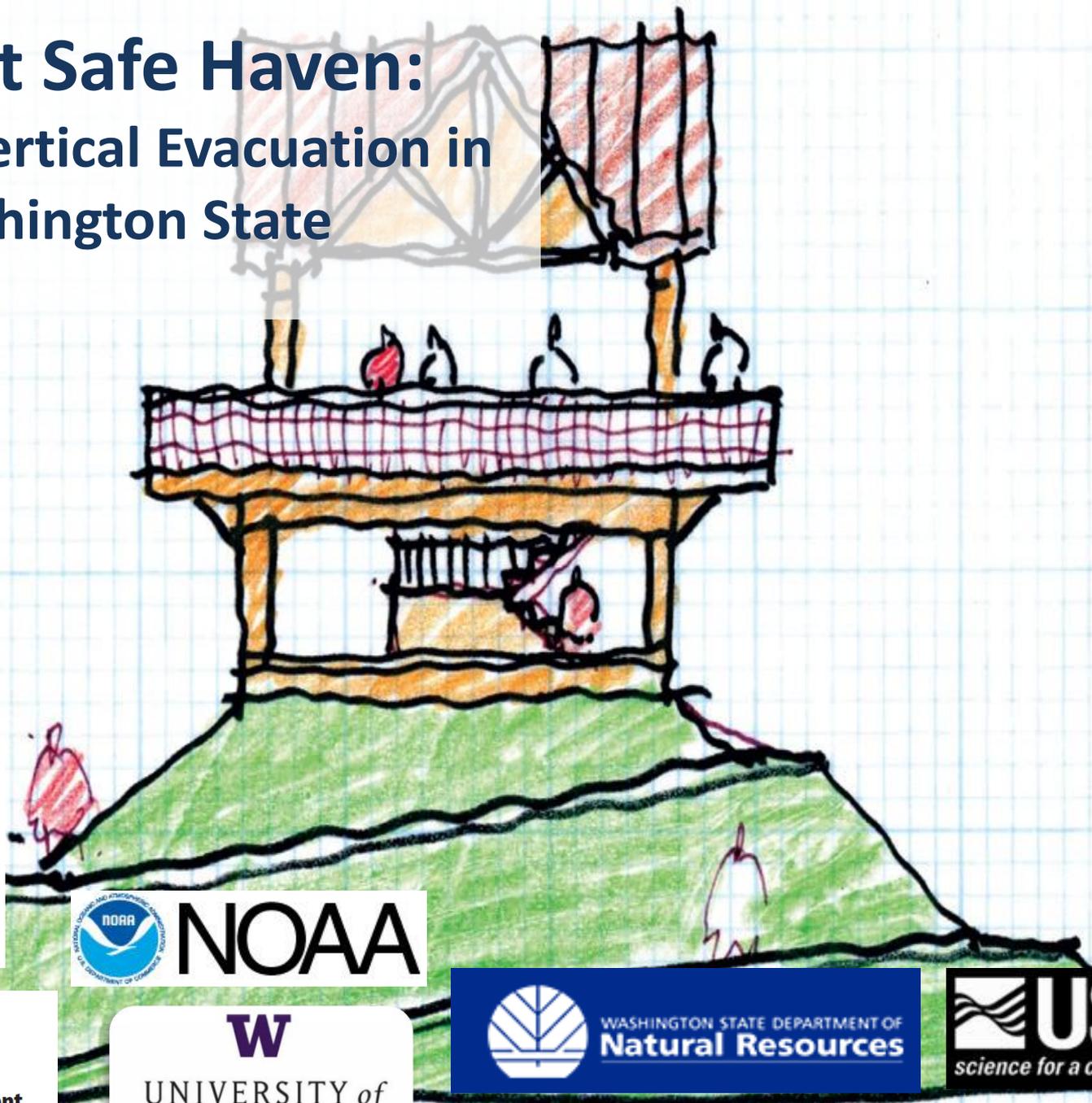


Project Safe Haven: Tsunami Vertical Evacuation in Washington State



National Tsunami Hazard
Mitigation Program



NOAA



Washington Military Department
Emergency Management Division

W

UNIVERSITY of
WASHINGTON



WASHINGTON STATE DEPARTMENT OF
Natural Resources

USGS
science for a changing world

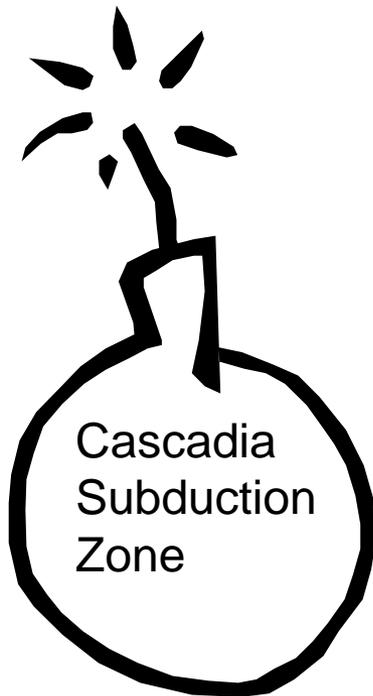
ron kasprisk

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



Tsunami Vertical Evacuation: Why Now?

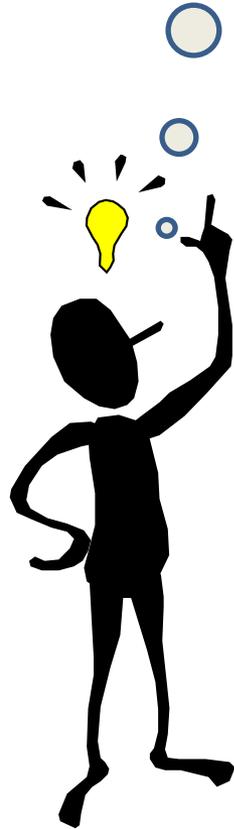


Current Situation:

Local Earthquake!



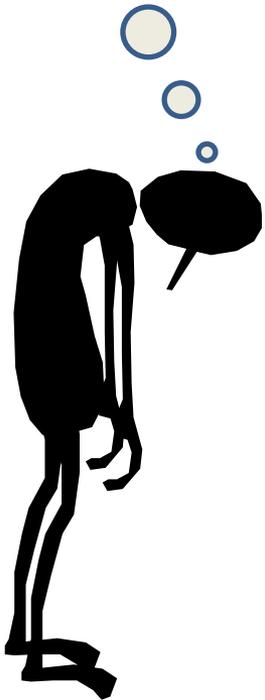
Ah ha!



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



Bummer!



Why Now?

Official Engineering/Planning Guidance



Guidelines for Design of Structures for Vertical Evacuation from Tsunamis

FEMA P646 / June 2008



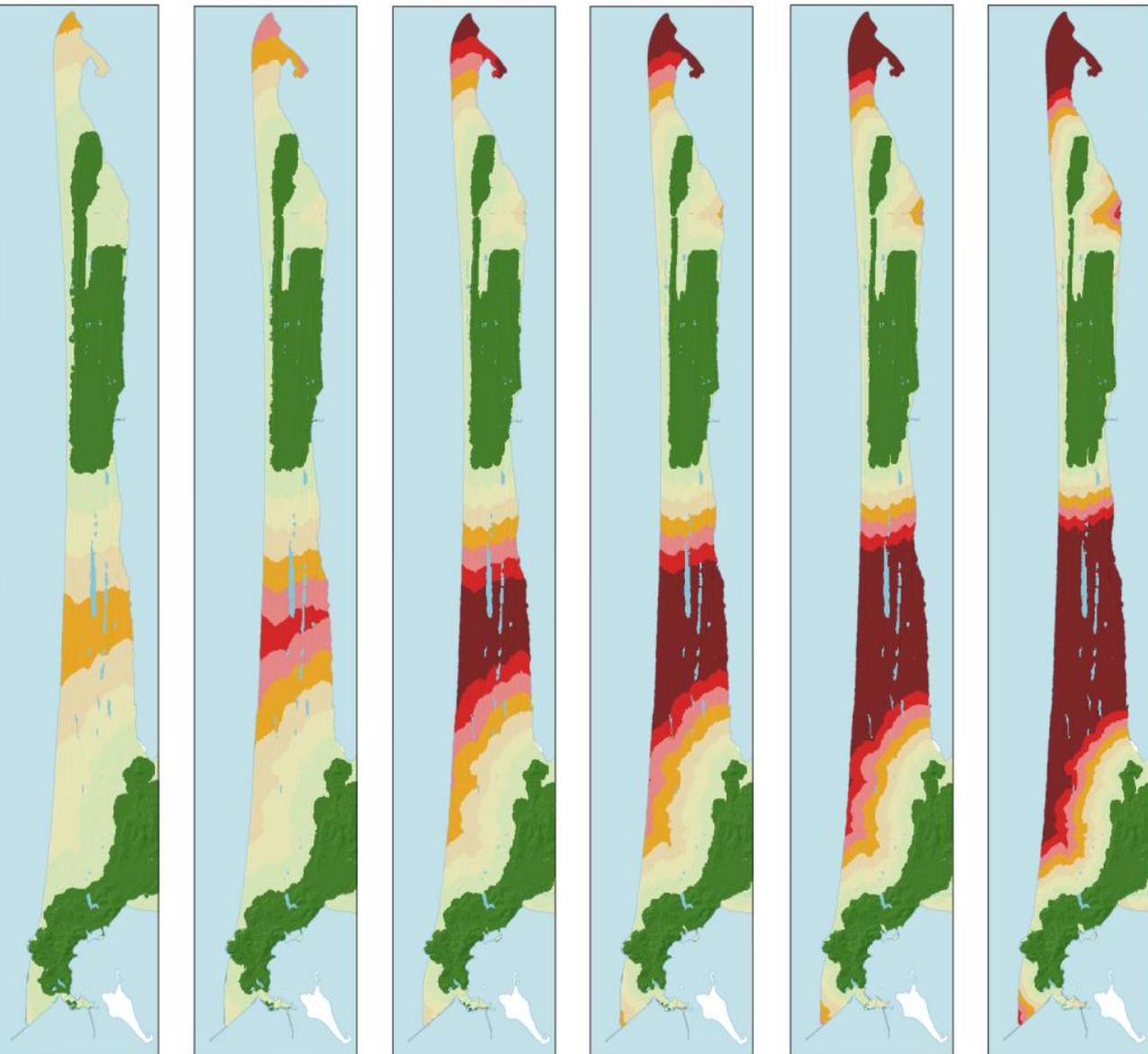
Vertical Evacuation from Tsunamis: A Guide for Community Officials

FEMA P646A / June 2009



Pedestrian evacuation modeling

Run Fast 3.9 m/s (7-min mile)
Run Moderate 2.7 m/s (10-min mile)
Run Slow 1.8 m/s (15-min mile)
Walk Fast 1.5 m/s (18-min mile)
Walk Moderate 1.2 m/s (22-min mile)
Walk Slow 0.9 m/s (29-min mile)



- **Collaboration between WA EMD, WA DNR, & USGS**
- **2011 – Method development**
 - Long Beach Peninsula case study
- **2012 (potential)**
 - Evacuation-time mapping for entire Washington coast
 - Decision support tool for safe haven planning

Travel Time to Safety (minutes)

- 0
- 1 - 10
- 10 - 20
- 20 - 30
- 30 - 40
- 40 - 50
- 50 - 60
- Greater than 60

0 2 Miles
0 2 Kilometers

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:

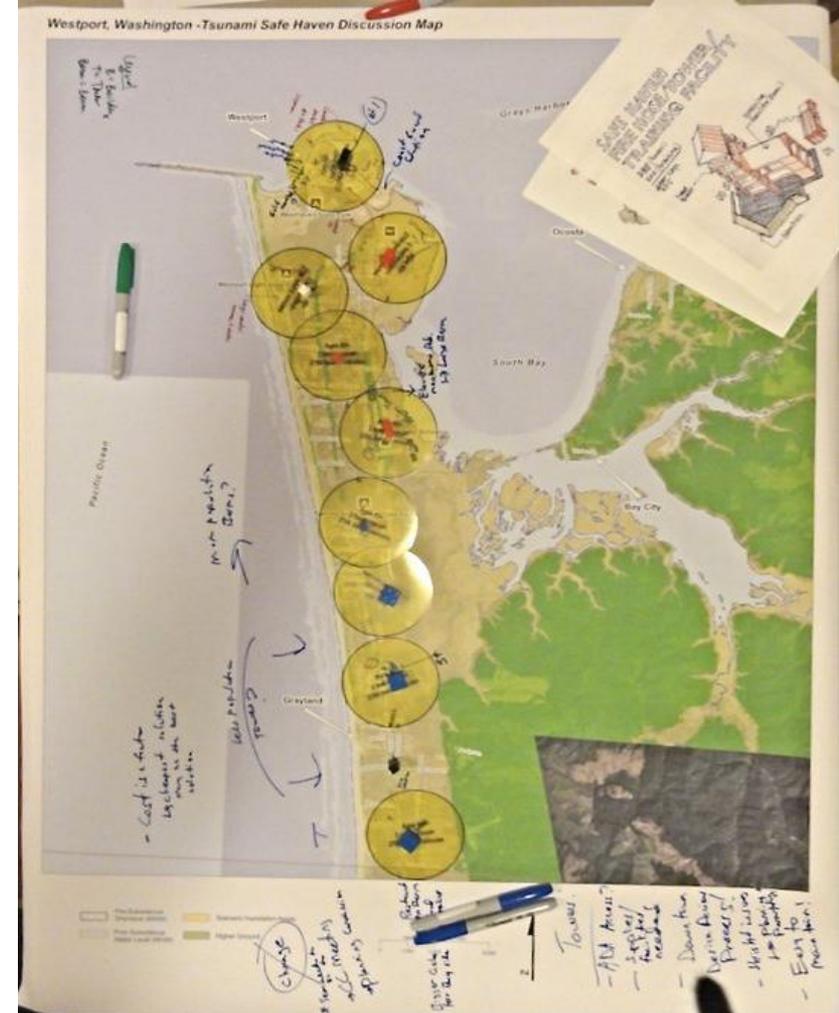
- **33%** of workforce in tsunami inundation zone
- Businesses focus on tourism, social services, and manufacturing

Critical and Essential Facilities:

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

Project Safe Haven:

- **Community-based, 'top-down' planning approach** (hint: the community is at the top)
 - All options are on the table for consideration by community participants
 - Community members provide 100% of the input, experts are on hand to answer technical questions and facilitate the planning and design meetings.
- After all, this should be the **community's plan...**



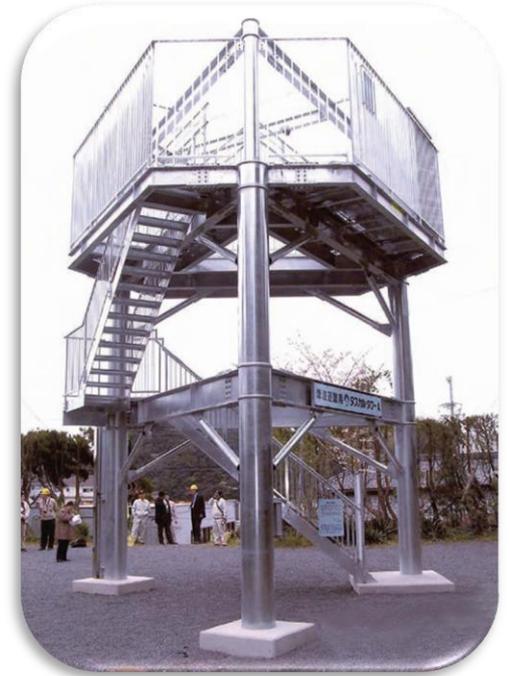
Common Themes:

- 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
- May Block 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 –

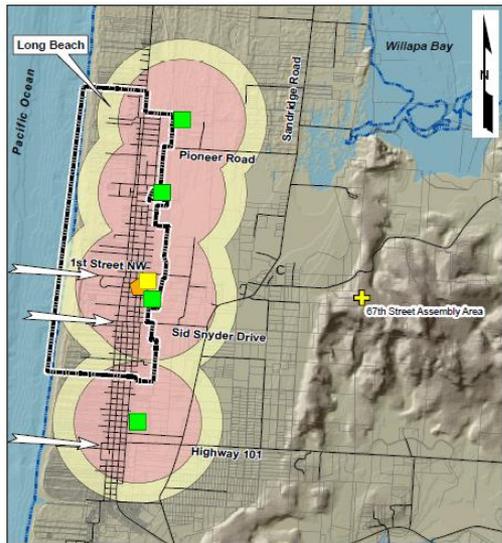
- A Less Expensive Option
- Can be Multi-Purpose
- May be Placed to Limit View Blocking



Safe Haven Planning Process



Figure 2 - Preferred Strategy



Kick off Meeting with Local Emergency Manager

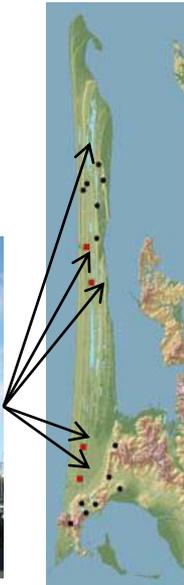
Community World Café Meeting (Gather initial community input)

Alternatives Analysis (SWOT) By Community Members

Community Development of Preferred Alternative

Urban Design Charrette with Architects

Community Ranking of Locations & Final Plan Development



Step 1. Figure out where the community wants these things!

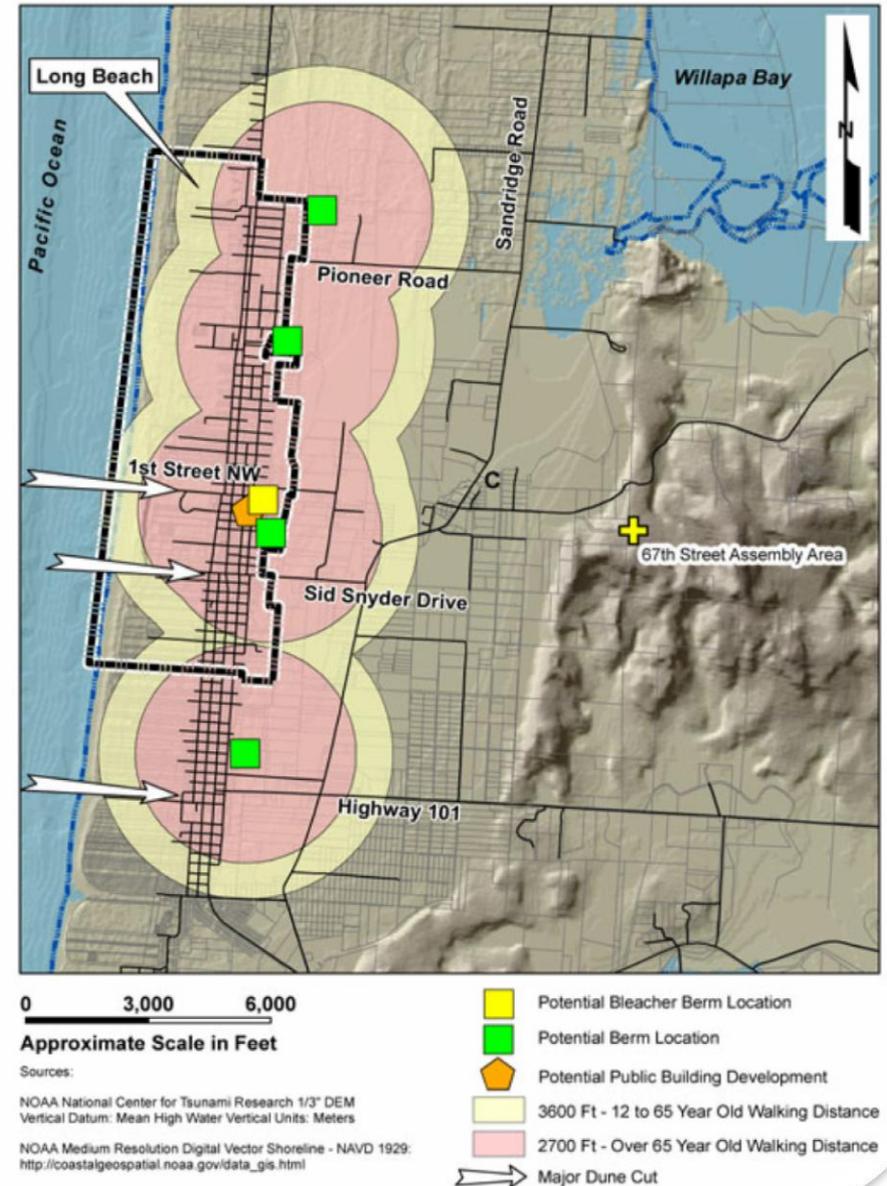


1. City of Long Beach, WA

Preferred Strategy

- Five Berms Distributed Along Eastern Extent of Community
- Potential Public Building Development in Center of Town
- Permanent Residents Able to be Served by Structures
- Will accommodate tourists

Figure 2 - Preferred Strategy

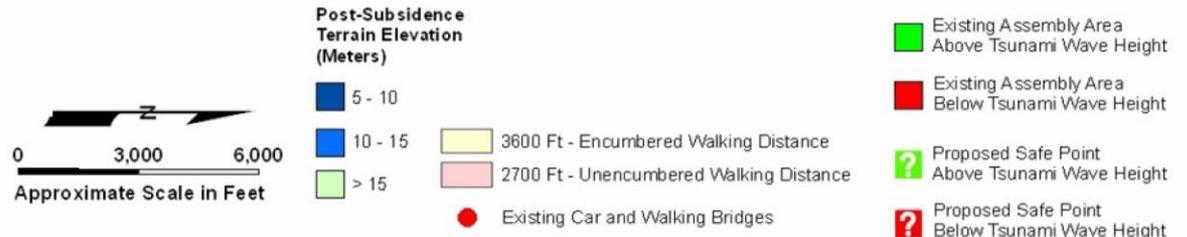
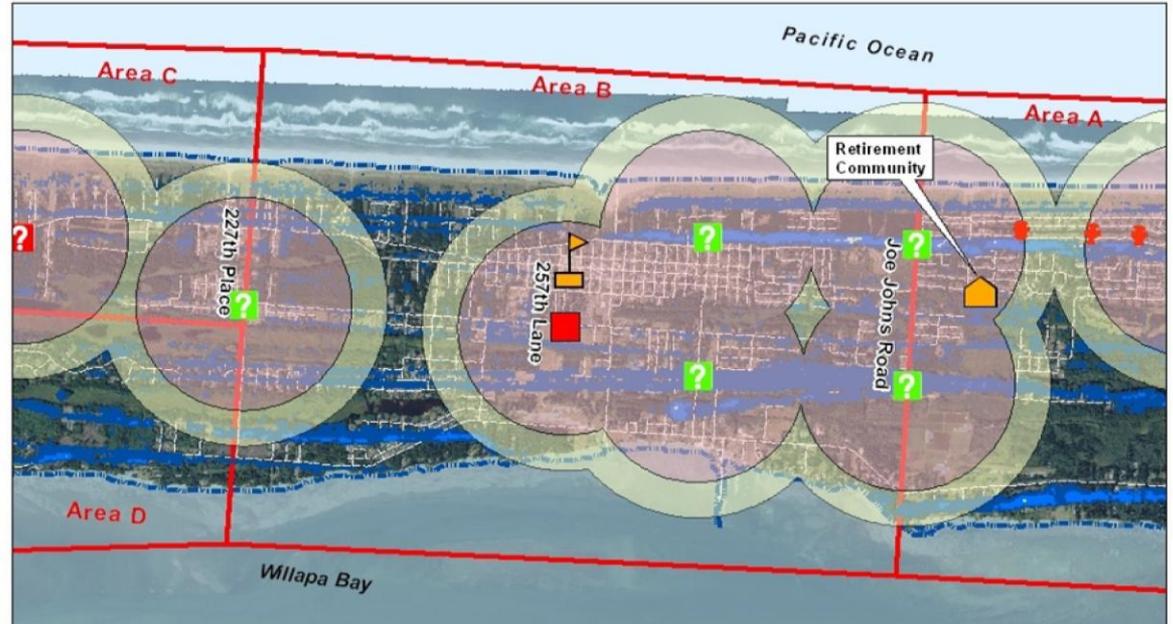


2. North Peninsula

Preferred Strategy

- Focus on walking routes
- Natural high ground

Ocean Park, Washington - Area B, Preliminary Strategy

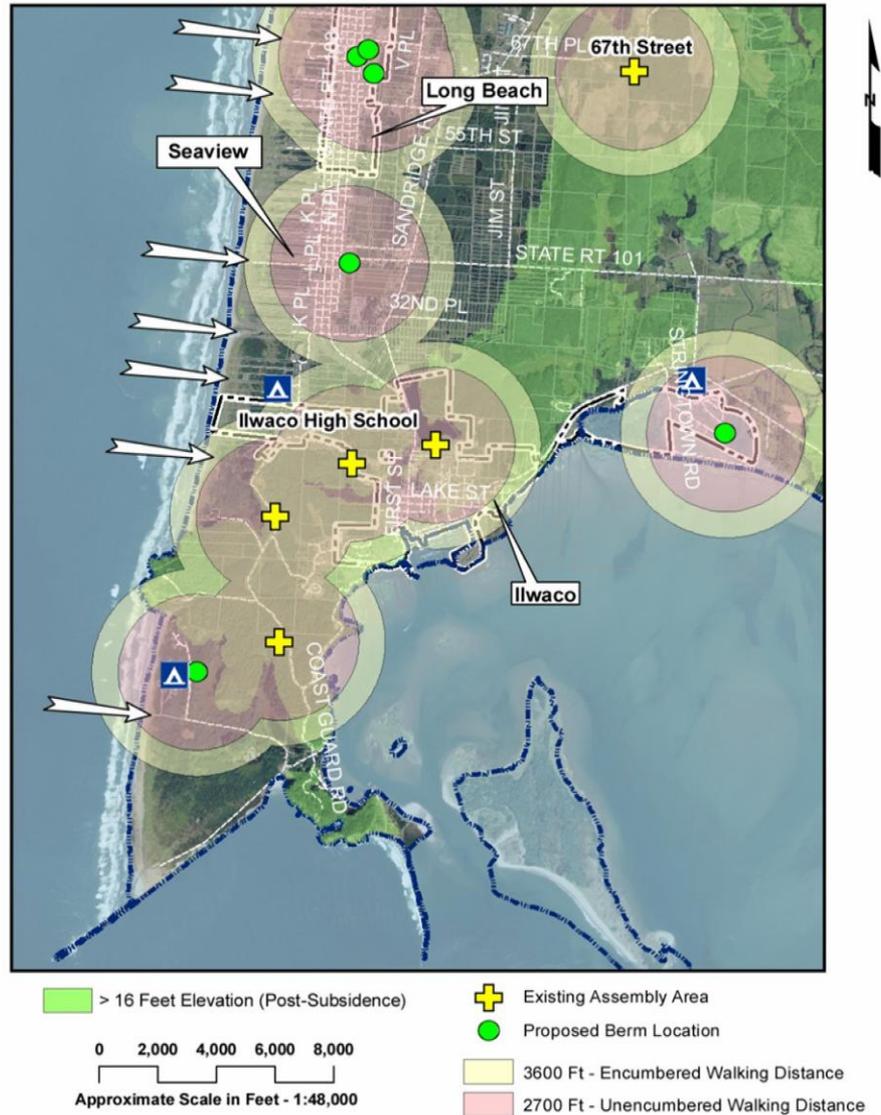


3. Ilwaco/Seaview, WA

Preferred Strategy

- Abundant natural high ground in Ilwaco
- Vandalia subdivision
- Campgrounds
- Seaview – low elevation

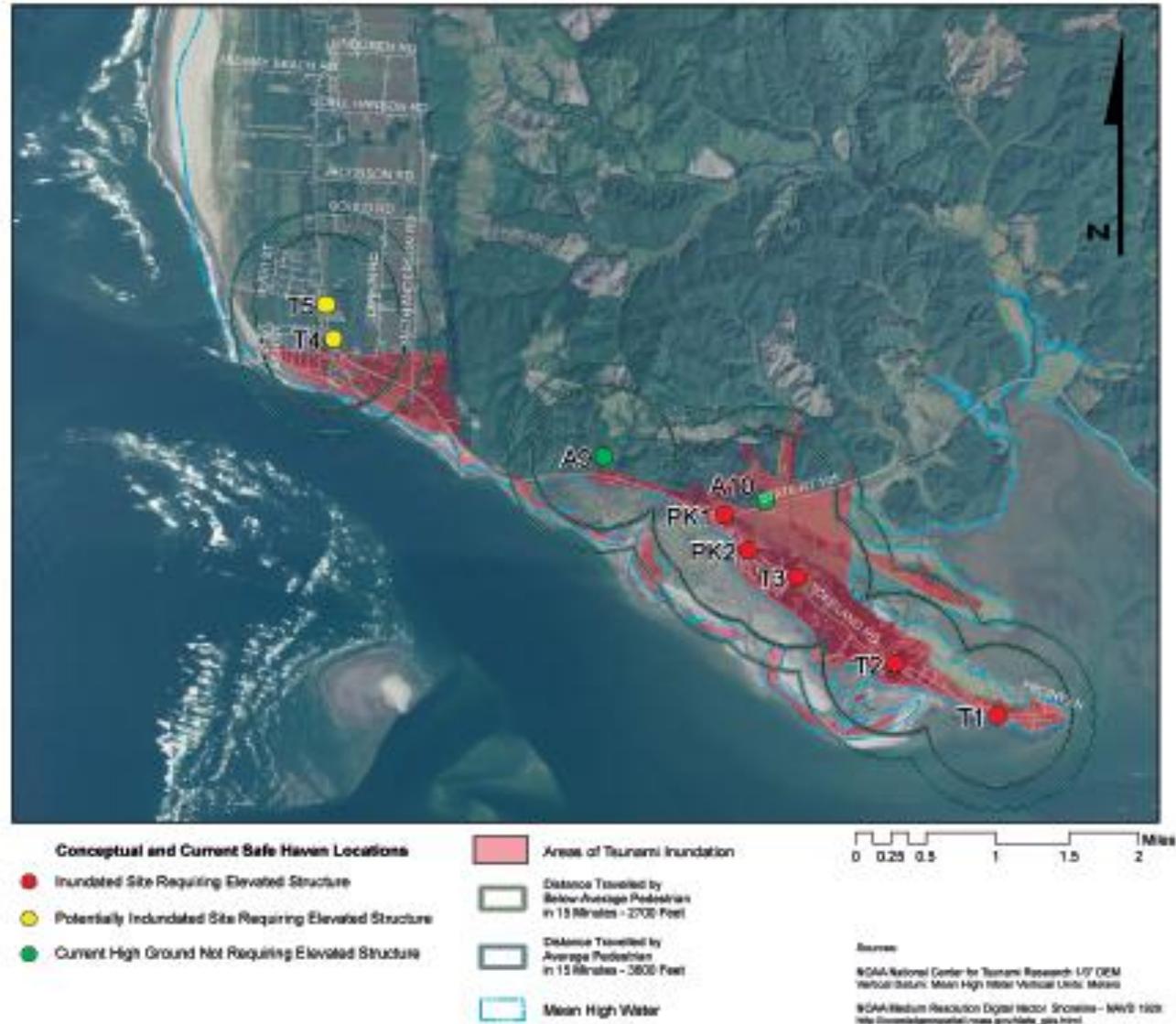
Ilwaco, Washington - Possible Vertical Evacuation Strategies



4. Tokeland/North Cove, WA

Preferred Strategy

- Focus on towers that can be used for bird watching.
- Leverage casino facility uses and construct elevated parking structure.



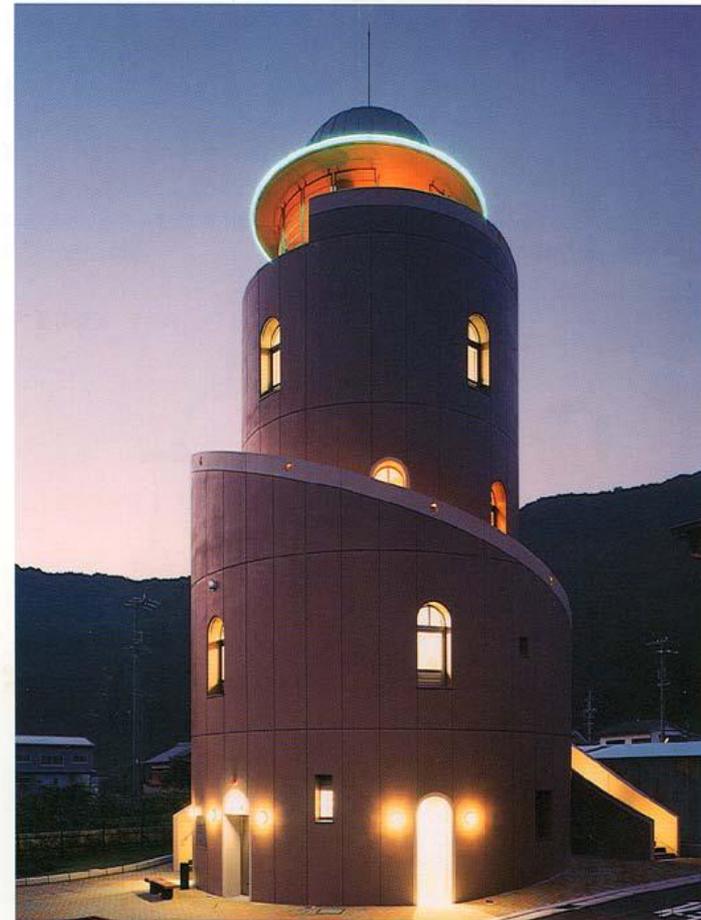
Grays Harbor Co. Evacuation Capacity Analysis

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

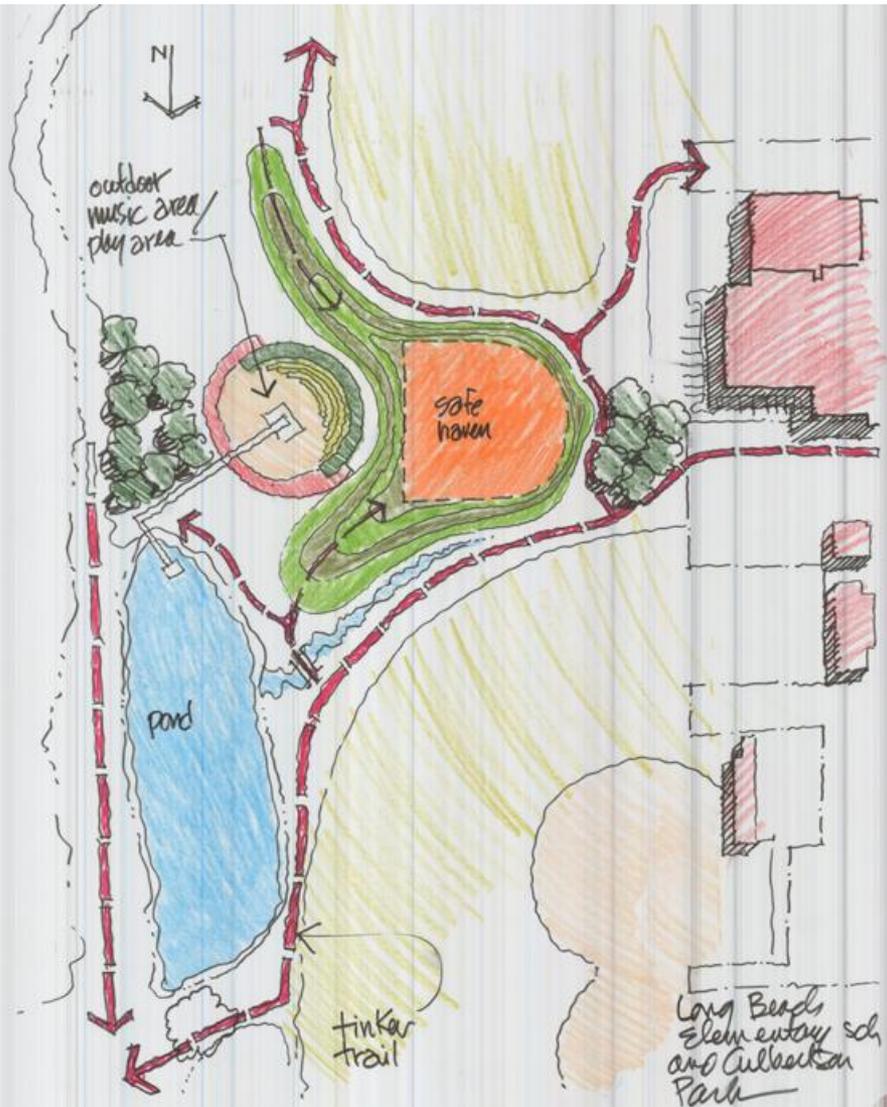
Step 2. Figure out what the community wants these things to look like!



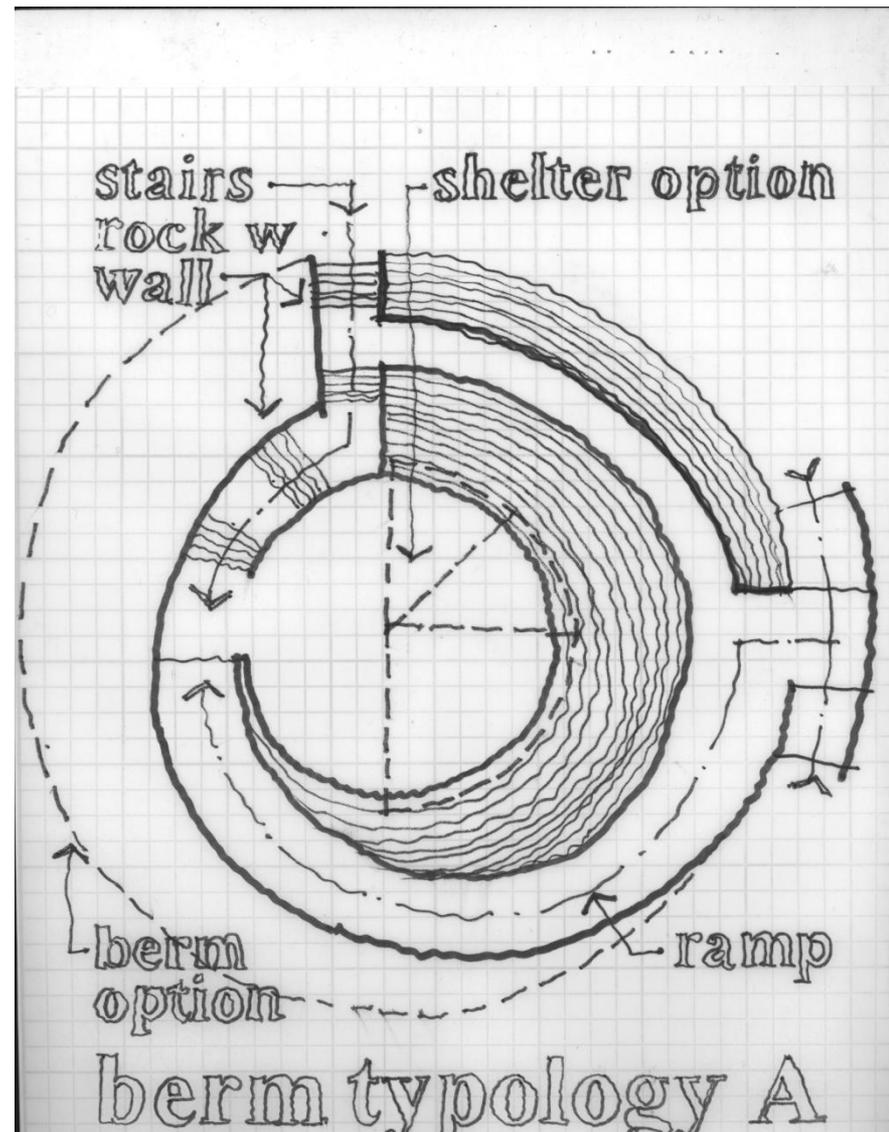
OR



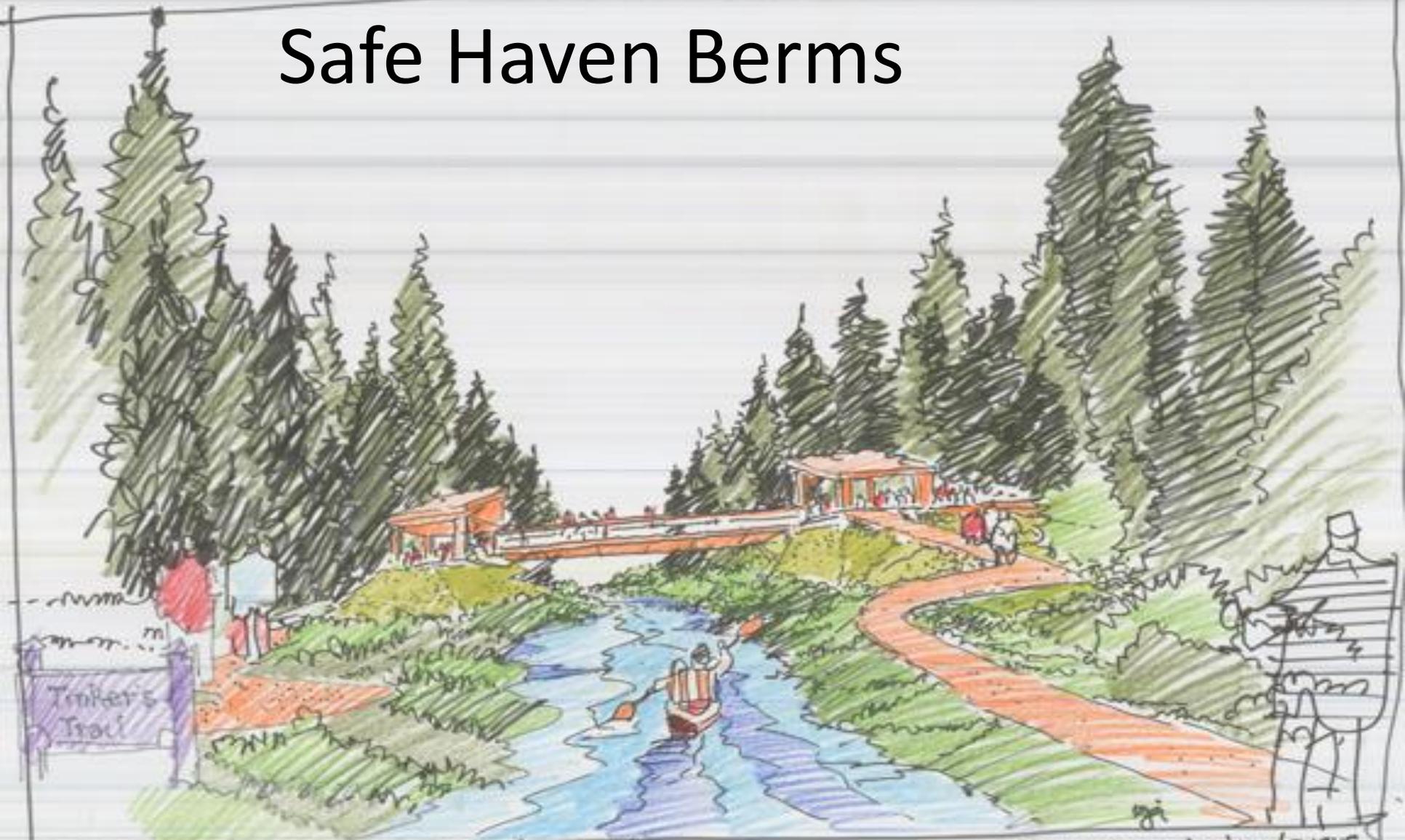
Safe Haven Berms



Safe Haven Berms



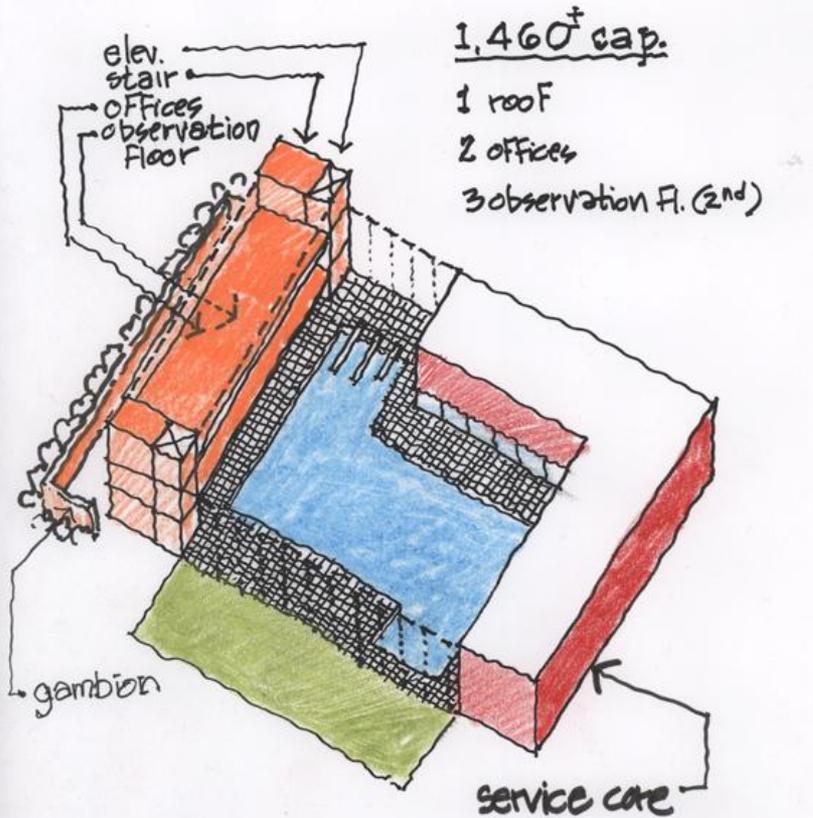
Safe Haven Berms



Long Beach Lagoon Park system

Berm/ramp viewing towers
w/s.H. bridge
100 - 200 people

Safe Haven Buildings



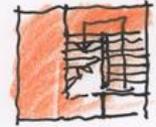
SAFE HAVEN POOL
BUILDING COMPONENT

SAFE HAVEN RESORT

BUILDING COMPONENT

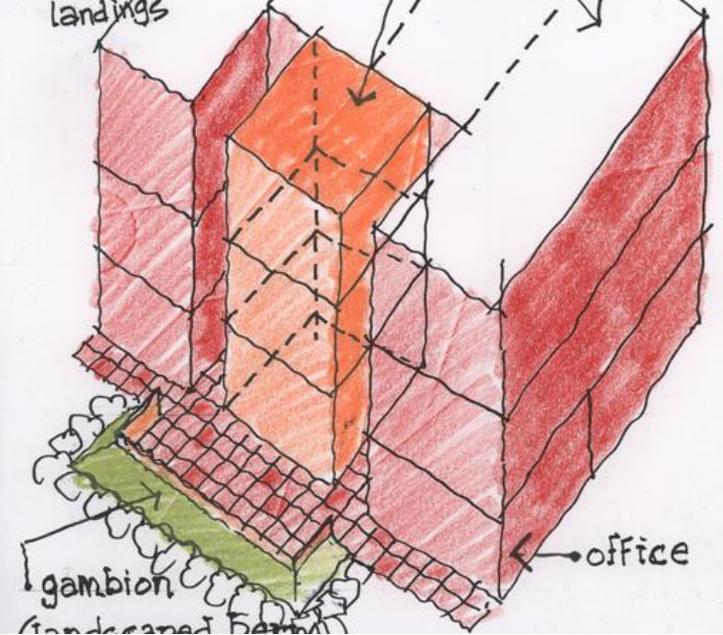
36 cap.

1 roof
2 stair/
landings



STAIR CORE

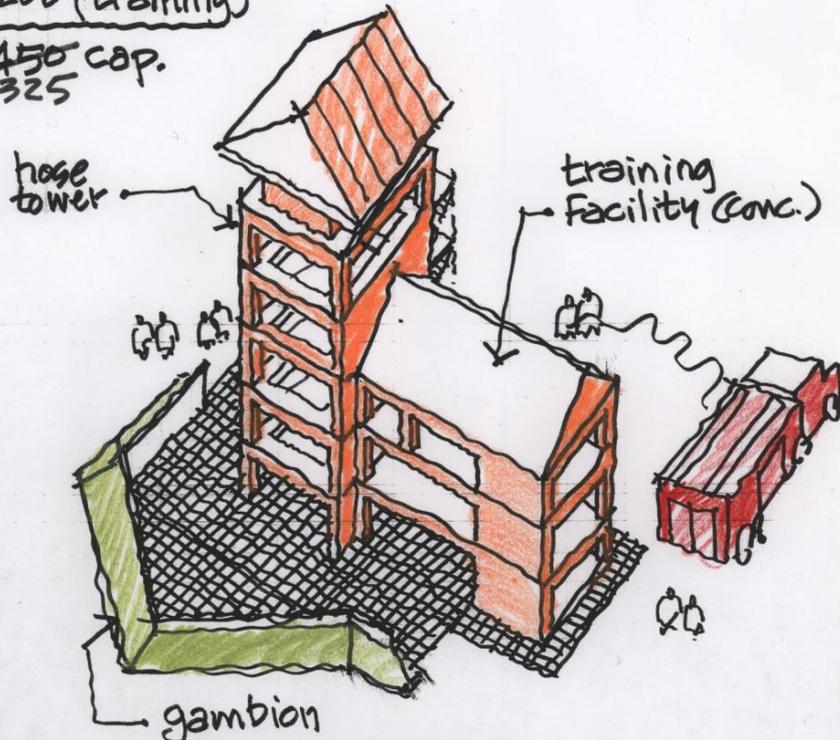
UNITS



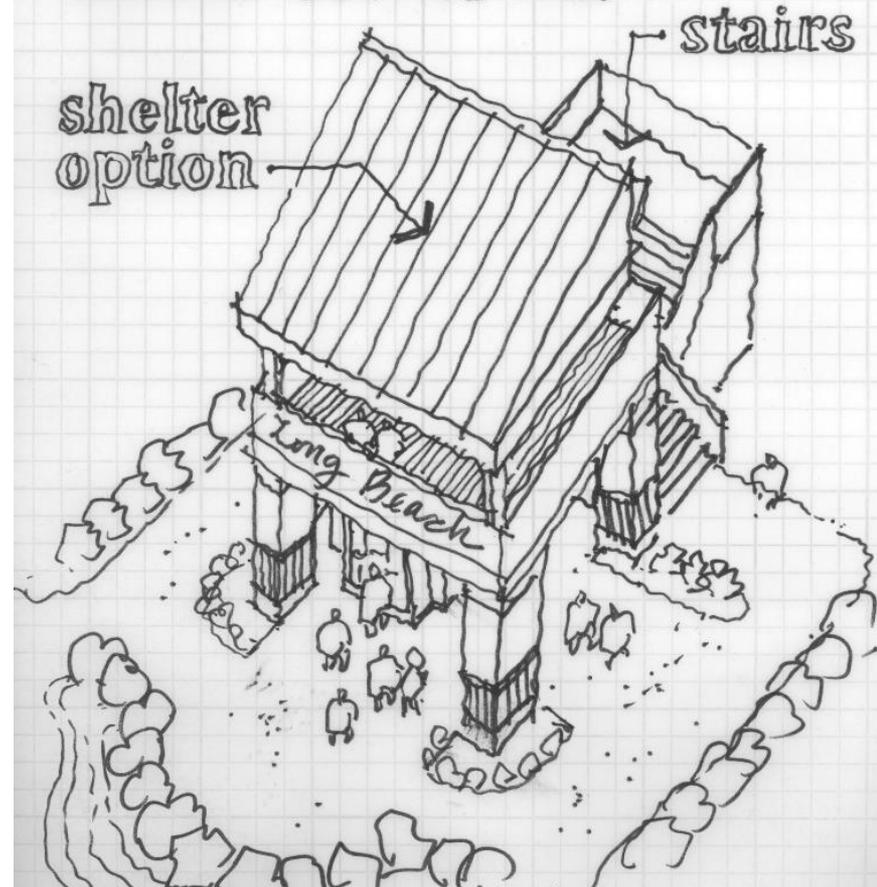
Safe Haven Towers

SAFE HAVEN FIRE HOSE/TOWER/ TRAINING FACILITY

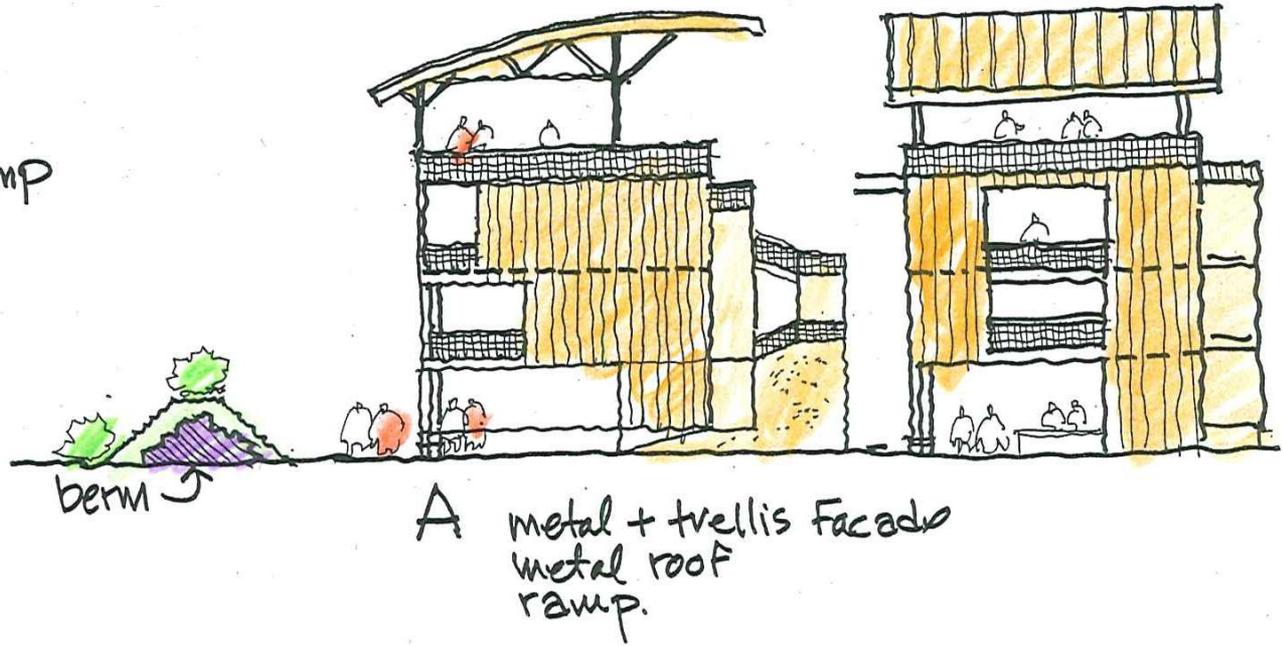
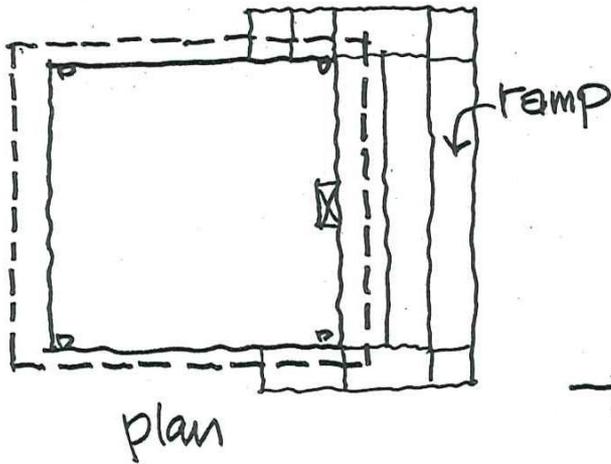
250 (tower)
125
200 (training)
450 cap.
325



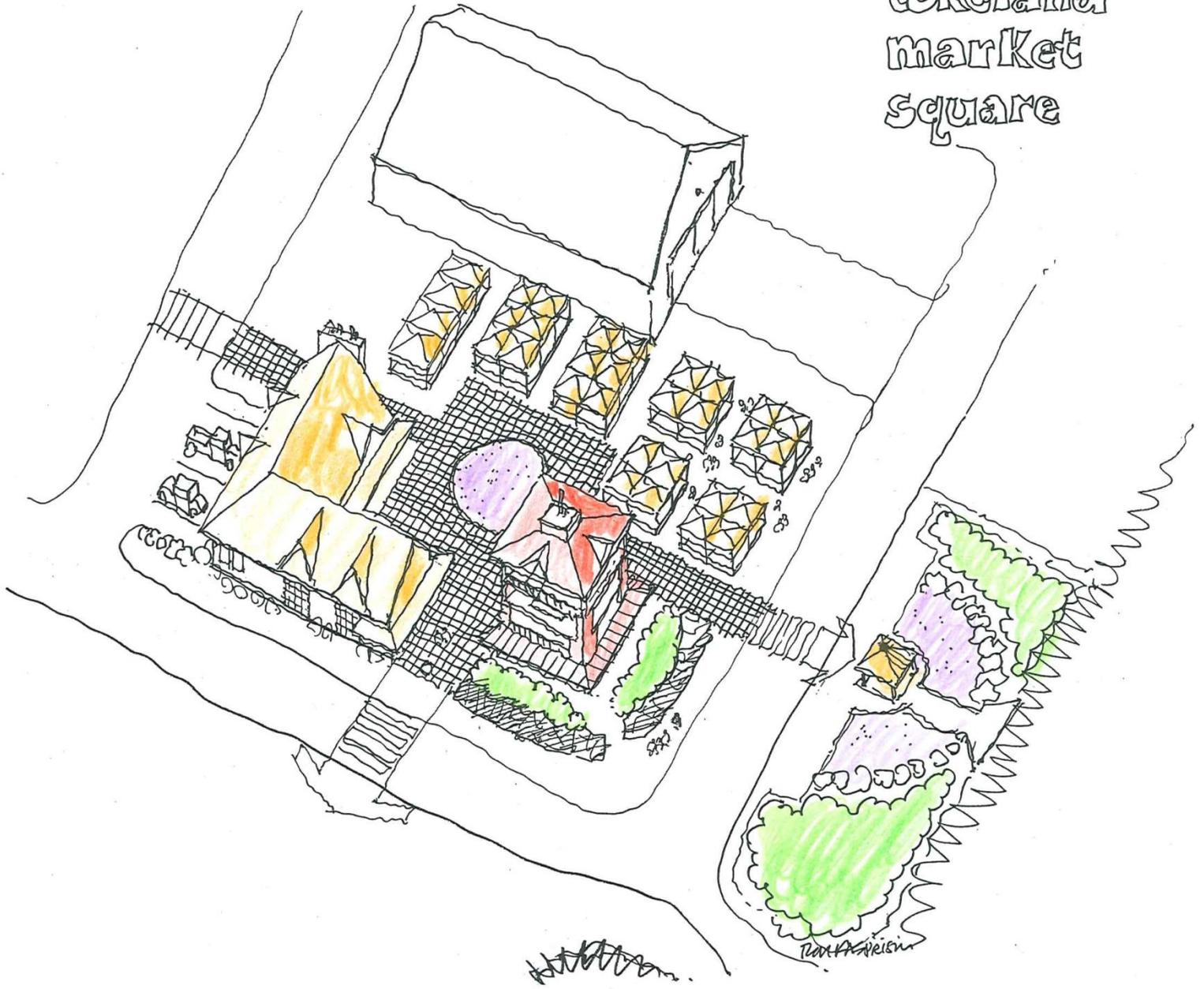
tower typology A visitor center ex.



Tokeland Tower Options



tokeland
market
square



Step 3. Figure out what the cost is...



(thank you, engineers)

	<i>Type</i>	<i>Community</i>	<i>Site</i>	<i>Min. Structure Height (feet)</i>	<i>Capacity (# of people)</i>	<i>Estimated Cost</i>
B1	berm	Long Beach	N Place & 41st Place	12	600	\$644,095
B2	berm	Long Beach	Washington Avenue South & 5th Street South	9	1000	\$839,708
B3	berm	Long Beach	Washington Avenue South & 2nd Street South	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

Detailed cost estimates for berm at Long Beach Elementary School (~1,000 person capacity)

Table 1: Long Beach Berm	
Scope	Cost
Site Utilities	\$49,814
Excavation-Backfill	\$289,512
Concrete	\$153,951
Landscaping	\$74,094
Construction Totals	\$567,370
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
Project Total	\$839,708

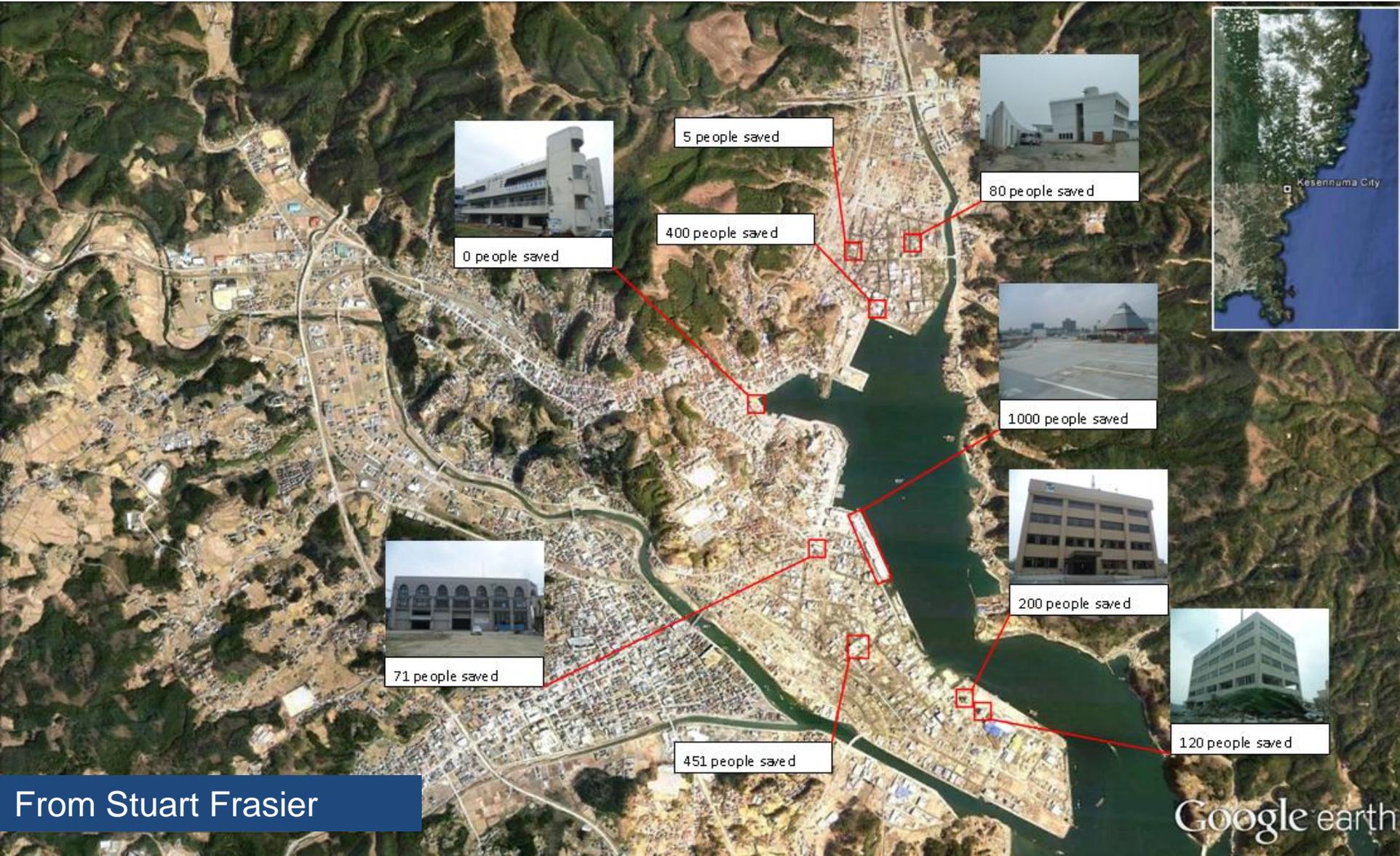
Step 4. Deliver a community based plan...



**And how do we know this will
work here????**

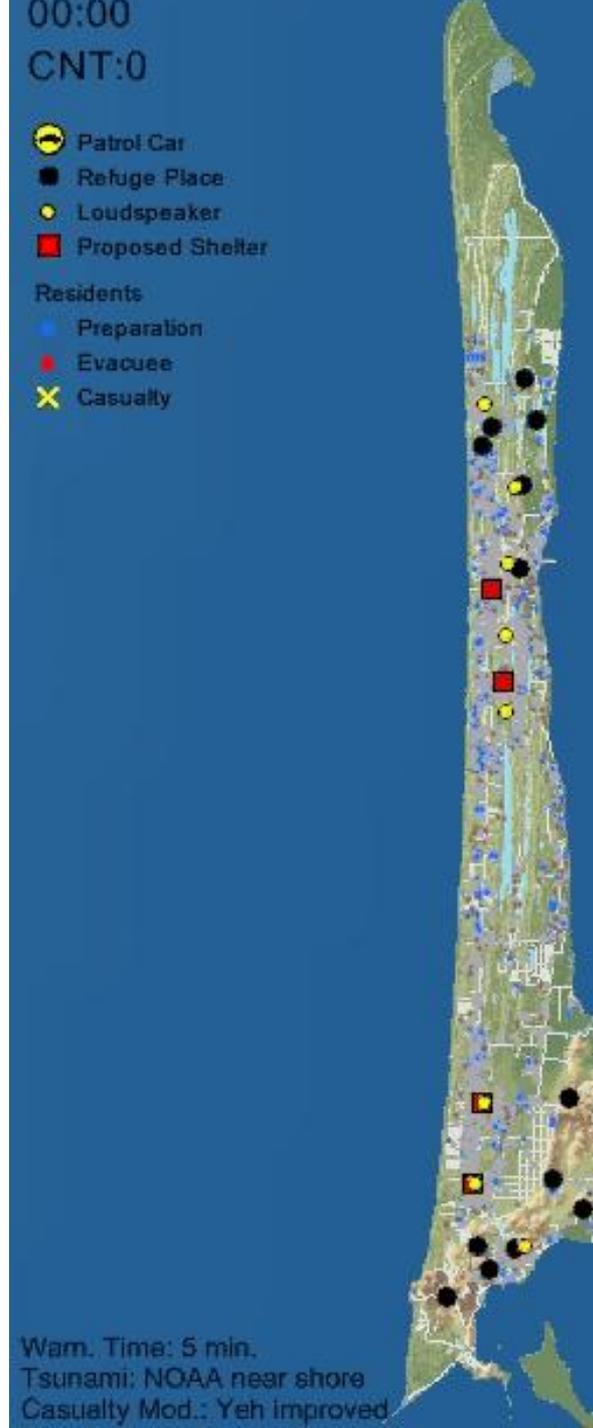


Because we've seen it work there!!!

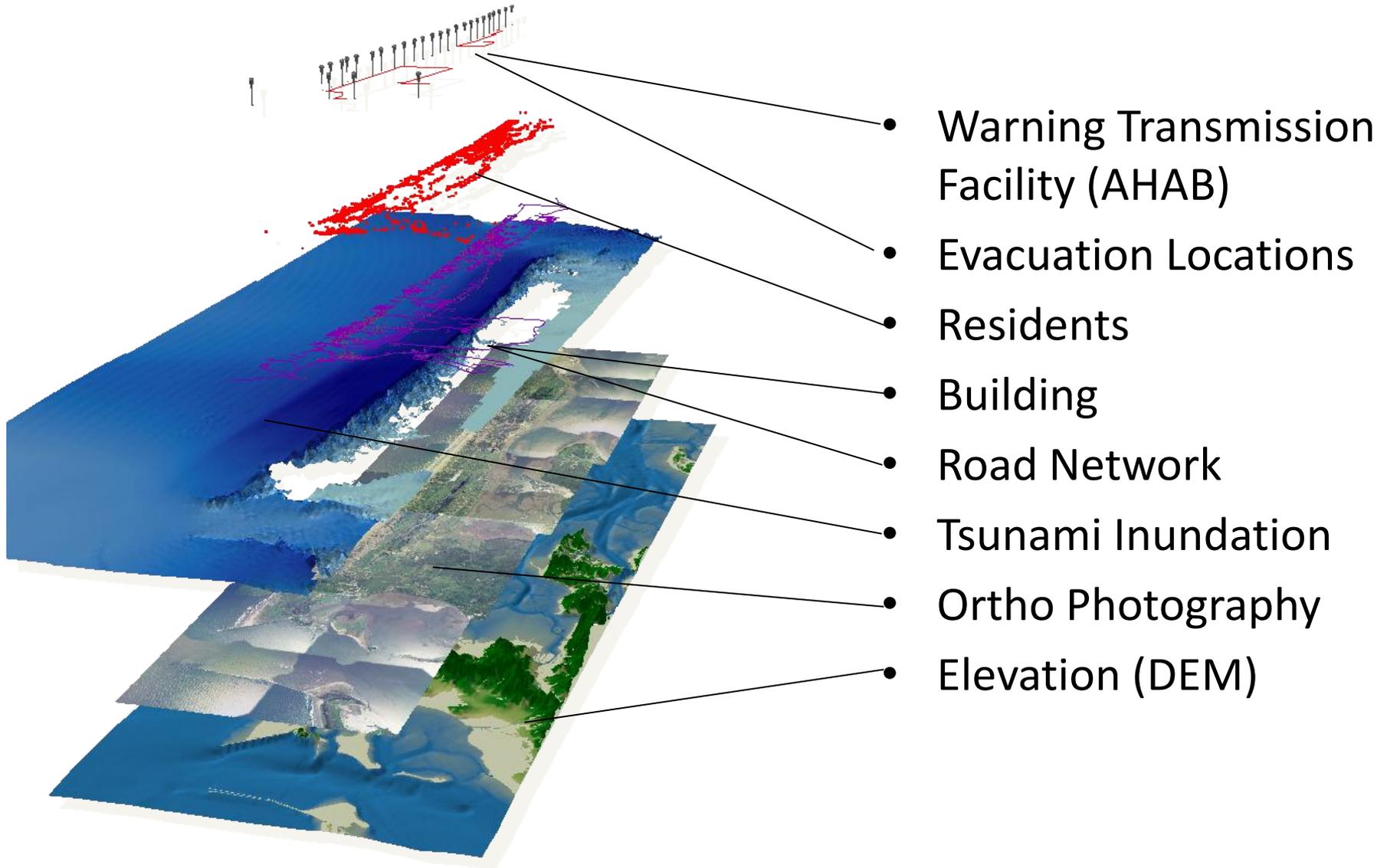


Tsunami Simulator for Evacuation Modeling

- Model developed for evacuation by Dr. Harry Yeh, Oregon State University and Tim Feitz, Gartnell Group
- Based on Japanese Modeling/Simulations



Tsunami Evacuation Simulator: Data Structure



Evacuees reaching safe havens (total population of 9097)

Locations of Safe Havens	Base Case	Scenario 1	Scenario 2	Scenario 3
Northern high grounds	2847	2884	2023	1780
67 th Place assembly area	878	649	664	324
HWY 101 high ground	776	722	726	514
Southern high grounds	1520	1273	1243	875
Long Beach refuge	---	850	850	803
Ocean Park refuge	---	---	830	782
Klipsan Beach refuge	---	---	---	724
Seaview refuge	---	---	---	896
Survived outside the safe zones	999	1008	1044	1048
Total survived/dead	7020/2077	7386/1711	7380/1717	7746/1351

So, Where Are We Going From Here?

- Finish Clallam County Safe Haven Plan (mid-2012)
 - Makah and Quileute Tribes
- Final presentations to County & Tribal Officials
- Additional modeling underway based on new LIDAR to verify minimum heights
- Continue to work with Counties, Tribes, Federal partners, State agencies, Private industry, etc. to seek funding for implementation
- Continue the Outreach - “Like” us on Facebook!

www.facebook.com/projectsafehaven

facebook