex.





# Safe Haven Buildings

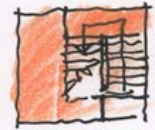


## SAFE HAVEN RESORT

### BUILDING COMPONENT

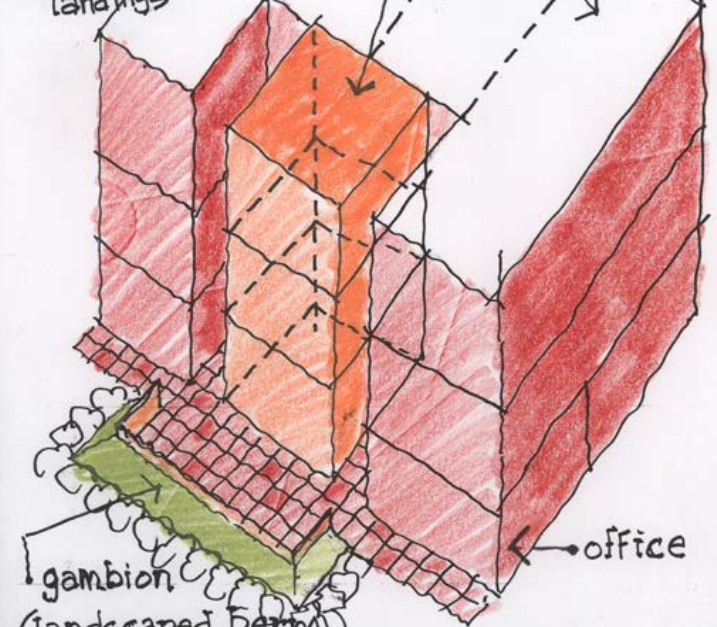
36 cap.

1 roof  
2 stair/landings



STAIR CORE

UNITS



				Structure Height (feet)	Capacity (# of people)	Estimated Cost
Type	Community	Site				
B1	berm	Long Beach	N Place & 41st Place	12	600	\$644,095
B2	berm	Long Beach	Washington Avenue South & 5th Street	9	1000	\$706,266
B3	berm	Long Beach	Washington Avenue South & 2nd Street	12	400	\$509,621
B4	berm	Long Beach	13th Street South & Washington Avenue	9	700	\$546,830
B5	berm	Long Beach	Q Street (Washington) & 26th Street North	9	500	\$440,540
B6	berm	Ocean Park	U Street & 227th Place	9	600	\$493,685
B7	berm	Ocean Park	SR 103 & 210th Place	12	200	\$375,147
B8	berm	Ocean Park	SR 103 & 188th Place	16	200	\$522,162
B9	berm	Ocean Park	SR 103 & 162nd Lane	25	150	\$879,152
B10	berm	Ocean Park	SR 103 & Cranberry Road	9	400	\$387,394
B11	berm	Ocean Park	U Street & 260th Street	20	800	\$1,322,779
B12	berm	Seaview	N Place & 37th Place	12	400	\$509,621
B13	berm	Ilwaco	Ortelius Drive & Scarboro Lane North	16	300	\$608,188
T1	tower	Tokeland	Kindred Avenue (Nelson Crab)	19	100	\$104,218
T2	tower	Tokeland	Tokeland Road & Evergreen Street	19	150	\$112,770
T3	tower	Tokeland	Tokeland Road & Pine Lane	19	75	\$99,942
T4	tower	North Cove	SR 105 & Whipple Avenue	21	100	\$105,929
T5	tower	North Cove	SR 105 & Warrenton Cannery Road	23	100	\$107,639
PK1	parking structure	Tokeland	Shoalwater Bay Casino	25	1000	\$828,403
PK2	parking structure	Tokeland	Shoalwater Bay Tribal Complex	19	500	\$414,201



## Draft cost estimates for berm at Long Beach Elementary School *(1,000 person capacity)*

<b>Table 1: Long Beach Berm</b>	
<b>Scope</b>	<b>Cost</b>
Site Utilities	\$49,814
Excavation-Backfill	\$289,512
Concrete	\$153,951
Landscaping	\$74,094
<b>Construction Totals</b>	<b>\$567,370</b>
Design Fees (8%)	\$45,390
General Conditions (10%)	\$56,737
Contractor Fees, O&P (15%)	\$85,106
Construction Contingency (5%)	\$28,369
Estimate/Design Contingency (10%)	\$56,737
<b>Project Total</b>	<b>\$839,708</b>

# 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



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## 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.

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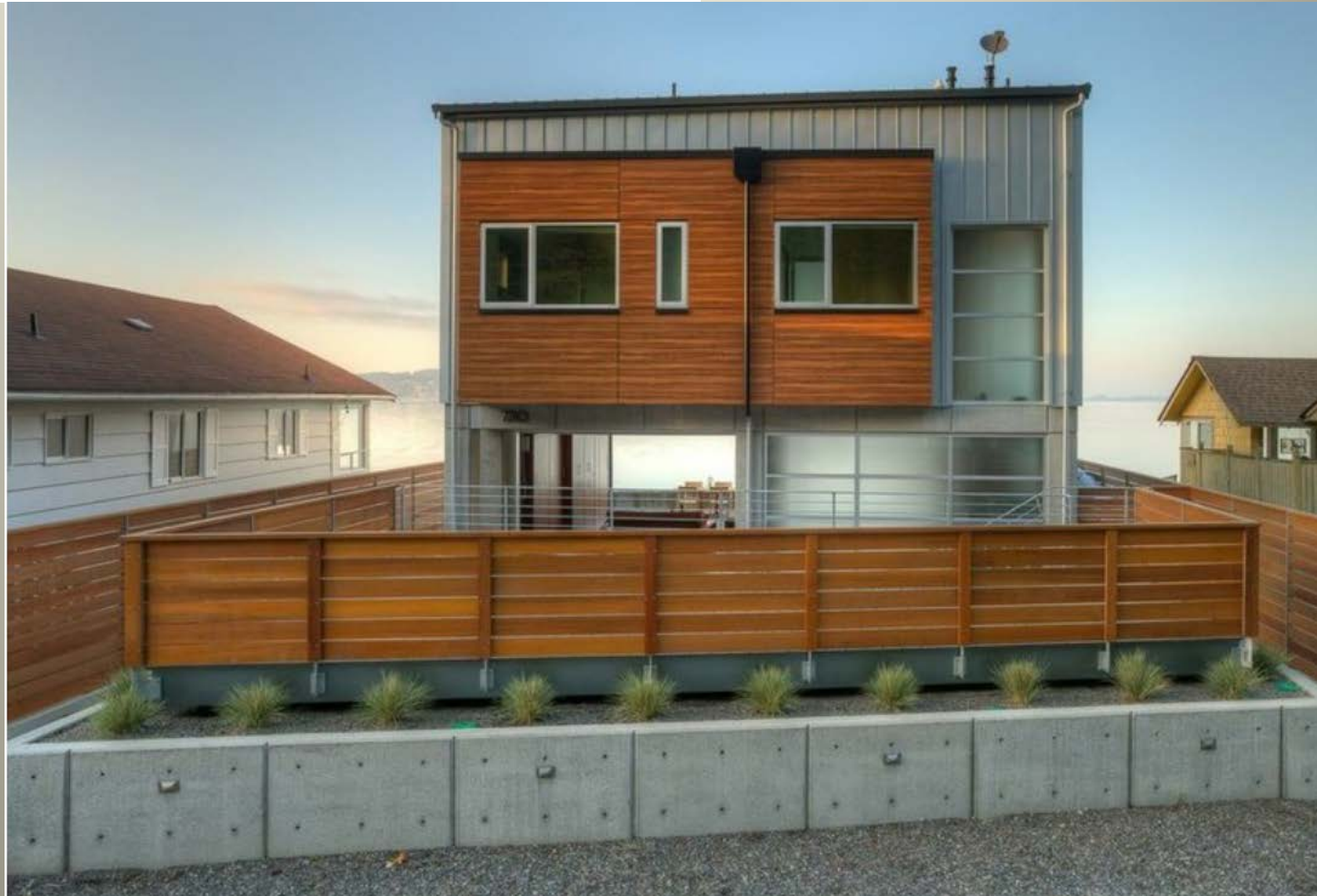
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MIKE COVERDALE / SPECIAL TO THE SEATTLE TIMES

# This House is Built to Withstand the Force of a Tsunami

A clever idea to let water flow through a home may allow residents in Puget Sound to escape the fate that locals centuries ago could not



SOURCE: [http://www.smithsonianmag.com/innovation/house-built-withstand-force-tsunami-180949455/?utm\\_source=smithsoniantravandcult&utm\\_medium=email&utm\\_campaign=201401-travel](http://www.smithsonianmag.com/innovation/house-built-withstand-force-tsunami-180949455/?utm_source=smithsoniantravandcult&utm_medium=email&utm_campaign=201401-travel)