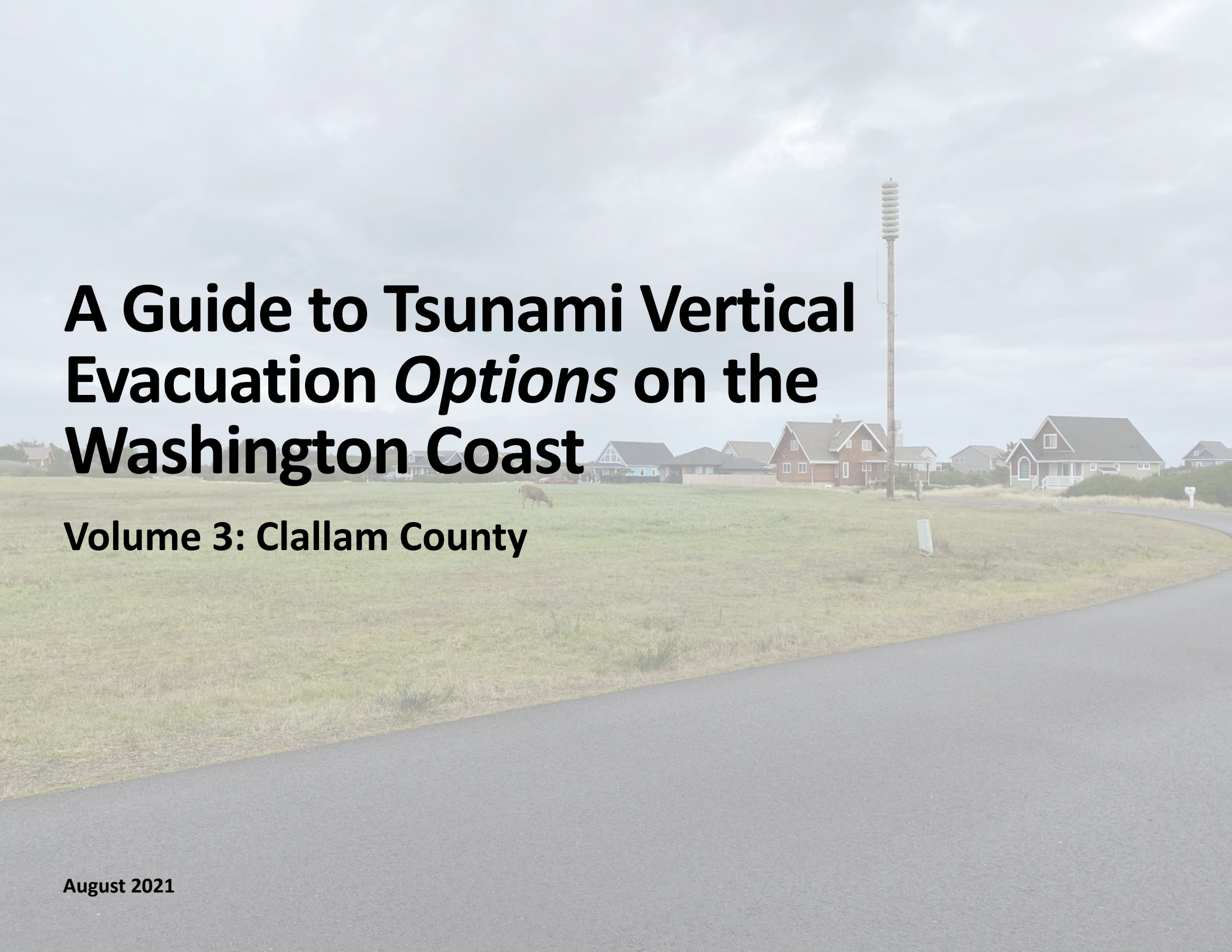

A Guide to Tsunami Vertical Evacuation *Options* on the Washington Coast

Volume 3: Clallam County

August 2021

Tsunami Vertical Evacuation *Options*

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Front Cover*: Spinnaker Park, Ocean Shores. Photo Credit: Jeana C. Gómez*

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Purpose

This guide was written to help Washington coastal communities save lives from tsunamis through the construction of accessible vertical evacuation structures. This effort is the product of an evolution of work began over 15 years ago. This guide builds upon prior efforts with the specific purpose being of verifying potential sites for vertical evacuation structures within coastal communities vulnerable to local source tsunamis. It is the intent of this guide to provide community leaders with a tool to save lives.

Vertical evacuation, as a strategy to reduce tsunami risk, has been explored and its applicability researched for over a decade. In the beginning, a series of community vertical evacuation planning meetings were held in Pacific County, Grays Harbor County, and Clallam County. The meetings and research efforts took place over the span of two years, which resulted in the development of a series of "SafeHaven" reports for each County. The reports are available on the State of Washington's Emergency Management Division's (EMD) website and are still accessible for download and review (https://mil.wa.gov/tsunami). Cost estimates for suggested sites were prepared in 2016 and the results are also available on the EMD website (https://mil.wa.gov/asset/5ba41ffe1efe2).

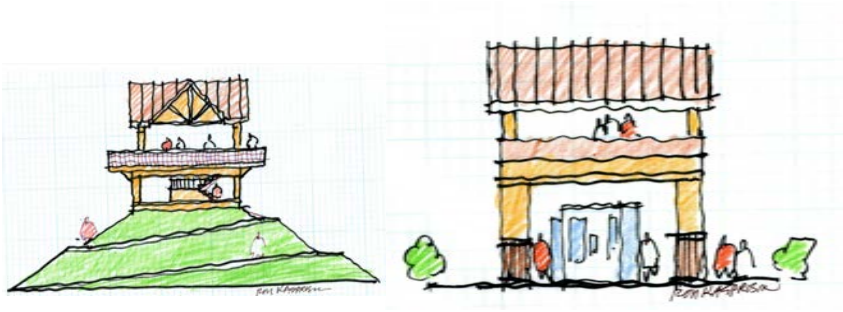
The first tsunami vertical evacuation structure built in north America is the Ocosta Elementary School. It was completed in 2016 and is near Westport, Washington. The Ocosta school district's superintendent had participated in the initial vertical evacuation planning for Westport and Grays Harbor County in 2011 and was a key advocate for not only getting the new Ocosta school funded through a local school bond, but also making it a vertical evacuation structure.

Building upon the successes and outcomes of the first completed vertical evacuation structure and initial rounds of community meetings and subsequent increasing public awareness, a "Manual for Tsunami Vertical Evacuation Structures" was completed in 2018. The Manual guides communities through the process of constructing tsunami vertical evacuation structures using a 7-phase approach. The Manual, 7-Phase Checklist, and PowerPoint presentation are available for download from the EMD website (https://mil.wa.gov/tsunami).

10 Years in the Making:

Community-Based Planning Process

- **2010 - 2012**: Pacific County, Grays Harbor County, Clallam County Community Planning + Visioning Process
- **2016**: Cost Estimate Report
- **2018**: Vertical Evacuation Manual for Communities
- **2020**: Site Verification and Assessment of Vertical Evacuation Options



In the 2010 “SafeHaven” reports, proposed vertical evacuation structure scenarios were developed for each participating community. Community members and other key stakeholders were the primary authors of each proposed scenario, especially the proposed locations or sites. Several vertical evacuation typologies were considered: structures, towers, berms and combinations. Technical experts and University of Washington researchers and community planners supported the process and led the report production.

This guide is an evolution of the work completed since 2010. The specific purpose of this research effort is to verify and analyze the proposed or potential sites for vertical evacuation structures in each study area using four vertical evacuation options. The 2010 “Safe Haven” reports identified multiple potential locations for vertical evacuation structures based on public land availability, walking distances/times, and population clusters (see Appendix A for a complete list of 2010 sites).

After completion of the SafeHaven reports, the USGS-developed the Pedestrian Evacuation Analyst Tool (PEAT), an ArcGIS/ArcMap extension that analyzes the walk times for each proposed vertical evacuation site. This tool was seen as a way to verify and strengthen the community-based suggestions of the earlier SafeHaven efforts, and it became the driver of this guide.

The PEAT takes into account terrain, population location, land use, water features, likely walk routes, and elevation. Additionally, the PEAT analyzes and calculates walk times and routes for communities using no added potential vertical evacuation. For the purposes of this research, the “no vertical evacuation” scenario became Option 1 and can be considered the baseline for each community. Option 2 included all proposed sites from the 2010-2011 community planning effort and Options 3 and 4 were adaptations of Option 2. Option 3 expanded the spatial coverage of Option 2 by adding additional potential vertical evacuation sites and Option 4 attempts to highlight the most efficient or lean approach to vertical evacuation for each community (often with a reduced number of sites, leaving only the most strategic locations). Each option has an accompanying set of statistics that identify the benefits of each, and the percentage of the population accommodated by each option. Population types are broken down into residents, schools, and fire departments. The complete set of results for each community study area will serve as the basis of local decision-making.

The research results in this guide can be adapted and further explored. It is assumed that local leaders will have feedback as to how the outcomes of this work can support their decision-making and be fine-tuned for the specifics of the evolving nature of their communities. This research team looks forward to on-going engagement with the local communities highlighted in this report.

Project Assumptions

Tsunami Hazard

1. The scenario event is a 9.0 magnitude subduction zone earthquake approximately 80 miles off the coast of the Long Beach peninsula.

2. The earthquake shaking could last five to six minutes and will create a tsunami.

3. Six feet of subsidence is expected.

4. The warning before the tsunami will be the earthquake.

5. There will be about 15 minutes between the cessation of shaking and arrival of the first tsunami wave.

6. Although tsunami models estimate that people will have approximately 20 minutes to get to high ground once the shaking begins, the preferred strategies contained within this study are based on people having only 15 minutes due to approximately 5 minutes of expected intense shaking. This reduced response time does not take into account the following challenges that people will face in getting to high ground: people not evacuating right away due to not understanding what is happening or what to do, looking for more information, contacting loved ones, finding pets, being injured, and grabbing supplies; poor road/evacuation route conditions resulting from landslides, liquefaction, downed power lines/trees, and traffic; and possible panic. People will have 15 minutes or less to get to high ground.

7. Tsunamis consist of multiple waves over a 12-24 hour or longer time period. The first wave is often not the highest wave.

8. Tsunami refugees will need to remain on the structure until it is safe to return to the ground. This could take 24-48 hours or longer.

9. Routes to high ground, including vertical evacuation structures will be available, accessible, and discernible after the earthquake and at night.

10. Those evacuating will walk/run to high ground, which includes the vertical evacuation structures. Travel by car will not be possible.

11. Communication will be limited.

12. Many of the bridges located in the study area, hazard area are assumed to be “out” following the shaking from the earthquake. This is reflected in the walk times for each community.

Population Capabilities

1. The majority of the population in the tsunami risk areas is physically mobile and can walk to the proposed tsunami evacuation sites.

2. The average fast walking speed of a typical individual is 1.52 meters/ second or 4,488 feet in 15 minutes and the average slow walking speed of a typical individual is 1.1 meters/second or 3,248 feet in 15 minutes. For the purposes of this analysis, the slow walking speed was used. Source: FHA (2009)

3. People on the beach have average to high physical mobility.

4. Residents and visitors understand the tsunami risk, know what to do to protect themselves, know where high ground is and how to get to it as quickly as possible.

Vertical Evacuation Tower Design + Construction

1. Vertical evacuation structures can be provided.

2. The margin of safety (distance between the height of the tsunami and the floor of the tower) is factored to be 30% of the height of the tsunami, plus 10 feet.

3. If the vertical evacuation structures are constructed on sites where wetlands are compromised, new wetlands will be developed or the compromised wetland will be mitigated in another way.

4. Each vertical evacuation structure will provide ten square feet of space per person (FEMA design standard minimum).

Other Considerations

1. Each community will need to obtain funding to construct the vertical evacuation structures that best accommodate the needs of its resident population. This can come in the form of a local tax, federal funding, grant funding, etc.

2. In addition, the extent to which visitors are considered will need to be determined. Options 1-4 **only consider residents, workers, and overnight visitors staying at hotels/motels. The options do not include all types of visitors or peak summer day visitor populations.**

3. Options 1-4 uses a "maximum build-out" population scenario to determine population numbers and location. Meaning, the estimated population includes every residentially-zoned property with a structure and assumes *average occupancy* for each residentially-zoned property with a structure.

4. Average occupancy per residential property with a structure is based on each community's 2010 Census "Average Household Size." The complete set of residential properties included in the analysis are:

    - Single-family
    - 2-4 units
    - Multifamily
    - Mobile Home Park
    - Hotel/Motel (occupancy based on # of rooms)
    - Institutional

5. VES stands for "Vertical Evacuation Structure"

6. Options 1-4 assume that people within the "slow walking speed" distance of existing "natural high ground" will be able to reach it and thus not need to evacuate to a VES. These areas of "natural high ground" throughout the study areas are often small and unmarked areas of land. Some of these areas may be difficult to identify and access during a tsunami.

7. Option 2 was developed in partnership with local community members, state scientists, and researchers from the University of Washington (2010-2011).

8. Options 1, 3, and 4 were developed as an outcome of further and ongoing analysis conducted in 2020 to assess multiple options per each community study area.

9. *Resident and visitor knowledge of existing natural high ground in each community study area is not a given. In fact, natural high ground signage and way-finding should be considered a key component of a vertical evacuation strategy. The analysis completed in this study relies upon access to existing natural high ground for some residents or visitors.

Methodology

The methodology developed and used in the preparation of this guide leaned heavily upon the use of the Tsunami Pedestrian Evacuation Analysis Tool (PEAT), an ArcGIS extension developed by the United States Geologic Survey (USGS). The PEAT served as the primary basis for analysis of four vertical evacuation options in Pacific County, Grays Harbor County, and Clallam County. Several high-risk communities or "study areas" in each County were assessed. A complete list of the "study areas":

- Pacific County: Ilwaco, Seaview, Long Beach South, Long Beach North, Ocean Park, Oysterville, Leadbetter, Tokeland, and North Cove
- Grays Harbor County: Grayland, Westport, Ocean Shores West, Ocean Shores East, Taholah, and Aberdeen/Hoquiam/Cosmopolis
- Clallam County: La Push and Neah Bay

In preparation for the analysis element of the project, several existing datasets and policies had to be gathered and interpreted, both to serve as a reference point and context as well as data input. This project includes the results of the 2010-2011 SafeHaven community planning effort as a starting point that developed a single vertical evacuation option or scenario, by "study area." The various individual community scenarios were developed by the community members with support from University of Washington researchers, State technical and subject-matter experts, and local leaders. The primary driver of these SafeHaven developed scenarios included a walking circle exercise to help community members determine how many people would be able to walk (or run) to each proposed vertical evacuation structure (VES). The walking circles used the research of Kaeser and Laplante (2007) and assumed a walk speed of 4 feet/second for average able-bodied individuals and a walk speed of 3 feet/second for slower than average individuals (i.e. the elderly with limited physical mobility, etc.). The walking circles helped community members decide where the vertical evacuation structures should be located. Proposed sites were also determined based upon public or vacant land availability (as it existed in 2010-2011) and strategic locations close to population, visitor centers, schools, senior centers, etc.

Within this guide, two of the four resulting vertical evacuation options for each community were already developed going into this round of research and analysis: Option 1 (*no vertical evacuation*) and Option 2 (*community-derived*). The remaining two options are new: Option 3 (*broad spatial coverage*) and Option 4 (*efficient/lean*). All four vertical evacuation options were analyzed during this effort using the PEAT. Each "study area" required a 5-step process to analyze all vertical evacuation options, including an option without vertical evacuation. The 5-step process includes the following:

1. Context Map: Identifies tsunami risk zone, naturally-occurring high ground, impassable areas that have a land classification of either wetland or water (per the National Land Classification Database or the National Wetlands Inventory), tsunami siren locations, school locations, and fire department locations.

2. Option #1: No Vertical Evacuation

    - This option assumes no new or future vertical evacuation structures will be built. It models resident walk times as if the scenario tsunami were to happen tomorrow.

3. Option #2: Community-Derived Vertical Evacuation Structures

    - This option includes VES locations that were proposed and confirmed through a rigorous community planning process, called "Project Safe Haven." At the time, various types of vertical evacuation structures were considered by the community (i.e. berm, tower, etc.), however for the purposes of current research effort we are assuming a generic vertical evacuation type and did not drill down to the scale of measuring or considering the merits of each potential type of structure. Rather, the placement or location of each structure is what matters most for this effort.

4. Option #3: Broad Spatial Coverage

    - This option attempts to achieve broad spatial coverage in each study area or community. In some cases, depending upon the study area, vertical evacuation structures were added to Option #2 to fill gaps. In other cases, Option #2 already met the goal of broad spatial coverage for the populations of primary concern (resident/worker/overnight visitor/school) so no changes were necessary.

5. Option #4: Efficient/Lean

    - This option attempts to strike a balance between cost and coverage. Meaning, this option presents the "biggest bang for the buck" or, "the best of both worlds." Each proposed location in Options #2 and #3 were analyzed to determine most efficient placement to maximize coverage. Some locations were moved or even removed entirely to develop an option that is both strong (in terms of coverage, # of people in walking distance) and realistic (in terms of cost).

Population

Estimated resident, school, fire department, and overnight visitor population was added to each study area in each expected spatial location. The population layer informed each vertical evacuation option (1-4) to calculate evacuation times and routes to "safe zones" (both naturally-occurring and proposed vertical evacuation structures). Furthermore, the addition of people helps to determine which option serves the greatest number of people with the fewest vertical evacuation structures.

Estimated population was calculated using the following process: County parcel-level data, referencing use codes. All residential parcels were selected and exported as their own layer. Then, the residential parcel layer was further refined based upon whether or not there was a structure located in the parcel. This step was supported by the addition of Microsoft's national Building Footprint shapefile. A spatial join was used to bring the residential parcel data and the building footprint data together to create a unique layer of residential parcels with single or multiple buildings. This calculation was used to assume occupancy and to sharpen the population estimate. Depending upon the type of residential parcel (i.e. single family, multi family, hotel, etc.), a population count was assigned using the following methodology:

1. Each study area's average household size was calculated, based on the 2010 Census, except for Neah Bay (which was based on the 2019 ACS estimate). This set average people per single family residential parcel, or average household size (AHS) as determined by the 2010 Census:

    - Single-family = average household size (AHS)
    - 2-4 units = AHS * 3
    - Multifamily = AHS * 8
    - Mobile Home Park = AHS * # of units per each park (Google Earth to identify # of units)
    - Hotel/Motel = AHS * # of rooms (hotel website or called hotel to determine # of rooms)
    - Institutional = AHS * # of rooms or occupancy for each facility (facility website or phone to determine occupancy)

The population methodology errs on the conservative estimate side because it assumes every residential parcel with a structure is occupied. We used this approach as it provides a solid basis for population estimation that may reflect a community's future population growth. It also provides flexibility for higher counts of visitors in the summer or even several days each year with spikes in visitors due to tourist events.

Note: The 2010 Census reflects population statistics that are ten years old. 2019 ACS estimates have also been documented for each community study area in this guide and are provided in Appendix C, for comparison and awareness as to general population and household trends in the last ten years.

Pedestrian Evacuation Analyst Tool (PEAT)

Each Option was analyzed using the ArcGIS PEAT. The PEAT uses a 9-Step process to calculate walk times, per each Option, and produce results:

Step 1: **Set the community study area boundaries**.

Three State of Washington counties are most at-risk from the tsunami scenario and therefore selected to inform this research: Pacific County, Grays Harbor County, and Clallam County. The PEAT works best at a smaller scale, so each county was sub-divided into several communities. The study areas follow existing jurisdictional boundaries (where they exist) and some of the larger jurisdictions were further sub-divided into sub-areas to meet the processing constraints of PEAT.

Note: The sub-dividing of community study areas was required for this work to meet the constraints of the PEAT. At the same time, for some communities like Long Beach and Ocean Shores, it is assumed that the results of each community sub-area will be looked at more closely in the future before decision-making due to the limitations of sub-dividing at the community or city scale. For example, there are some proposed VES locations in Long Beach - South that are close to a proposed VES location in Long Beach - North. The current sub-division likely over estimates the necessary number of VES. To get a clearer understanding of the VES needs for the entire City of Long Beach an additional PEAT run for the entire city would need to be completed. This requires a high processing speed computer and a patient researcher. It's challenging, but certainly possible. The authors of this guide foresee additional "whole community" PEAT runs in the community for both Long Beach and Ocean Shores to sharpen the level of comprehensive analysis.

Step 2: **Pre-process digital elevation model (DEM) data**.

This step took high resolution elevation data and applied it to the study area. It's an important first step because high resolution elevation data provides a basis for determining ultimate realistic evacuation routes.

Pacific County	Grays Harbor County	Clallam County
Ilwaco	Grayland	La Push
Seaview	Ocean Shores - West	Neah Bay
Long Beach - South	Ocean Shores - East	
Long Beach - North	Taholah	
Ocean Park	Aberdeen/Hoquiam/Cosmopolis	
Oysterville		
Leadbetter		
Tokeland		
North Cove		

DEM data from the USGS (Washington 10-meter DEM) was used for this project, set to an analysis cell size of 3 (http://gis.ess.washington.edu/data/raster/tenmeter/byquad/index.html). Important note: All GIS data used or created for this project used the following coordinate system and projection:

- Coordinates: NAD_1983_HARN_StatePlane_Washington_South_FIPS_4602_Feet
- Projection: Lambert_Conformal_Conic

Step 3: **Pre-process land use and land cover data**.

This step referenced several land use and land cover inputs, and combined them into a single land use/land cover layer for analysis. The primary base layer is land classification data defined by the North American Land Change Monitoring System (NALCMS), set at 30 meters, with a publish date of 2015 (http://www.cec.org/north-american-environmental-atlas/land-cover-30m-2015-landsat-and-rapideye/#:~:text=This%20map%20of%20North%20American,and%20RapidEye%20imagery%20for%20Mexico). The base layer uses a system of nineteen Level II land cover classes defined using the Land Cover Classification System (LCCS) standard developed by the Food and Agriculture Organization (FAO) of the United Nations. Of the nineteen categories, only eleven are relevant to the Pacific County, Grays Harbor County, and Clallam County study areas: 1, 5, 6, 8, 10, 14, 15, 16, 17, 18, 19.

The complete list includes:

- Value 1, Temperate or sub-polar needleleaf forest (.**6667**)
- Value 2, Sub-polar taiga needleleaf forest
- Value 3, Tropical or sub-tropical broadleaf evergreen forest
- Value 4, Tropical or sub-tropical broadleaf deciduous forest
- Value 5, Temperate or sub-polar broadleaf deciduous forest (.**6667**)
- Value 6, Mixed forest (.**6667**)
- Value 7, Tropical or sub-tropical shrubland
- Value 8, Temperate or sub-polar shrubland (.**8883**)
- Value 9, Tropical or sub-tropical grassland
- Value 10, Temperate or sub-polar grassland (.**8883**)
- Value 11, Sub-polar or polar shrubland-lichen-moss
- Value 12, Sub-polar or polar grassland-lichen-moss
- Value 13, Sub-polar or polar barren-lichen-moss
- Value 14, Wetland, RGB (**0**)
- Value 15, Cropland, RGB (.**5556**)
- Value 16, Barren lands (.**5556**)
- Value 17, Urban, RGB (.**9091**)
- Value 18, Water, RGB (**0**)
- Value 19, Snow and Ice (**0**)

The relevant categories are also indicated with a decimal number located in parenthesis. This number categorizes the "speed" at which a pedestrian would be able to traverse this land classification on foot. A classification of **1** is fastest (i.e. roads) and a classification of **0** means travel is not possible (i.e. water).

In addition to the NALCMS land classification data, the following data was added as ancillary layers:

- Impassable Land (wetland and water). This data further clarifies land that is either currently water or would become water (current classification = wetland) post-earthquake shaking and subsequent subsidence. Because we don't know when the scenario earthquake/tsunami will take place (i.e. winter, high tide, etc.) we made the decision to classify all wetlands as water. This is a more conservative approach, but one we are confident in making for providing a conservative baseline estimate. If any particular local jurisdiction would like to augment this approach, that would be possible following the completion of this round of analysis. The data comes from the National Wetlands Inventory, produced by the Department of Fish and Wildlife. This data was assigned a travel value of **0**.

- Sand/Beach land classification.* This data further clarifies the land that may also have a water classification in the National Wetlands Inventory, but at times throughout the tide cycle is actually sand (or beach) and may have people located in these areas that will need to evacuate on foot. This data was assigned a travel value of **.5556**.

- Roads. The roads layer for each county was downloaded from the Pacific County, Grays Harbor County, and Clallam County GIS data download websites. The exception is that the Grays Harbor County roads layer was augmented by the Open Street Map roads layer for Grays Harbor County as we found it was more comprehensive than the roads layer from the County. A 25-foot buffer was drawn for all roads layers to represent the width of the road network more fully. This was important as the roads network is the primary or best path for

pedestrian evacuation to either high ground or proposed vertical evacuation structures. This data was assigned a travel value of **1**.

- Bridges likely to have collapsed, in an impassable condition, following earthquake shaking.* This data layer was created after field work to confirm the location, typology, and condition of area bridges. For the purposes of this project we are assuming bridges over water bodies will collapse during the earthquake shaking and therefore will not be a reliable pathway for pedestrian evacuation. This data, therefore, was assigned a travel value of **0**.

- Parcels located in wetlands, but with residential structures.* For the purposes of this project and the decision to err on the side of caution regarding assumptions made about land classified as wetlands (set at a travel value of **1**), some residential structures are located in travel value land classifications of **0**, meaning that the people who live in those structures were left out of the pedestrian counts. To rectify this, and to create a more comprehensive pedestrian evacuation count, the residential parcels with structures were added back into the analysis and re-assigned a travel value of **.5556**, the same travel value used for sand.

Step 4: **Pre-process tsunami hazard area data**.

This step includes the addition of the scenario event's (Cascadia subduction zone tsunami, 9.0 earthquake) tsunami inundation areas. This data layer tells us which area of the community will be inundated with water from the tsunami. The source of this data is from the State of Washington's Department of Natural Resources. The inverse of the inundation zone is defined as the "safe zone."

Step 5: **Run the "Path Distance" tool to determine likely walk paths**.

This step takes the pre-processed DEM data and the pre-processed safe zone data to determine the travel distance from every cell in the study area to the nearest safe zone.

Step 6: **Run the "Evacuation Time Surface" tool to determine walking time bands along likely walking paths**.

This step takes the Path Distance output and multiplies it by a set travel speed. For the purposes of this project, we are using the slowest available travel speed "slow walk" as the baseline/primary travel speed. This is to, again, err on the side of caution and account for people who walk slower than the average person. This is particularly relevant for many of the communities in the study areas as they often have a higher than average elderly population whose walking speeds may be impacted by a number of factors. The "slow walk" travel speed assumes a travel-speed value (meters/second) of 1.1. For comparison, a "slow run" travel-speed value is 1.79 and a "fast run" travel speed value is 3.85. The walking speeds come from the Federal Highway Administration (2009); running speeds form MarathonGuide.com (2011).

Step 7: **Run the "Time Map Generation" tool to convert the "Evacuation Time Surface" results into 1-minute increment bands**.

This step takes the output from Step 6 (Evacuation Time Surface) and converts it into 1-minute increment bands. This properly maps the pedestrian evacuation walking time to safety (aka. naturally-occurring high ground) from any given location in the profiled community or study area.

Step 8: **Run a full analysis for each proposed vertical evacuation structure/location, including a time map for each structure**.

This step is the most important for the purposes of this project. Here is where the potential vertical evacuation locations get added to Step 7's results. The potential vertical evacuation locations augment Step 7's results by creating additional "safe zones." As a result, potential vertical evacuation locations change the time map bands - producing a new time map output that is customized for each vertical evacuation option. Step 8 was completed for each unique vertical evacuation option, per each study area or community. Step 8's output is more robust than the previous steps. Here, Step 8 produces a set of new results for each vertical

evacuation option, including: a revised “safe zone” shapefile and a revised “time map” - one for each individual potential vertical evacuation location and one for the entire set of potential vertical evacuation locations, referred to as “All”.

Step 9: **Determine population counts at various travel times to safety and creates output tables to quantify # of people per # of minutes**.

The final step includes the addition of population counts for each vertical evacuation option (*see Population methodology*). This step is important because it references the estimated location of people and number people, as well as provides the starting point for pedestrian evacuation (which determines minutes to safety). The PEAT allows for differentiating between different types of populations. For the purposes of this project, we created three population categories: residents (including workers and overnight visitors), schools, and fire departments. Adding population to the potential vertical evacuation sites determines the hazard zone population served by each structure. This kind of information supports site selection decision-making. The output of Step 9 includes spreadsheets for each population type according to how many people per each minute of evacuation time increment. For example: Long Beach - North’s Vertical Evacuation Option 3 approximates 2,917 people within under 15 minutes from a “safe zone,” 1,117 people between 15 minutes and 25 minutes from a “safe zone,” and 74 people over 25 minutes from a “safe zone.” This is exactly the kind of granular data required to make informed decisions about each study area’s vertical evacuation options.

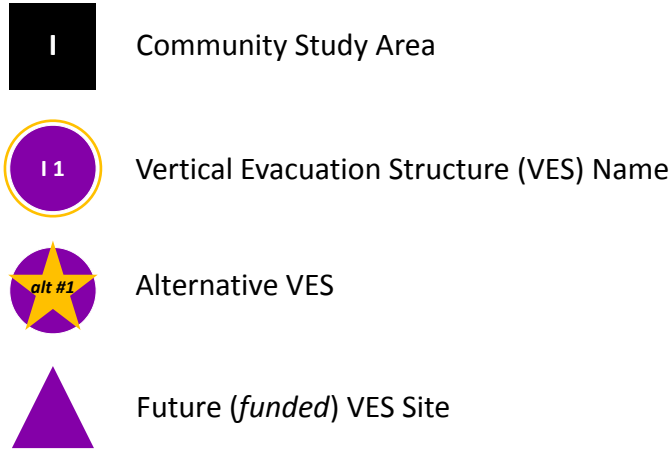
Vertical Evacuation + Pedestrian Evacuation Assessment Tool [PEAT] Results

Symbology Key

Map Icons =

- Community Study Areas
- Fire Station
- School
- Tsunami Siren
- Natural High Ground
- Water/Wetland (Impassable)
- Evacuation Zone

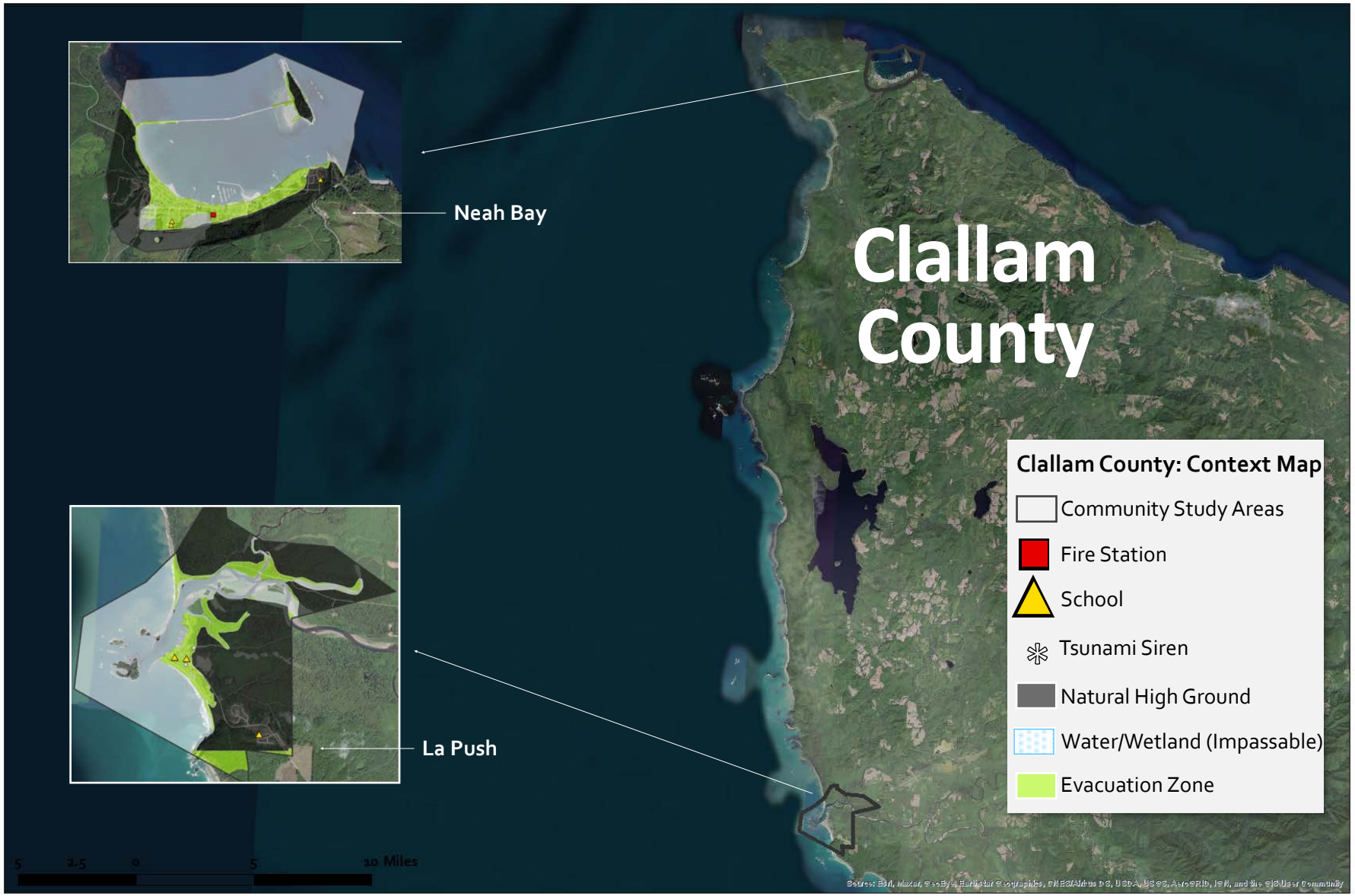
Community Study Area Icons =



- Community Study Area
- Vertical Evacuation Structure (VES) Name
- Alternative VES
- Future (*funded*) VES Site

(Slow Walk) Walk Speed to High Ground Color Scale =

- <15 Minutes
- 15-25 Minutes
- 25+ Minutes


Neah Bay
La Push
Clallam County
Clallam County: Context Map
Community Study Areas
Fire Station
School
Tsunami Siren
Natural High Ground
Water/Wetland (Impassable)
Evacuation Zone
5 2.5 0 5 10 Miles

LP

La Push

La Push community study area population <u>in the tsunami hazard area</u> = ~325 people

Resident/Worker/Overnight Visitor population = ~175 people

Fire Department occupancy = N/A

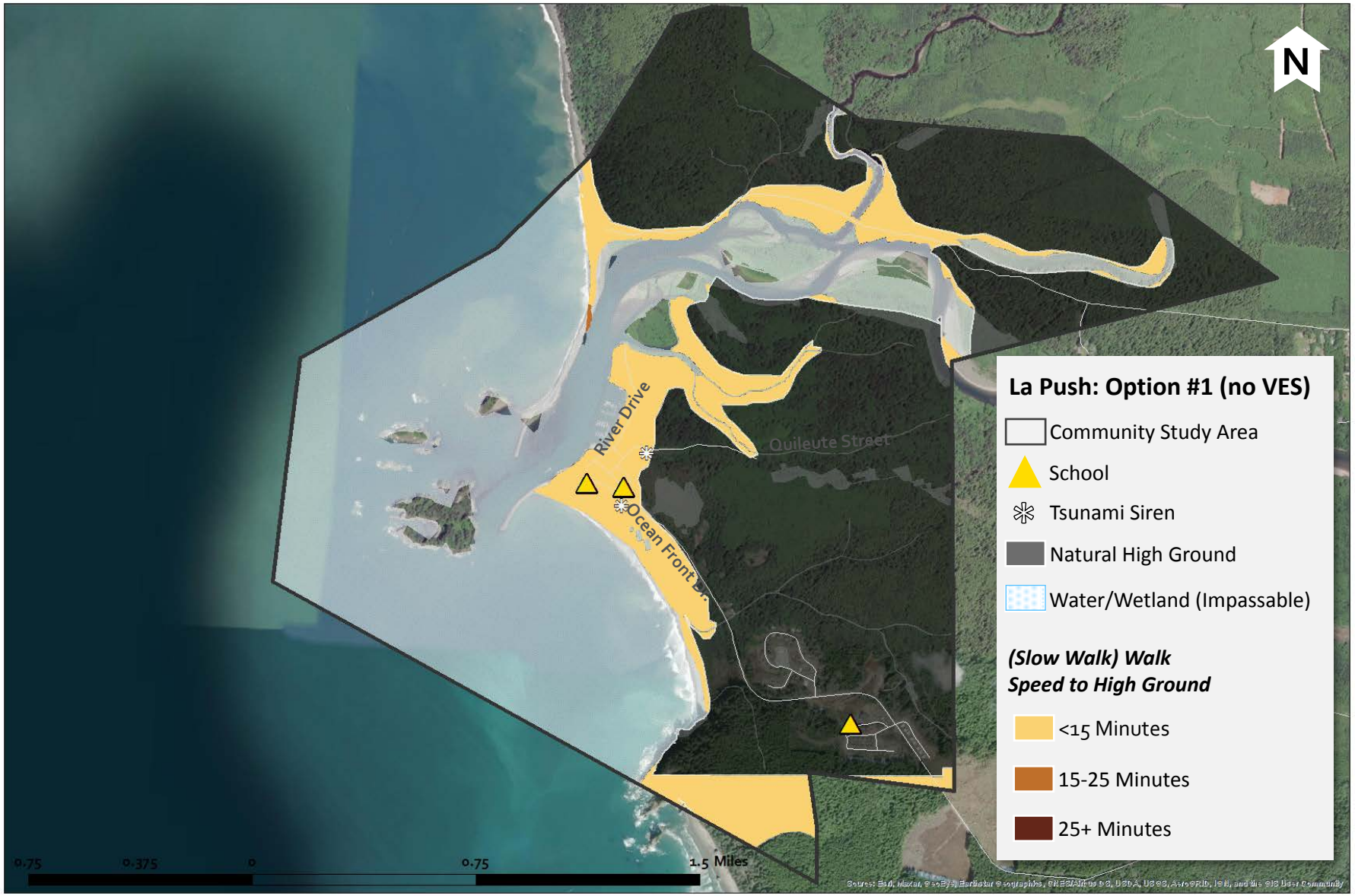
Schools occupancy = ~150 people

Source: Quileute Tribe; Clallam County Residential Land Use

LP

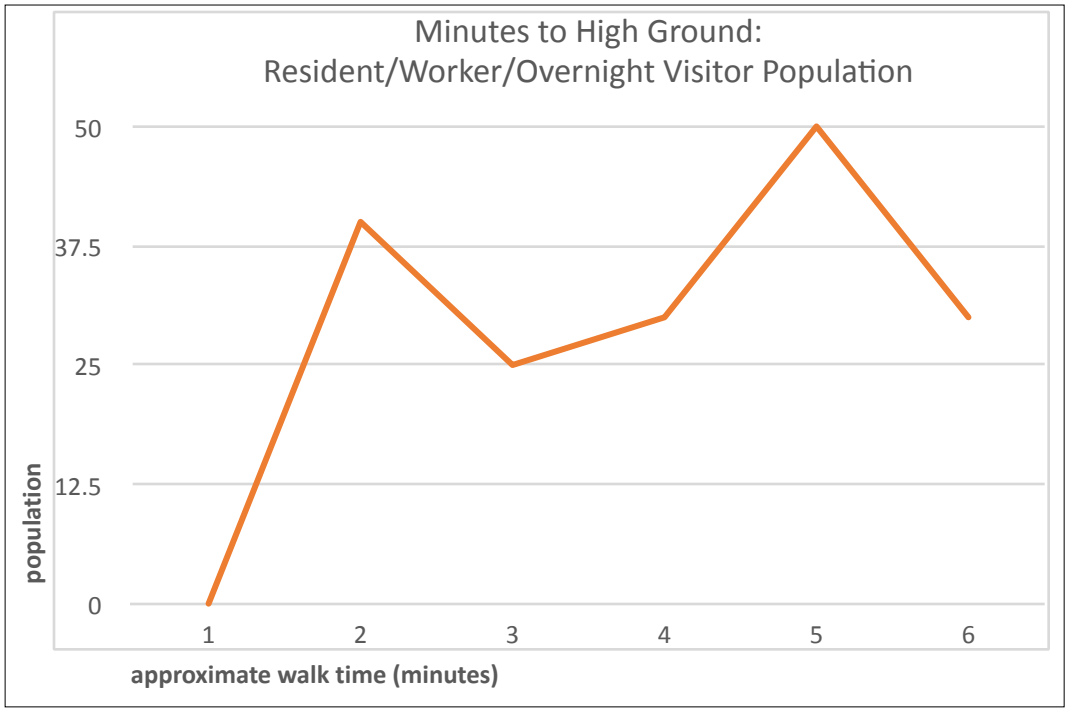

N
River Drive
Quileute Street
Ocean Front Dr
La Push: Context Map
Community Study Area
School
Tsunami Siren
Natural High Ground
Water/Wetland (Impassable)
Evacuation Zone
0.75
0.375
0
0.75
1.5 Miles

LP


N
La Push: Option #1 (no VES)
Community Study Area
School
Tsunami Siren
Natural High Ground
Water/Wetland (Impassable)
(Slow Walk) Walk Speed to High Ground
<15 Minutes
15-25 Minutes
25+ Minutes
River Drive
Quileute Street
Ocean Front Dr
0.75
0.375
0
0.75
1.5 Miles

La Push: VES Option #1 (No VES)

LP



*Approximate *maximum* walk time accounts for the resident/ worker/overnight visitor population locations only. This does not factor in daytime visitors or beach visitors, for example.

Approximate # of People, by Walking Time Bands, to High Ground

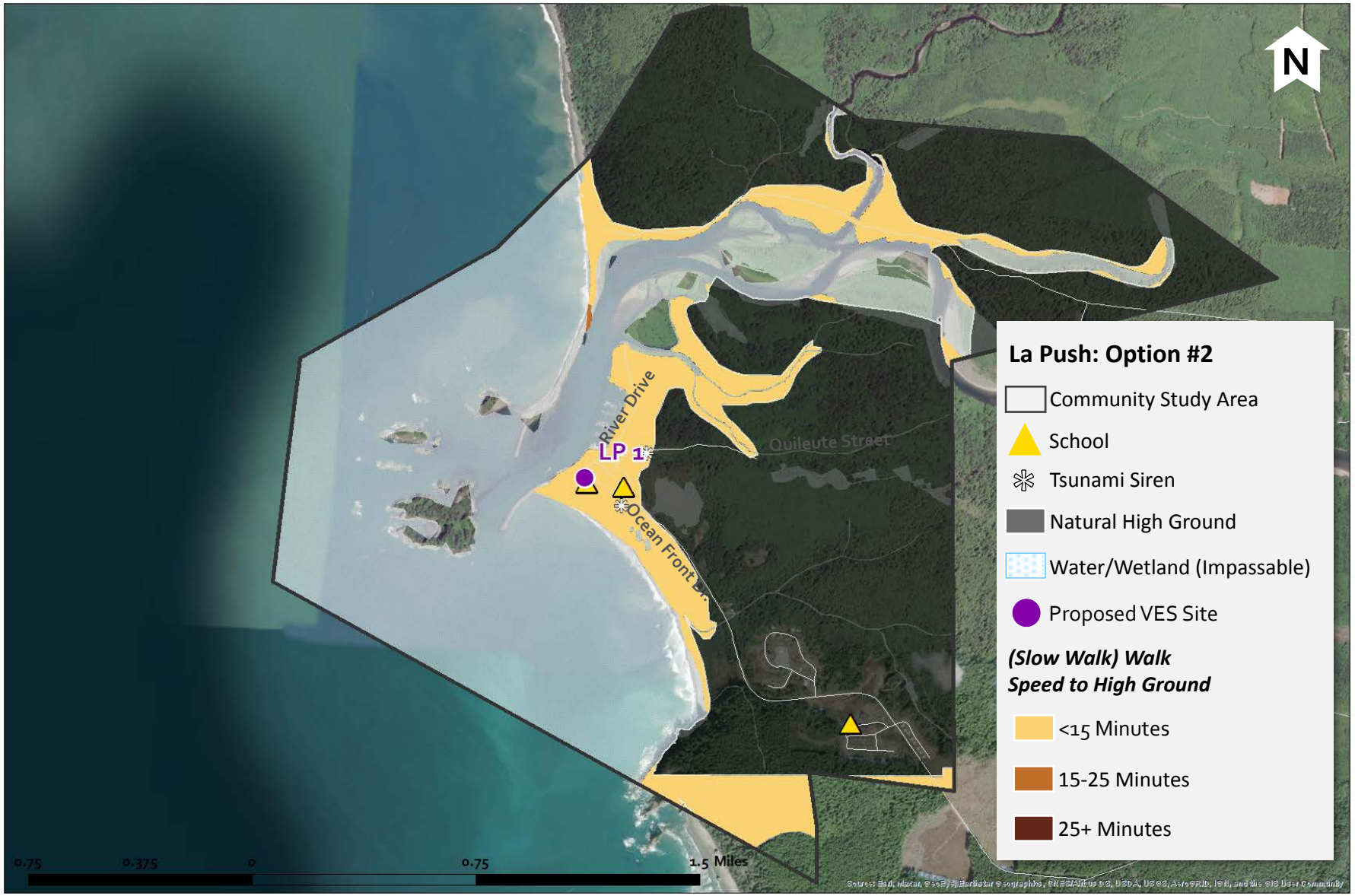
<15 minutes	15-25 minutes	25+ minutes
325 people	n/a	n/a

Fire Station: N/A

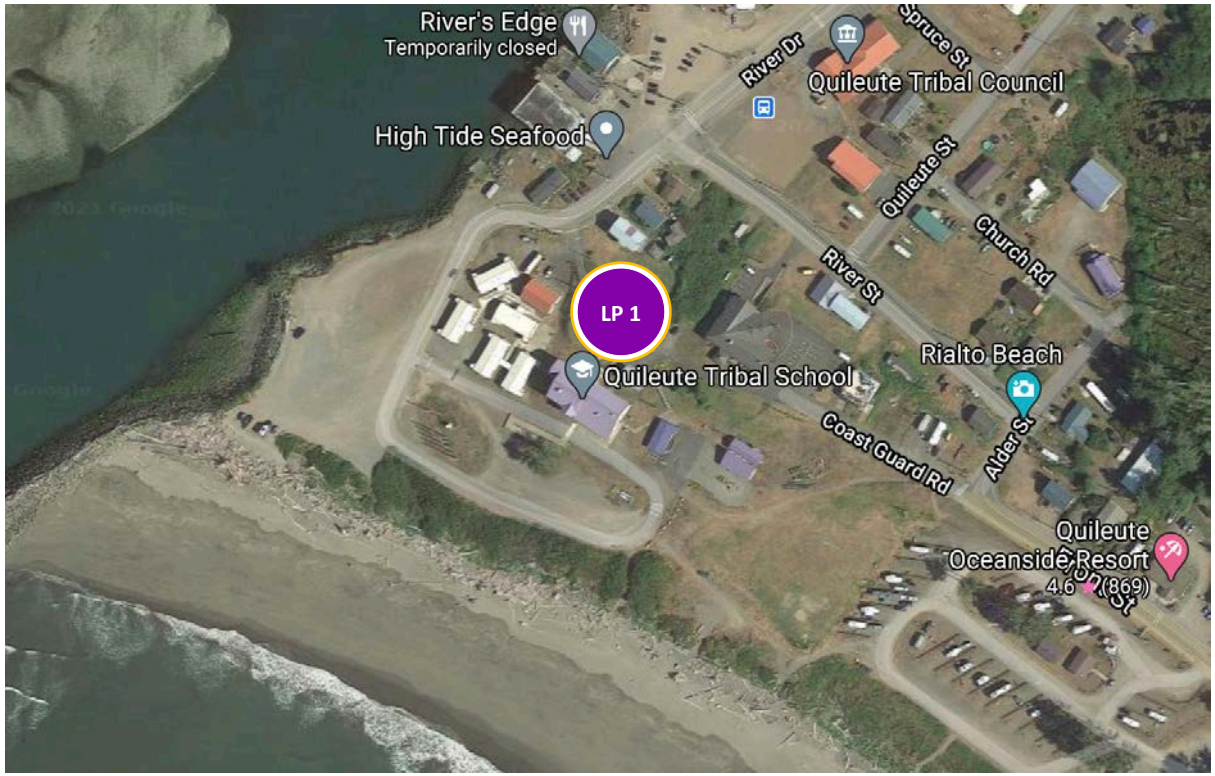
Schools: Approximate 6 minute walk time to high ground

Under **Option #1:**

- approximately **100%** of the total estimated La Push population are within 15 minutes to natural high ground
- approximate **maximum* walk time to natural high ground for identified population = **6** minutes


N
La Push: Option #2
Community Study Area
School
Tsunami Siren
Natural High Ground
Water/Wetland (Impassable)
Proposed VES Site
(Slow Walk) Walk Speed to High Ground
<15 Minutes
15-25 Minutes
25+ Minutes
River Drive
LP 1
Quileute Street
Ocean Front Dr
0.75
0.375
0
0.75
1.5 Miles

La Push: LP 1



LP 1	
Address	40 Ocean Drive
Intersection	Ocean Drive & River Drive
Options	2
Notes	Quileute Tribal School

Source: *Google Maps*

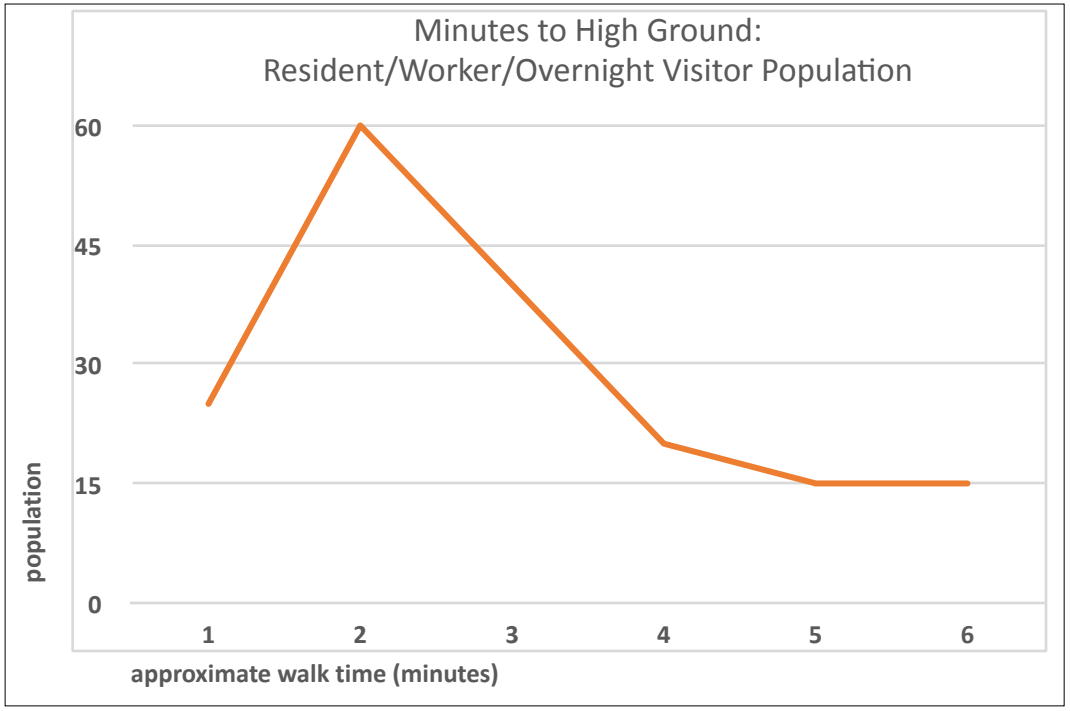
La Push: LP 1

LP 1 - Quileute Indian School, entrance off Ocean Drive (River Drive). Photo Credit: *Google Maps Street View*

La Push: VES Option #2 (community-derived)

LP

LP 1



Approximate # of People, by Walking Time Bands, to High Ground

<15 minutes	15-25 minutes	25+ minutes
325 people	n/a	n/a

Fire Station: N/A

Schools: Approximate 1 minute walk time to high ground or VES

Under **Option #2:**

- approximately **100%** of the total estimated La Push population are within 15 minutes to natural high ground OR vertical evacuation
- approximate *maximum* walk time to natural high ground or vertical evacuation for identified population = **6** minutes
- approximate *minimum* VES capacity need (15 minute walk time) = **0** people
- # of proposed VES = **1**

La Push: Comparison of All Options (1, 2)

LP

Option #1

# of proposed VES = 0

*Minimum VES Capacity (# of People)	% of people within **15 minutes** of high ground	% of people within **25 minutes** of high ground
N/A	**100%**	**100%**

Option #2

# of proposed VES = 1

*Minimum VES Capacity (# of People)	% of people within **15 minutes** of high ground or vertical evacuation	% of people within **25 minutes** of high ground or vertical evacuation
0	**100%**	**100%**

Option #3

NOT COMPLETED

Option #4

NOT COMPLETED

LP

La Push: Comparison of All Options (1, 2)

Notes:
**Minimum VES Capacity* = the delta (or difference) between Option #1 (no VES) number of people at each minute mark and Options #2, #3, and #4 number of people at each minute mark. For example: If 10 people are within 15 minutes of high ground under Option #1 but that number increases to 25 people under Option #2 - then we know that a minimum of 15 additional people have been put within 15 minutes of high ground through the addition of a Vertical Evacuation Structure. Therefore, the minimum VES capacity for this example is 15 people.

NB

Neah Bay

Neah Bay community study area population <u>in the tsunami hazard area</u> = ~917 people

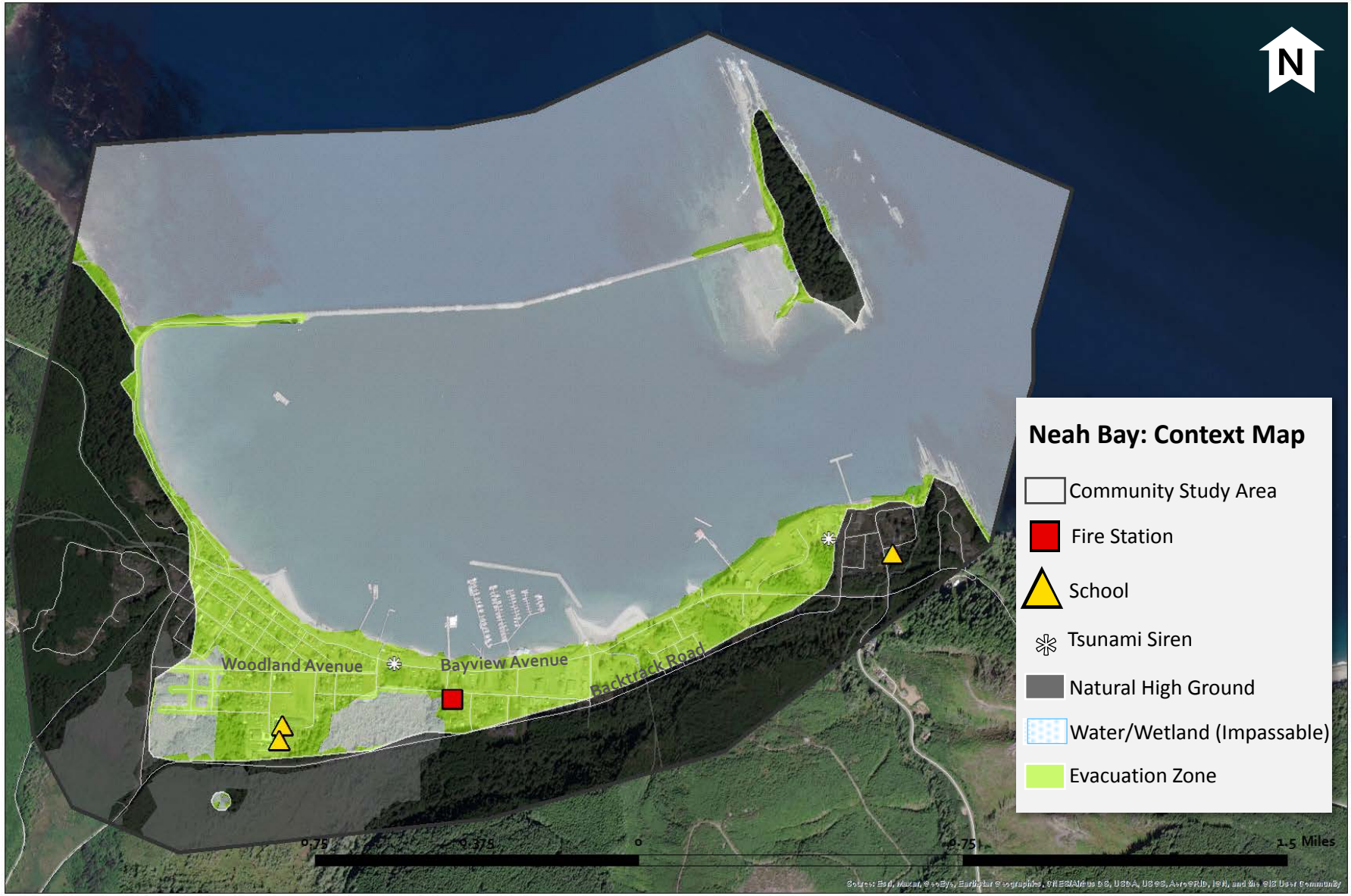
Resident/Worker/Overnight Visitor population = ~387 people

Fire Department occupancy = ~30 people

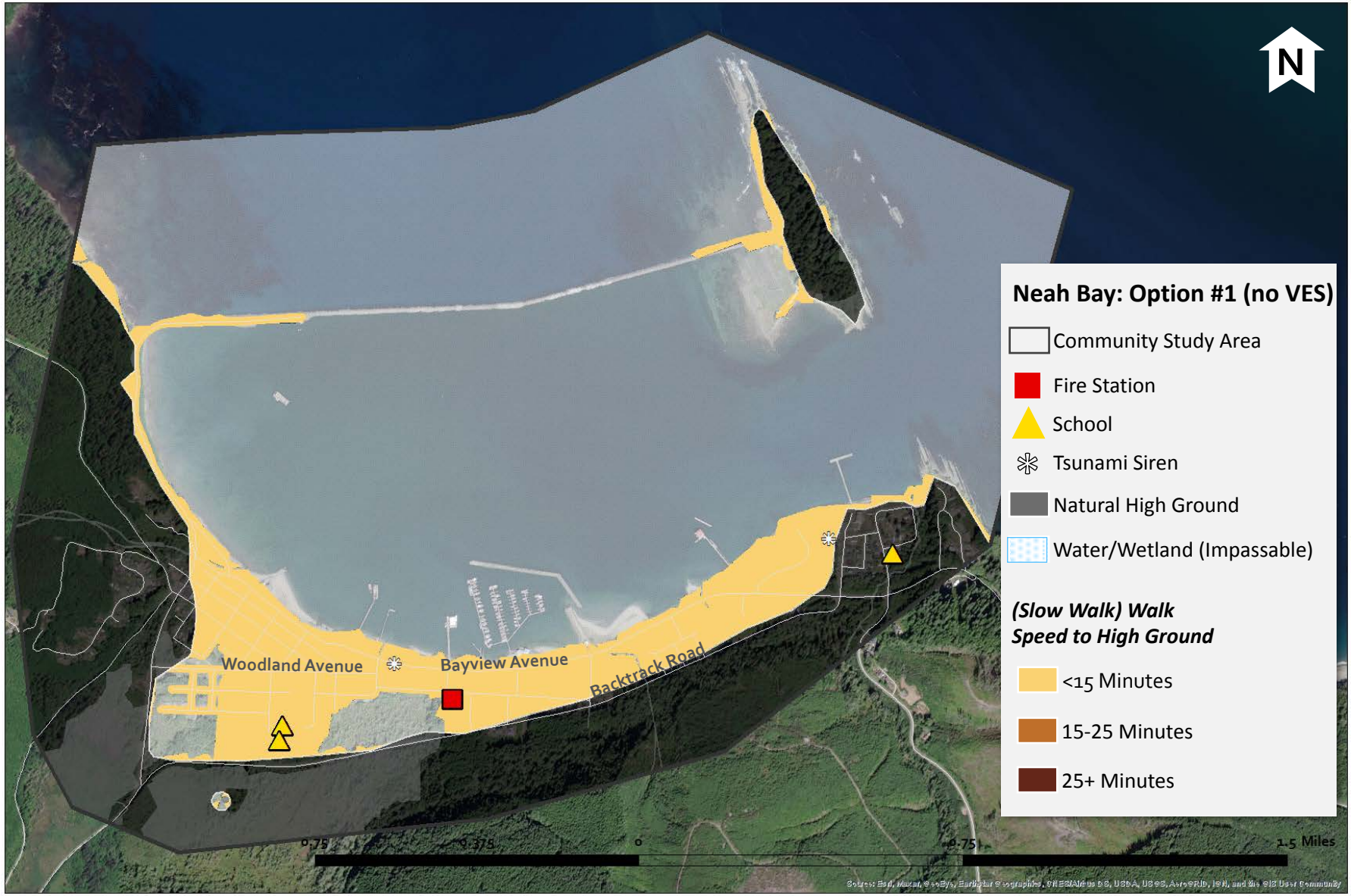
Schools occupancy = ~500 people (~75 additional people located in a natural high ground area)

Source: 2018 American Community Survey (average household size); Clallam County Residential Land Use

NB

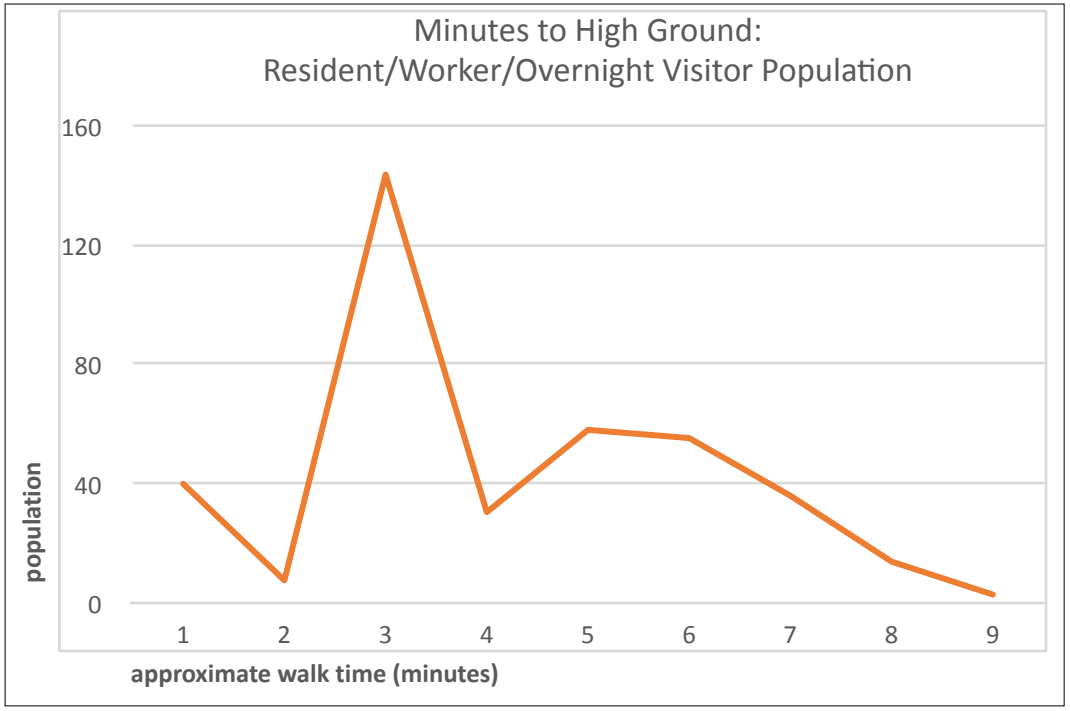

N
Neah Bay: Context Map
Community Study Area
Fire Station
School
Tsunami Siren
Natural High Ground
Water/Wetland (Impassable)
Evacuation Zone
Woodland Avenue
Bayview Avenue
Backtrack Road
0.75
0.375
0
0.75
1.5 Miles

NB


N
Neah Bay: Option #1 (no VES)
Community Study Area
Fire Station
School
Tsunami Siren
Natural High Ground
Water/Wetland (Impassable)
(Slow Walk) Walk Speed to High Ground
<15 Minutes
15-25 Minutes
25+ Minutes
Woodland Avenue
Bayview Avenue
Backtrack Road
0.75
0.375
0
0.75
1.5 Miles

Neah Bay: VES Option #1 (No VES)

NB



*Approximate *maximum* walk time accounts for the resident/ worker/overnight visitor population locations only. This does not factor in daytime visitors or beach visitors, for example.

Approximate # of People, by Walking Time Bands, to High Ground

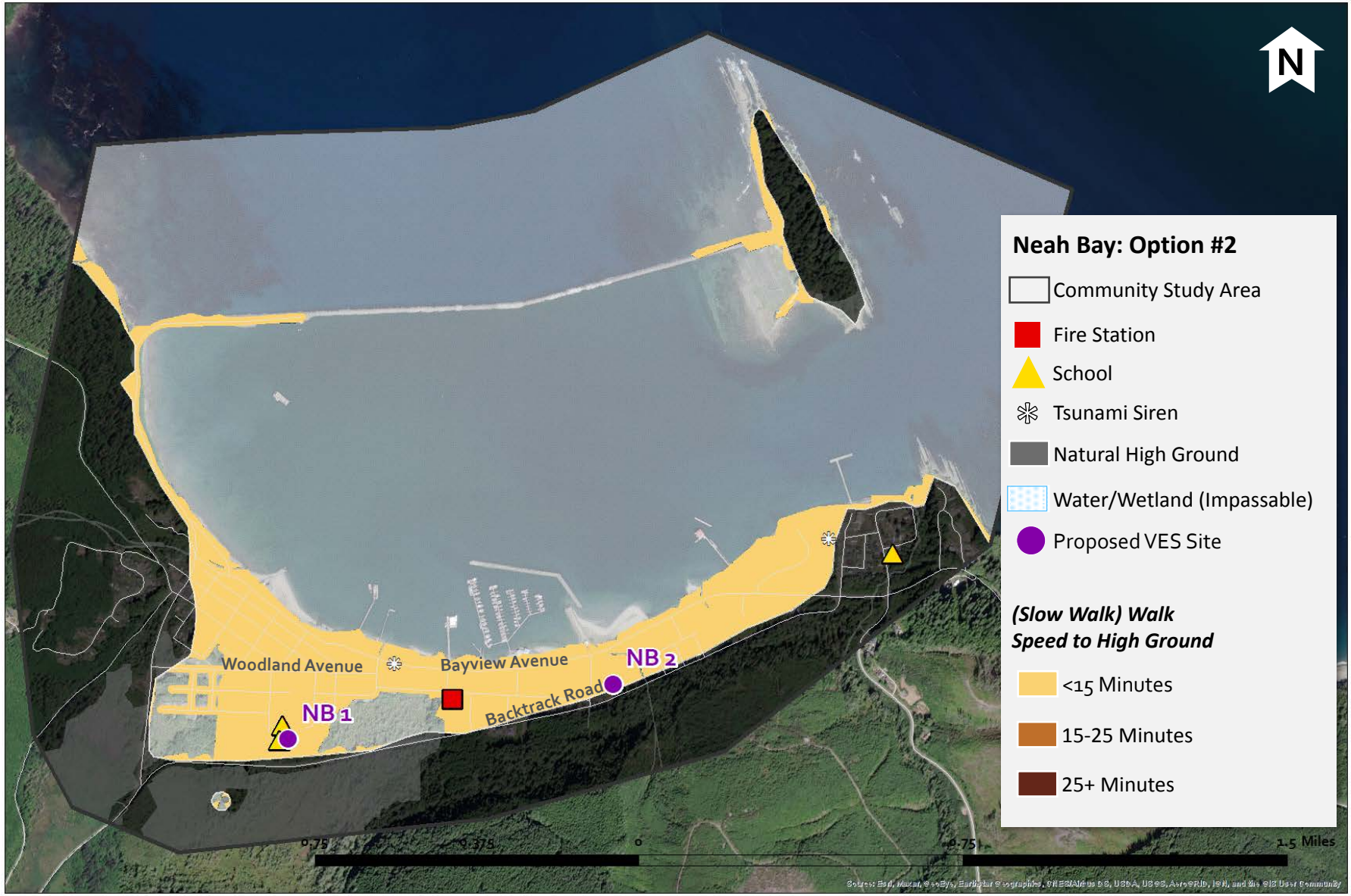
<15 minutes	15-25 minutes	25+ minutes
917 people	n/a	n/a

Fire Station: Approximate 3 minute walk time to high ground

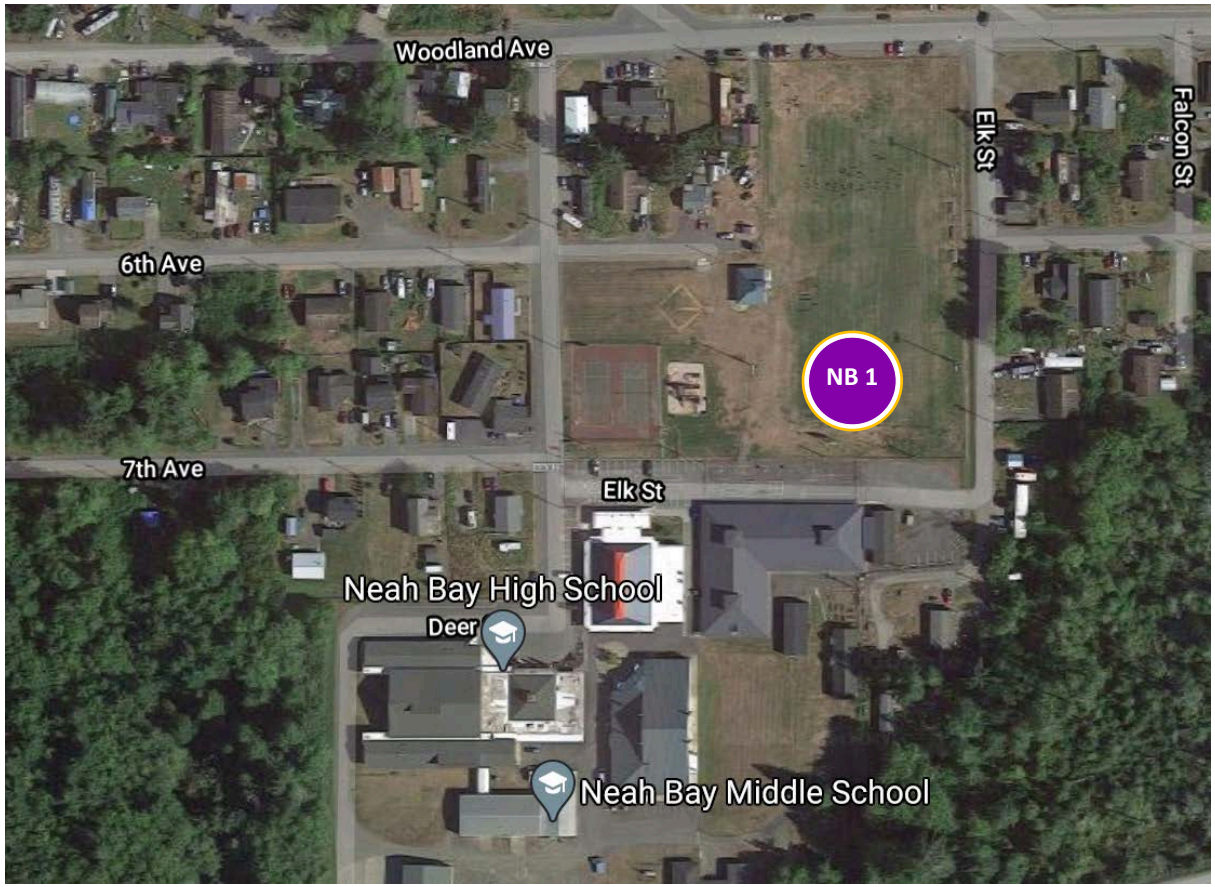
Schools: Approximate 2 and 3 minute walk time to high ground (approximately 75 additional people located in natural high ground)

Under **Option #1:**
- approximately **100%** of the total estimated Neah Bay population are within 15 minutes to natural high ground
- approximate **maximum* walk time to natural high ground for identified population = **9** minutes

NB


N
Neah Bay: Option #2
Community Study Area
Fire Station
School
Tsunami Siren
Natural High Ground
Water/Wetland (Impassable)
Proposed VES Site
(Slow Walk) Walk Speed to High Ground
<15 Minutes
15-25 Minutes
25+ Minutes
Woodland Avenue
Bayview Avenue
Backtrack Road
NB 1
NB 2
0.75
0.375
0
0.75
1.5 Miles

Neah Bay: NB 1



NB 1	
Address	3560 Deer Street
Intersection	Elk Street & Deer Street
Options	2, 4
Notes	Large sports field north of Neah Bay High School and Neah Bay Middle School - may accommodate a VES

Source: *Google Maps*

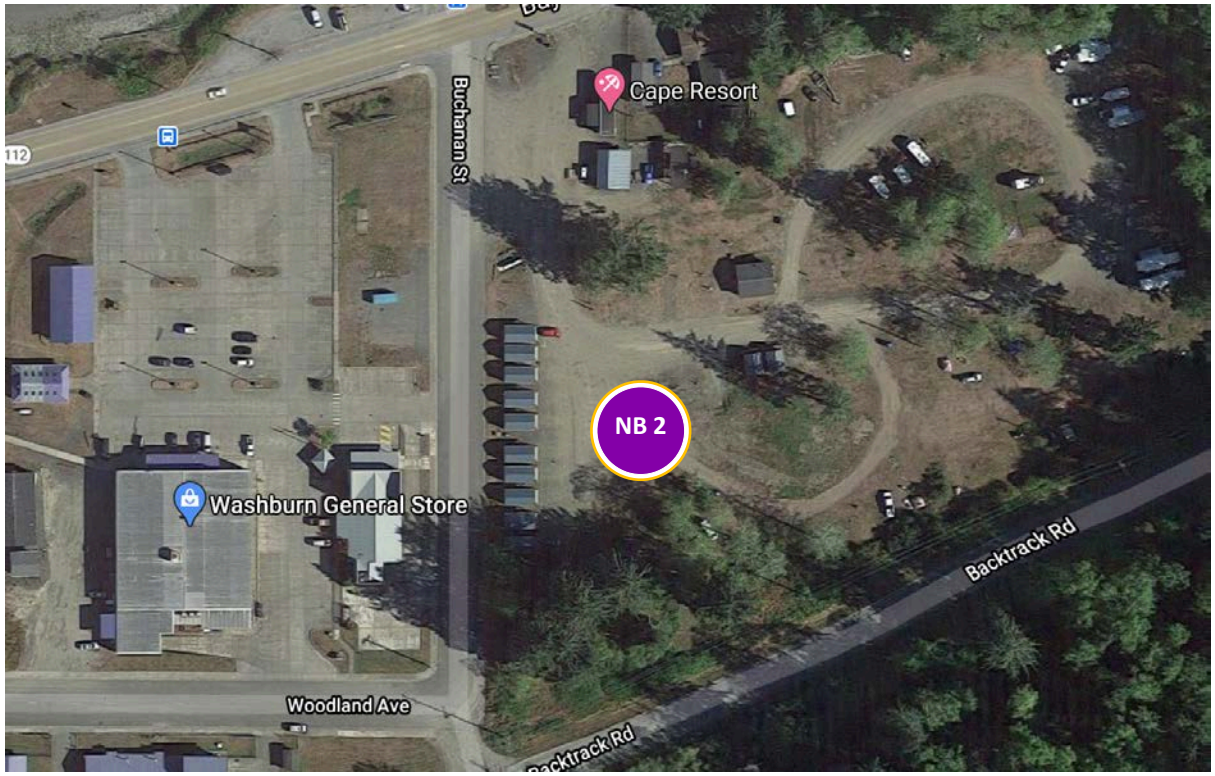
Neah Bay: NB 1

NB 1

NB 1 - Sports field just north of Neah Bay High School and Neah Bay Middle School

Photo Credit: *Google Maps Street View*

Neah Bay: NB 2



NB 2	
Address	1510 Bayview Avenue
Intersection	Buchanan Street & Bayview Avenue
Options	2
Notes	Cape Resort, RV spaces and cabins with plenty of open space.

Source: *Google Maps*

Neah Bay: NB 2

NB 2

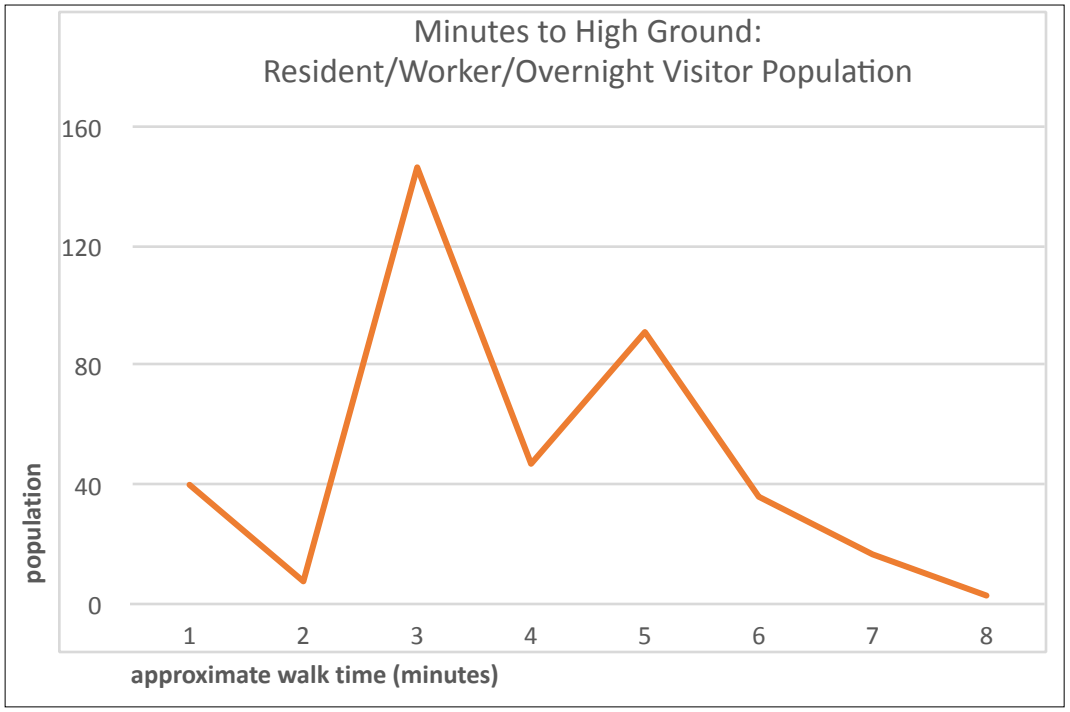
NB 2 - Campground, RV and small cabins. Open space could potentially accommodate a VES.

Photo Credit: *Google Maps Street View*

Neah Bay: VES Option #2 (community-derived)

NB

NB 1 NB 2



Approximate # of People, by Walking Time Bands, to High Ground

<15 minutes	15-25 minutes	25+ minutes
917 people	n/a	n/a

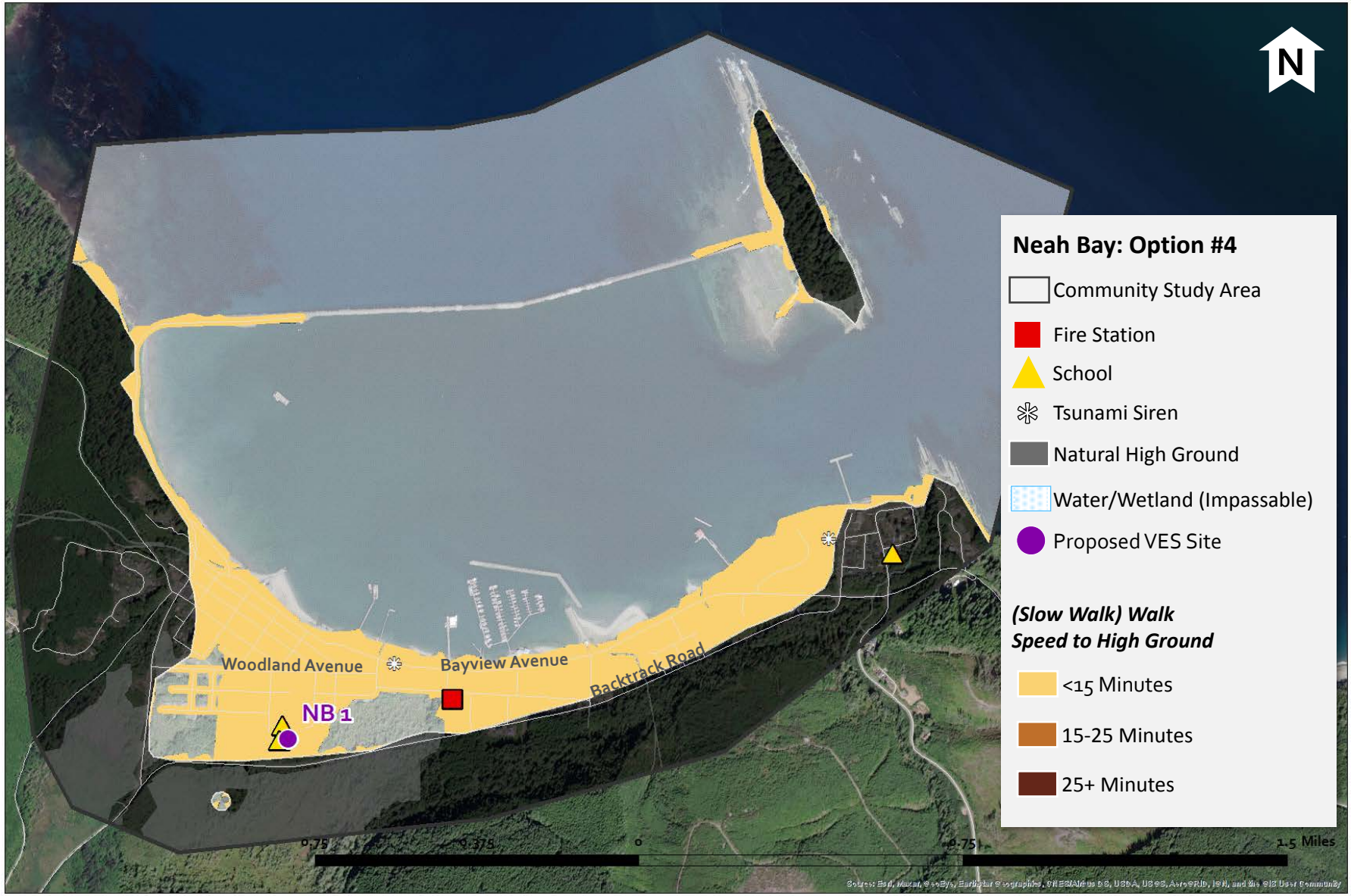
Fire Station: Approximate 3 minute walk time to high ground or VES

Schools: Approximate 1 and 2 minute walk time to high ground or VES (approximately 75 additional people located in natural high ground)

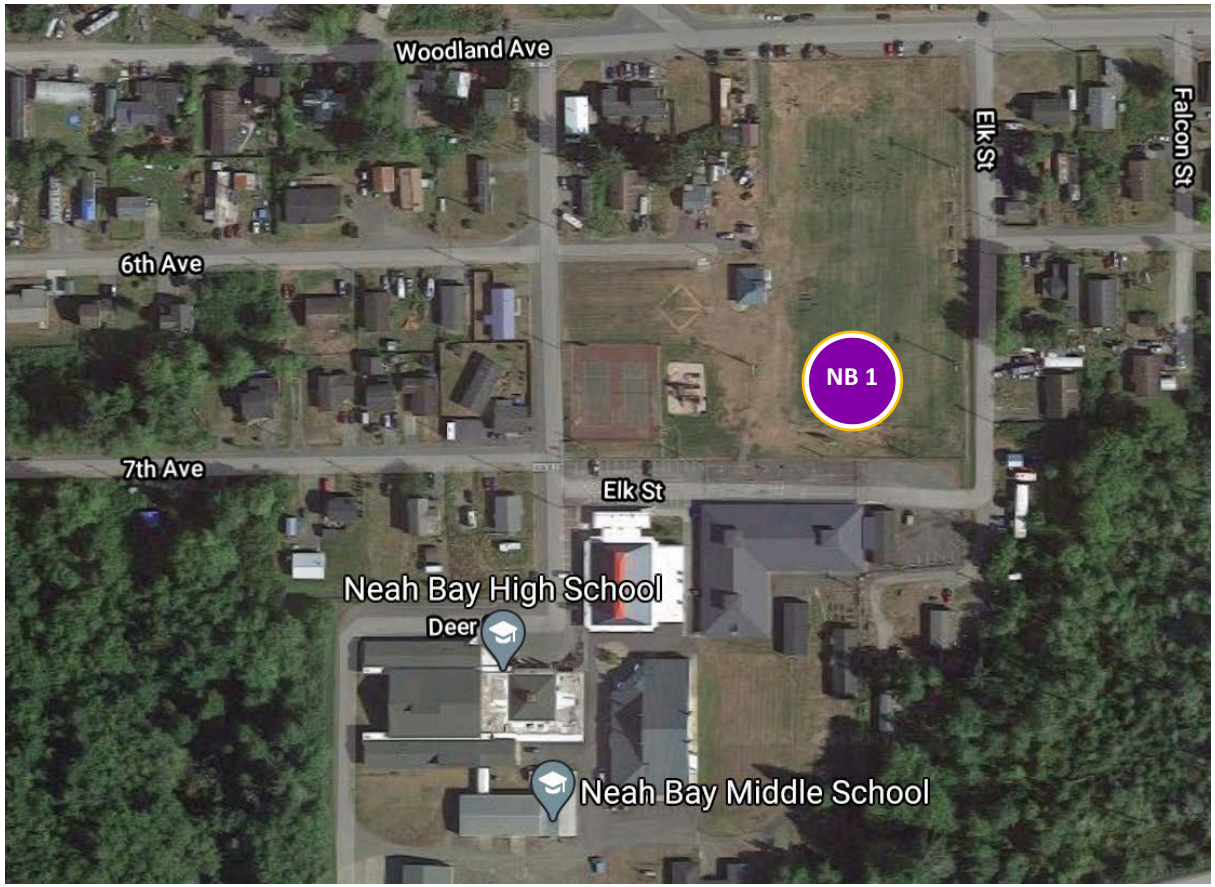
Under **Option #2:**

- approximately **100%** of the total estimated Neah Bay population are within 15 minutes to natural high ground OR vertical evacuation
- approximate *maximum* walk time to natural high ground or vertical evacuation for identified population = **8** minutes
- approximate *minimum* VES capacity need (15 minute walk time) = **0** people
- # of proposed VES = **2**

NB


N
Neah Bay: Option #4
Community Study Area
Fire Station
School
Tsunami Siren
Natural High Ground
Water/Wetland (Impassable)
Proposed VES Site
(Slow Walk) Walk Speed to High Ground
<15 Minutes
15-25 Minutes
25+ Minutes
Woodland Avenue
Bayview Avenue
Backtrack Road
NB 1
0.75
0.375
0
0.75
1.5 Miles

Neah Bay: NB 1



NB 1	
Address	3560 Deer Street
Intersection	Elk Street & Deer Street
Options	2, 4
Notes	Large sports field north of Neah Bay High School and Neah Bay Middle School - may accommodate a VES

Source: *Google Maps*

Neah Bay: NB 1

NB 1

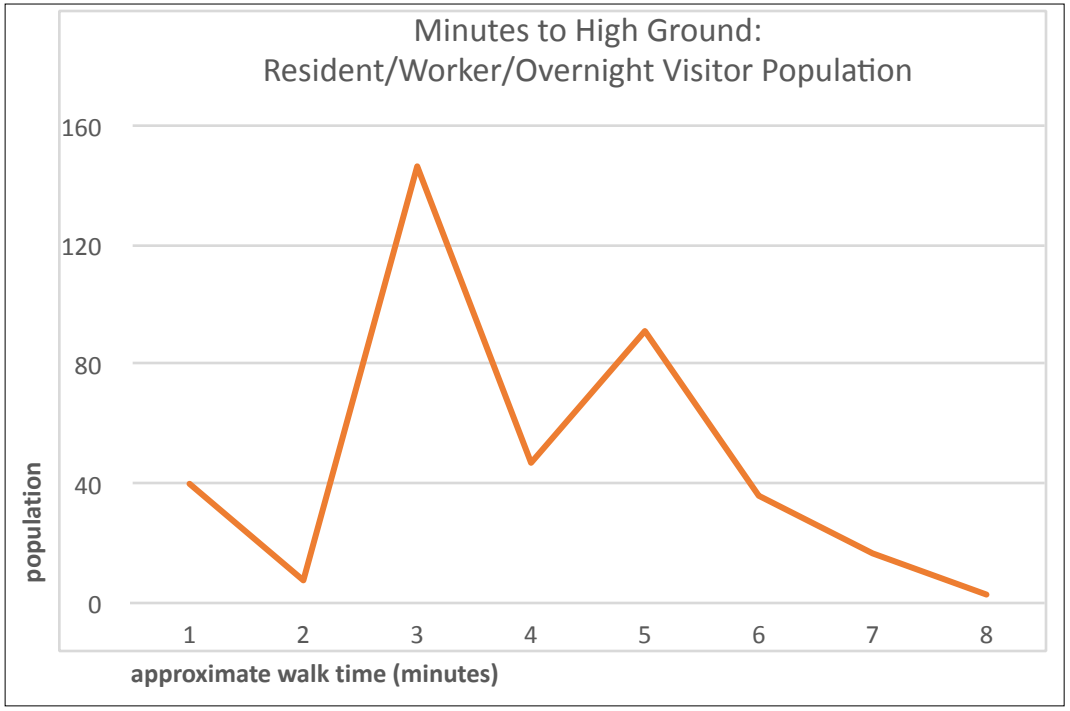
NB 1 - Sports field just north of Neah Bay High School and Neah Bay Middle School

Photo Credit: *Google Maps Street View*

Neah Bay: VES Option #4 (lean/efficient)

NB

NB 1



Approximate # of People, by Walking Time Bands, to High Ground

<15 minutes	15-25 minutes	25+ minutes
917 people	n/a	n/a

Fire Station: Approximate 3 minute walk time to high ground or VES

Schools: Approximate 1 and 2 minute walk time to high ground or VES (approximately 75 additional people located in natural high ground)

Under **Option #4:**

- approximately **100%** of the total estimated Neah Bay population are within 15 minutes to natural high ground OR vertical evacuation
- approximate *maximum* walk time to natural high ground or vertical evacuation for identified population = **8** minutes
- approximate *minimum* VES capacity need (15 minute walk time) = **0** people
- # of proposed VES = **1**

Neah Bay: Comparison of All Options (1, 2, 4)

NB

Option #1

# of proposed VES = 0

N/A

*Minimum VES Capacity (# of People)

100%

% of people within **15 minutes** of high ground

100%

% of people within **25 minutes** of high ground

Option #2

# of proposed VES = 2

0

*Minimum VES Capacity (# of People)

100%

% of people within **15 minutes** of high ground or vertical evacuation

100%

% of people within **25 minutes** of high ground or vertical evacuation

Option #3

NOT COMPLETED

Option #4

# of proposed VES = 1

0

*Minimum VES Capacity (# of People)

100%

% of people within **15 minutes** of high ground or vertical evacuation

100%

% of people within **25 minutes** of high ground or vertical evacuation

NB

Neah Bay: Comparison of All Options (1, 2, 4)

Notes:
**Minimum VES Capacity* = the delta (or difference) between Option #1 (no VES) number of people at each minute mark and Options #2, #3, and #4 number of people at each minute mark. For example: If 10 people are within 15 minutes of high ground under Option #1 but that number increases to 25 people under Option #2 - then we know that a minimum of 15 additional people have been put within 15 minutes of high ground through the addition of a Vertical Evacuation Structure. Therefore, the minimum VES capacity for this example is 15 people.

Clallam County: Comparison of All Options (1-4)

Community Study Area	VES Option	# of VES	Minimum VES Capacity	% of People Within 15 Minutes to High Ground/VES	% of People Within 25 Minutes to High Ground/VES
La Push	1	0	**N/A**	100%	100%
La Push	2	1	**0**	100%	100%
Neah Bay	1	0	**N/A**	100%	100%
Neah Bay	2	2	**0**	100%	100%
Neah Bay	4	1	**0**	100%	100%

Summary Tables

SA

Study Area Summary Tables, by Option: 1-4

[*total estimated population in tsunami zone = ~71,186*]

OPTION 1							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES
N/A	**N/A**	54.9%	39,115	45.1%	32,073	66.4%	47,282

OPTION 2							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES
58	**16,302**	77.9%	55,420	22.1%	15,766	95.4%	67,907

OPTION 3							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES
82	**22,804**	87.0%	61,959	13.0%	9,227	99.2%	70,603

OPTION 4							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES
58	**21,049**	86.3%	61,441	13.7%	9,747	98.4%	70,013

SA

Study Area Summary Table: ~Average VES Size

Average Size of Each Proposed VES, per Option (#2, #3, #4)				
Option	**# of Proposed VES**	**Minimum VES Capacity Need**	**Approximate # of People per VES**	**Approximate Average SF per VES** (*based on FEMA's requirement of 10 SF per person*)
#2	**58**	**16,302**	**281**	**2,810 square feet**
#3	**82**	**22,804**	**278**	**2,780 square feet**
#4	**58**	**21,049**	**363**	**3,630 square feet**

For Reference:
The approved Tokeland/Shoalwater Bay Tribal tower is anticipated to have a capacity of 384 people.

Based on FEMA's guidelines, the actual refuge area will be ~3,800 square feet.

Equation:

(Minimum VES Capacity Need / # of Proposed VES) * 10 = Approximate average size per VES

PC

Pacific County Summary Tables, by Option: 1-4

[*total estimated population in tsunami zone = ~25,923*]

OPTION 1							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES
N/A	**N/A**	51.5%	13,349	48.5%	12,574	64.3%	16,681

OPTION 2							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES
25	**7,192**	79.2%	20,541	20.8%	5,382	97.6%	25,311

OPTION 3							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES
40	**9,612**	88.5%	22,940	11.5%	2,983	99.0%	25,669

OPTION 4							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES
25	**8,670**	85.3%	22,120	14.7%	3,803	98.2%	25,464

PC

Pacific County Summary Table: ~Average VES Size

Average Size of Each Proposed VES, per Option (#2, #3, #4)				
Option	**# of Proposed VES**	**Minimum VES Capacity Need**	**Approximate # of People per VES**	**Approximate Average SF per VES** (*based on FEMA's requirement of 10 SF per person*)
#2	**25**	**7,192**	**288**	**2,880 square feet**
#3	**40**	**9,612**	**240**	**2,403 square feet**
#4	**25**	**8,670**	**347**	**3,470 square feet**

For Reference:
The approved Tokeland/Shoalwater Bay Tribal tower is anticipated to have a capacity of 384 people.

Based on FEMA's guidelines, the actual refuge area will be ~3,800 square feet.

Equation:

(Minimum VES Capacity Need / # of Proposed VES) * 10 = Approximate average size per VES

GHC

Grays Harbor County Summary Tables, by Option: 1-4

[*total estimated population in tsunami zone = ~44,021*]

OPTION 1							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES
N/A	**N/A**	55.7%	24,524	44.3%	19,499	66.7%	29,359

OPTION 2							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES
30	**9,110**	76.4%	33,637	23.6%	10,384	93.9%	41,354

OPTION 3							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES
42	**13,192**	85.8%	37,777	14.2%	6,244	99.3%	43,692

OPTION 4							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES
32	**12,379**	86.5%	38,079	13.5%	5,944	98.4%	43,307

Grays Harbor County Summary Table: ~Average VES Size

Average Size of Each Proposed VES, per Option (#2, #3, #4)				
Option	**# of Proposed VES**	**Minimum VES Capacity Need**	**Approximate # of People per VES**	**Approximate Average SF per VES** (*based on FEMA's requirement of 10 SF per person*)
#2	**30**	**9,110**	**304**	**3,040 square feet**
#3	**42**	**13,192**	**314**	**3,140 square feet**
#4	**32**	**12,379**	**387**	**3,870 square feet**

For Reference:
The approved Tokeland/Shoalwater Bay Tribal tower is anticipated to have a capacity of 384 people.

Based on FEMA's guidelines, the actual refuge area will be ~3,800 square feet.

Equation:

(Minimum VES Capacity Need / # of Proposed VES) * 10 = Approximate average size per VES

CC

Clallam County Summary Tables, by Option: 1-4

[*total estimated population in tsunami zone = ~1,242*]

OPTION 1							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES
N/A	**N/A**	100%	1,242	0%	0	100%	1,242

OPTION 2							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES
3	**0**	100%	1,242	0%	0	100%	1,242

OPTION 3							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES
N/A	**N/A**	100%	1,242	0%	0	100%	1,242

OPTION 4							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES
1	**0**	100%	1,242	0%	0	100%	1,242

CC

Clallam County Summary Table: ~Average VES Size

Average Size of Each Proposed VES, per Option (#2, #3, #4)				
Option	**# of Proposed VES**	**Minimum VES Capacity Need**	**Approximate # of People per VES**	**Approximate Average SF per VES** (*based on FEMA's requirement of 10 SF per person*)
#2	**3**	**0**	***0**	***0**
#3	**N/A**	**N/A**	**N/A**	**N/A**
#4	**1**	**0**	***0**	***0**

**Clallam County does not have population in areas with a > 15 minute walk to natural high ground. Any VES would be elective to support quicker or more high visibility tsunami evacuation endpoints*

For Reference:
The approved Tokeland/Shoalwater Bay Tribal tower is anticipated to have a capacity of 384 people.

Based on FEMA's guidelines, the actual refuge area will be ~3,800 square feet.

Equation:

(Minimum VES Capacity Need / # of Proposed VES) * 10 = Approximate average size per VES

Ilwaco Summary Tables, by Option: 1-4

[*total estimated population in tsunami zone = ~950*]

OPTION 1							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES
N/A	N/A	62.3%	592	37.7%	358	82.3%	782

OPTION 2							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES
1	356	99.8%	948	0.2%	2	100%	950

OPTION 3							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES
2	356	99.8%	948	0.2%	2	100%	950

OPTION 4							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES
1	356	99.8%	948	0.2%	2	100%	950

S

Seaview Summary Tables, by Option: 1-4

[*total estimated population in tsunami zone = ~2,663*]

OPTION 1							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES
N/A	**N/A**	15.3%	408	84.7%	2,255	57.3%	1,525

OPTION 2							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES
2	**995**	52.7%	1,403	47.3%	1,260	93.6%	2,492

OPTION 3							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES
4	**2,000**	90.4%	2,408	9.6%	255	95.6%	2,545

OPTION 4							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES
2	**1,263**	62.7%	1,671	37.3%	992	93.7%	2,494

LBS

Long Beach South Summary Tables, by Option: 1-4

[*total estimated population in tsunami zone = ~5,218*]

OPTION 1							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES
N/A	**N/A**	5.7%	295	94.3%	4,923	12.8%	667

OPTION 2							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES
5	**3,477**	72.3%	3,772	27.7%	1,446	98.6%	5,146

OPTION 3							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES
8	**4,062**	83.5%	4,357	16.5%	861	99.3%	5,182

OPTION 4							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES
7	**4,035**	83.0%	4,330	17.0%	888	96.5%	5,035

LBN

Long Beach North Summary Tables, by Option: 1-4

[*total estimated population in tsunami zone = ~4,108*]

OPTION 1							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES
N/A	**N/A**	32.6%	1,340	67.4%	2,768	43.3%	1,779

OPTION 2							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES
4	**1,226**	62.5%	2,566	37.5%	1,542	94.2%	3,868

OPTION 3							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES
7	**1,577**	71.0%	2,917	29.0%	1,191	98.2%	4,034

OPTION 4							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES
6	**1,543**	70.2%	2,883	29.8%	1,225	98.7%	4,053

OP

Ocean Park Summary Tables, by Option: 1-4

[*total estimated population in tsunami zone = ~6,275*]

OPTION 1							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES
N/A	**N/A**	93.0%	5,838	7.0%	437	99.7%	6,254

OPTION 2							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES
5	**0**	93.0%	5,838	7.0%	437	99.7%	6,254

OPTION 3							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES
6	**326**	98.2%	6,164	1.8%	111	100%	6,275

OPTION 4							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES
2	**326**	98.2%	6,164	1.8%	111	100%	6,275

O

Oysterville Summary Tables, by Option: 1-4

[*total estimated population in tsunami zone = ~4,098*]

OPTION 1							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES
N/A	N/A	93.9%	3,848	6.1%	250	100%	4,098

OPTION 2							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES

OPTION 3							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES

OPTION 4							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES

L

Leadbetter Summary Tables, by Option: 1-4

[*total estimated population in tsunami zone = ~513*]

OPTION 1							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES
N/A	N/A	79.5%	408	20.5%	105	95.1%	488

OPTION 2							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES

OPTION 3							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES
2	27	84.8%	435	15.2%	78	100%	513

OPTION 4							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES
1	27	84.8%	435	15.2%	78	100%	513

TO

Tokeland Summary Tables, by Option: 1-4

[*total estimated population in tsunami zone = ~1,234*]

OPTION 1							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES
N/A	**N/A**	46.8%	577	53.2%	657	69.7%	860

OPTION 2							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES
5	**615**	96.6%	1,192	3.4%	42	100%	1,234

OPTION 3							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES
6	**643**	97.2%	1,199	2.8%	35	100%	1,234

OPTION 4							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES
3	**521**	97.2%	1,199	2.8%	35	100%	1,234

N

North Cove Summary Tables, by Option: 1-4

[*total estimated population in tsunami zone = ~864*]

OPTION 1							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES
N/A	**N/A**	5.0%	43	95.0%	821	26.4%	228

OPTION 2							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES
3	**523**	65.5%	566	34.5%	298	90.4%	781

OPTION 3							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES
5	**621**	76.9%	664	23.1%	200	97.0%	838

OPTION 4							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES
3	**599**	74.3%	642	25.7%	222	94.0%	812

G

Grayland Summary Tables, by Option: 1-4

[*total estimated population in tsunami zone = ~1,722*]

OPTION 1							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES
N/A	**N/A**	1.9%	32	98.1%	1,690	18.6%	320

OPTION 2							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES
3	**770**	46.6%	802	53.4%	920	98.0%	1,688

OPTION 3							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES
5	**1,184**	70.6%	1,216	29.4%	506	100%	1,722

OPTION 4							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES
3	**900**	54.1%	932	45.9%	790	95.2%	1,640

Westport Summary Tables, by Option: 1-4

[*total estimated population in tsunami zone = ~4,245*]

OPTION 1							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES
N/A	**N/A**	74.8%	3,176	25.2%	1,069	88.3%	3,747

OPTION 2							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES
5	**888**	95.7%	4,064	4.3%	181	99.9%	4,244

OPTION 3							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES
6	**888**	95.7%	4,064	4.3%	181	99.9%	4,244

OPTION 4							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES
3	**867**	95.2%	4,043	4.8%	202	99.9%	4,244

OSW

Ocean Shores West Summary Tables, by Option: 1-4

[*total estimated population in tsunami zone = ~6,712*]

OPTION 1							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES
N/A	**N/A**	7.8%	524	92.2%	6,188	8.8%	588

OPTION 2							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES
11	**4,633**	76.9%	5,159	23.1%	1,553	99.4%	6,674

OPTION 3							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES
14	**5,027**	82.7%	5,550	17.3%	1,162	99.6%	6,682

OPTION 4							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES
11	**4,860**	80.2%	5,384	19.8%	1,328	99.5%	6,677

OSE

Ocean Shores East Summary Tables, by Option: 1-4

[*total estimated population in tsunami zone = ~5,558*]

OPTION 1							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES
N/A	**N/A**	8.8%	490	91.2%	5,068	10.2%	568

OPTION 2							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES
8	**2,819**	59.5%	3,310	40.5%	2,248	83.0%	4,612

OPTION 3							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES
13	**4,140**	83.3%	4,630	16.7%	928	95.2%	5,291

OPTION 4							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES
12	**4,018**	81.1%	4,508	18.9%	1,050	95.2%	5,291

TA

Taholah Summary Tables, by Option: 1-4

[*total estimated population in tsunami zone = ~579*]

OPTION 1							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES
N/A	**N/A**	100%	579	**N/A**	**N/A**	100%	579

OPTION 2							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES
3	**0**	100%	579	**N/A**	**N/A**	100%	579

OPTION 3							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES

OPTION 4							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES
N/A	**N/A**	100%	579	**N/A**	**N/A**	100%	579

AHC

Aberdeen, Hoquiam, Cosmopolis Summary Tables, by Option: 1-4

[*total estimated population in tsunami zone = ~25,205*]

OPTION 1							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES
N/A	**N/A**	78.3%	19,723	21.7%	5,482	93.5%	23,557

OPTION 2							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES

OPTION 3							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES
4	**1,953**	86.2%	21,738	13.8%	3,467	99.9%	25,174

OPTION 4							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES
3	**1,734**	89.8%	22,633	10.2%	2,573	98.7%	24,876

LP

La Push Summary Tables, by Option: 1-4

[*total estimated population in tsunami zone = ~325*]

OPTION 1							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES
N/A	**N/A**	100%	325	**N/A**	**N/A**	100%	325

OPTION 2							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES
1	**0**	100%	325	**N/A**	**N/A**	100%	325

OPTION 3							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES

OPTION 4							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES

NB

Neah Bay Summary Tables, by Option: 1-4

[*total estimated population in tsunami zone = ~917*]

OPTION 1							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES
N/A	**N/A**	100%	917	**N/A**	**N/A**	100%	917

OPTION 2							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES
2	**0**	100%	917	**N/A**	**N/A**	100%	917

OPTION 3							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES

OPTION 4							
# of VES	Minimum VES Capacity Need	% of People Within 15 Minutes to High Ground or VES	# of People Within 15 Minutes to High Ground or VES	% of People Not Within 15 Minutes to High Ground or VES	# of People Not Within 15 Minutes of High Ground or VES	% of People Within 25 Minutes to High Ground or VES	# of People Within 25 Minutes to High Ground or VES
1	**0**	100%	917	**N/A**	**N/A**	100%	917

Appendices

Appendix A:
All Potential Vertical Evacuation Sites in Study Area (Pacific, Grays Harbor, and Clallam Counties)

Pacific County VES Locations: all Options

Community	*VES ID*	*Location*	*Parcel Number*	*Parcel Owner*	*Intersection*
ILWACO	I 1	46.318953, -124.003979	73033000027	Keith and Carol Fogg	Scarboro Lane North & Ortelius Drive
	I 2	46.281534, -124.076274	09110800001	State of Washington	End of a trail, off Jetty Road
SEAVIEW	S 1	46.332184, -124.053629	10112133176	Jerry & Barbara Bruner	41st Place & N Place
	S 2	46.328340, -124.054777	73026111001	Sheila Rank	36th Street & SR 103
	S 3	46.342519,-124.053958	73026079008	City of Long Beach	15th Street SE & SR 103
	S 4	46.331460, -124.044037	10112143021	Public Utility District #2	HWY 101 & Sandridge Road
	S 5	46.335643, -124.054970	73026047007	Seaview Sewer District	46th Place & SR 103
LONG BEACH - SOUTH	LBS 1	46.395103, -124.057690	11113332166	State of Washington Parks & Rec	Cranberry Road, just west of SR 103
	LBS 2	46.396369, -124.031711	11113423016	Columbia Land Trust	Cranberry Road (between Birch & Sandridge)
	LBS 3	46.371961, -124.053016	10110921230	Channel West Properties, LLC	26th Street NE & SR 103
	LBS 4	46.355841, -124.053033	10110934043	Latter-Day Saints of Jesus Christ	1306 Washington Avenue North
	LBS 5	46.348683, -124.051201	10111634649	Long Beach School District #101	Washington Avenue S & 5th Street S
	LBS 6	46.386572, -124.053118	73059001000	Columbia Pacific Homeowners Association	116th Lane & SR 103
	LBS 7	46.347797, -124.058206	73051000006	City of Long Beach	7th Street SW & SR 103 - on 7th Street
	LBS 8	46.346029, -124.041615	10111688014	Fairytale Land LLC	Sandridge & Sid Snyder
LONG BEACH - NORTH	LBN 1	46.465866, -124.044994	11110431030	Pacific County	226th Place & U Street
	LBN 2	46.458766, -124.052260	11110996252	Loren H Corder Foundation	Peninsula Senior Center / Golden Sands
	LBN 3	46.438037, -124.051036	11111631070	State of Washington Fish & Wildlife	188th Place & SR 103
	LBN 4	46.416633, -124.051699	11112821003	Columbia Land Trust	158th Place & SR 103
	LBN 5	46.472791, -124.052700	74045004000	Western Washington Conservative Baptist Camping Association	Dunes Bible Camp & SR 103
	LBN 6	46.433579, -124.051831	11111633046	State of Washington Parks & Recreation	184th Place & SR 103
	LBN 7	46.414846, -124.039327	74011059000	Columbia Land Trust	Birch Street (north of Cranberry road, about 1.2 miles)

Pacific County VES Locations: all Options

Community	*VES ID*	*Location*	*Parcel Number*	*Parcel Owner*	*Intersection*
OCEAN PARK	OP 1	46.512057, -124.054214	76010007000	Melissa Candace Thompson	Joe Johns Road & K Lane
	OP 2	46.511885, -124.040747	12112113025	Gary D & J Marie McGee	Joe Johns Road & X Lane
	OP 3	46.498048, -124.052980	75004045001	Michael Mc Mahon & Shelly Hedges	270th Place & Park Avenue
	OP 4	46.497731, -124.037659	76026011001	Pacific County	270th Street & Z Street
	OP 5	46.489357, -124.043582	12113312242	Taylor-Ocean Park Cemetery	U Street & 260th Street
	OP 6	46.481538, -124.056674	12113395083	John Forrest Bailey & Wendi Rognrud	247th Place & J Place
LEADBETTER	L 1	46.587367, -124.062958	13112823019	Leadbetter Farms LLC	I Street
	L 2	46.561065, -124.056909	12110550304	Flood Control District #1	357th Street & I Street
TOKELAND	TO 1	46.725044, -124.019800	14110317000	Shoalwater Indian Reservation	State Route 105 & Tokeland Road
	TO 2	46.721536, -124.015933	78008002001	Shoalwater Indian Reservation	2373 Tokeland Road
	TO 3	46.718694, -124.008509	78036000001	Kitty J Sage	Tokeland Road & Pine Lane
	TO 4	46.709750, -123.990759	14111234014	USA/Trust for Shoalwater Bay	Kindred Avenue & Wye Drive
	TO 5	46.705469, -123.978893	78029005017	Nelson Crab Inc	Kindred Avenue & 2nd Street
	TO 6	46.711119, -123.995893	78013003001	Pacific County Fire District #5	2753 Tokeland Road
NORTH COVE	N 1	46.765180, -124.082727	15113011003	Grays Harbor County Public Utility District, #1	Udell Hanson & State Route 105
	N 2	46.745150, -124.080955	78035000034	Benjamin & Marion Bodwell	Warrenton Cannery Road & Seabreeze Avenue
	N 3	46.742110, -124.080011	78033000007	Sharon K & Edward A Leseman	Whipple Avenue & State Route 105
	N 4	46.790639, -124.087179	15111812028	Grays Harbor Audubon Society	Cranberry Road & State Route 105
	N 5	46.778139, -124.083352	15111911030	Pacific County	State Route 105 & Summers Lane

Grays Harbor County VES Locations: all Options

Community	*VES ID*	*Location*	*Parcel Number*	*Parcel Owner*	*Intersection*
GRAYLAND	G 1	46.849382, -124.105886	161225110030	Donna J & Richard B Martin	Bonge Avenue & SR 105
	G 2	46.830837, -124.098578	833500002700	Patrick S & Ann R Santee	Wood Lane: south of 6th Street & SR 105, east side of HWY, vacant private lot
	G 3	46.809388, -124.094058	743509100008	South Beach Regional Fire Authority	Cranberry Road & SR 105
	G 4	46.824477, -124.096319	161131340260	South Beach Christian Center	Marine Drive & SR 105 (northeast of intersection)
	G 5	46.794627, -124.090675	151107430150	State of Washington Parks and Recreation	2193 SR 105
WESTPORT	W 1	46.907976, -124.112647	104000200201	Darlene M Caldwell ET AL	East Dock Street & Nyhus Street North (parking lot)
	W 2	46.893475, -124.106909	103000801101	City of Westport	Adams Street & Baker Street
	W 3	46.886575, -124.118149	106501500000	Paul B Draper & RMT LLC	South Surf Street & West Ocean Avenue
	W 4	46.876554, -124.112586	102502900900	State of Washington Tax Commission	SR 105 & West Newell Avenue
	W 5	46.862497, -124.099020	161119220080	Ocosta School District #172	2580 South Montesano Street
	W 6	46.902235, -124.130312	616120132002	State of Washington	End of Jetty Haul Road
OCEAN SHORES - EAST	OSE 2	46.998326, -124.143688	94900900100	City of Ocean Shores	Duck Lake Drive NE & Albatross Street NE
	OSE 1	46.997690, -124.157170	90500079700	City of Ocean Shores	Octopus Avenue NE & Albatross Street NE
	OSE 3	46.978038, -124.155899	617121014001	North Beach School District #64	300 Mt Olympus Avenue SE
	OSE 4	46.978869, -124.141928	94700118200	Darlene J & Roland J Bahr Trust	Duck Lake Drive SE & Lake Bay Loop SE
	OSE 5	46.967208, -124.138620	94700500100	Diane Siebert & Chris Blackwell	Blue Wing Loop SE & Duck Lake Drive SE
	OSE 6	46.963596, -124.143383	91900061601	Ocean Shores Community Club	Mt Olympus Avenue SE & Cakesosta Street SE
	OSE 7	46.958165, -124.145076	92700016600	Lori & Brent Gambriell	Cormorant Street & Island Circle SE
	OSE 8	46.952658, -124.130549	92900060102	Quinault Land & Timber Enterprises	1020 Catala Avenue SE
	OSE 9	47.044871, -124.158170	181215440030	Public Utility District #1	State Route 109 & State Route 115
	OSE 10	47.012392, -124.153125	95101300000	City of Ocean Shores	E Rain Street NE & Cardinal Avenue NE
	OSE 11	46.991065, -124.149693	94901206100	Shelly & Derek Kane	Ponderosa Loop NE & Bass Avenue NE
	OSE 12	46.989265, -124.143273	94900601400	Harold Wiebenga Jr. Et Al	Olympic View Avenue & Hutton Street NE
	OSE 13	46.972591, -124.152807	91900061500	Ocean Shores Community Club	Skookumchuck Street SE & Makah Avenue SE

Grays Harbor County VES Locations: all Options

Community	*VES ID*	*Location*	*Parcel Number*	*Parcel Owner*	*Intersection*
OCEAN SHORES - WEST	OSW 1	47.070668, -124.168939	786501000500	Screamin' Eagle Campground	2nd Avenue & Ocean Boulevard
	OSW 2	47.042118, -124.170174	181222120010	Quinault Land & Timber	78 SR 115
	OSW 3	47.032457, -124.165071	181222420000	State of Washington	Ocean City State Park Campground
	OSW 4	47.018080, -124.159587	181227110010	North Beach School District #64	336 SR 115
	OSW 5	47.008412, -124.163416	90100700004	City of Ocean Shores	120 West Chance a La Mer NW
	OSW 6	46.984810, -124.162445	90300014900	Richard T Duffy	Ocean Lake Way SW & North Port Loop NW
	OSW 7	46.962666, -124.164543	92100028800	Pamala J & Michael A Cobb	North Razor Clam Drive & Butterclam Street SW
	OSW 8	46.971723, -124.166264	91700005800	Lisa & Randy Seal	Ocean Shores Boulevard SW & Taurus Boulevard SW
	OSW 9	46.952215, -124.168749	93300300700	Amy J Wolner	Ocean Shores Boulevard SW & Marine View Drive SW
	OSW 10	46.952514, -124.145951	93101209000	Christopher B Miller	Wowona Avenue SW & Tonquin Avenue SW
	OSW 11	46.934499, -124.166225	93900102100	City of Ocean Shores	South Spinnaker Street
	OSW 12	46.955773, -124.162348	93100705500	Ocean Shores Community Club	Torrisdale Avenue SW & Seashore Street SW
	OSW 13	46.993884, -124.166182	618122758170	City of Ocean Shores	Ocean Shores Blvd NW & Pacific Blvd NW
	OSW 14	47.056828, -124.167127	181210330010	Ocean Shores Outdoor Rec Club	Dunes Lane & Pine Lane
ABERDEEN, HOQUIAM, COSMOPOLIS	AHC 1	46.97174, -123.80099	027400400000	Grays Harbor Historical Seaport Authority	West Curtis Street & North Clark Street
	AHC 2	46.97789, -123.77931	317091011006	Grays Harbor County	Junction City Road
	AHC 3	46.96688, -123.82948	029407400000	City of Aberdeen	South Garfield Street & West State Street
	AHC 4	46.96561, -123.78971	317091521001	Aberdeen School District #5	South Farragut Street & East Perry Street
	AHC 5	46.97346, -123.83141	010400100100	Aberdeen School District #5	Pacific Avenue & North Division Street
	AHC 6	46.97461, -123.92440	056401200100	Port of Grays Harbor	Airport Way (near Bowerman Airport)
TAHOLAH	TA 1	47.346217, -124.289532	unknown	unknown	5th Avenue & Commux Street
	TA 2	47.344442, -124.293106	unknown	unknown	2nd Avenue & Spruce Street
	TA 3	47.345159, -124.284176	unknown	unknown	Park Place

Clallam County VES Locations: all Options

Community	*VES ID*	*Location*	*Parcel Number*	*Parcel Owner*	*Intersection*
LA PUSH	LP 1	47.908355, -124.637894	N/A	Quileute Tribe	Ocean Drive & River Drive
NEAH BAY	NB 1	48.364337, -124.621179	TBD	Neah Bay School District	Elk Street & Deer Street
	NB 2	48.365846, -124.606190	TBD	TBD	Buchanan Street & Bayview Avenue

Appendix B: Ocean Shores Bridges

Ocean Shores: Bridge Inventory + Locations

Bridge ID	*Community/Study Area*	*Location (Lat/Long)*	*Street*	*Notes*
1	Ocean Shores - East	47.005633, -124.150603	E Chance a La Mer	Located between Cardinal Avenue NE & Rainbow Court
2	Ocean Shores - East	46.998026, -124.148508	Albatross Street NE	Located between Sunset Avenue & E Chance a La Mer NE
3	Ocean Shores - East	46.988842, -124.146176	Overlake Street NE	Located just SW of Duck Lake Drive NE
4	Ocean Shores - East	46.984694, -124.156552	Ocean Lake Way NE	Located between Point Brown Avenue & Canal Drive
5	Ocean Shores - East	46.951139, -124.132280	Point Brown Avenue SW	Located between North Razor Clam Drive SW & South Razor Clam Drive SW
6	Ocean Shores - East	46.952582, -124.134914	Mount Olympus Avenue	Located between Falls of Clyde Loop SE & Hassalo Avenue SE
7	Ocean Shores - West	46.951540, -124.146702	Tonquin Avenue SW	Located between Wawona Avenue & Marine View Drive
8	Ocean Shores - West	47.071072, -124.167795	Second Avenue	Located between Pacific Boulevard & Ocean Boulevard

Appendix C: 2010 Census and 2019 American Community Survey (ACS) Estimates

Population Comparisons: 2010 Census vs. 2019 ACS

Community	*Type*	*2010 Census - Median Household Size*	*2019 ACS Estimate - Median Household Size*	*Difference (2019 ACS - 2010 Census)*
Ilwaco	Town	2.1	2.6	0.5
Seaview (98644)	Zip Code	1.9	2.3	0.4
Long Beach	Town	1.9	2	0.1
Ocean Park	Town	2.05	2.3	0.25
Oysterville (98640)	Zip Code	2.05	2.1	0.05
Leadbetter (98640)	Zip Code	2.05	2.1	0.05
Tokeland (98590)	Zip Code	2.18	2.4	0.22
North Cove (98547)	Zip Code	2.18	2	(0.18)
Grayland	Town	2.0	1.8	(0.2)
Westport	Town	2.1	2.1	0
Ocean Shores	Town	2.06	1.9	(0.16)
Taholah	Town	*Tribal population estimate used instead	*Tribal population estimate used instead	N/A
La Push (98350)	Zip Code	*Tribal population estimate used instead	*Tribal population estimate used instead	N/A
Neah Bay	Town	2.76	3.2	0.44