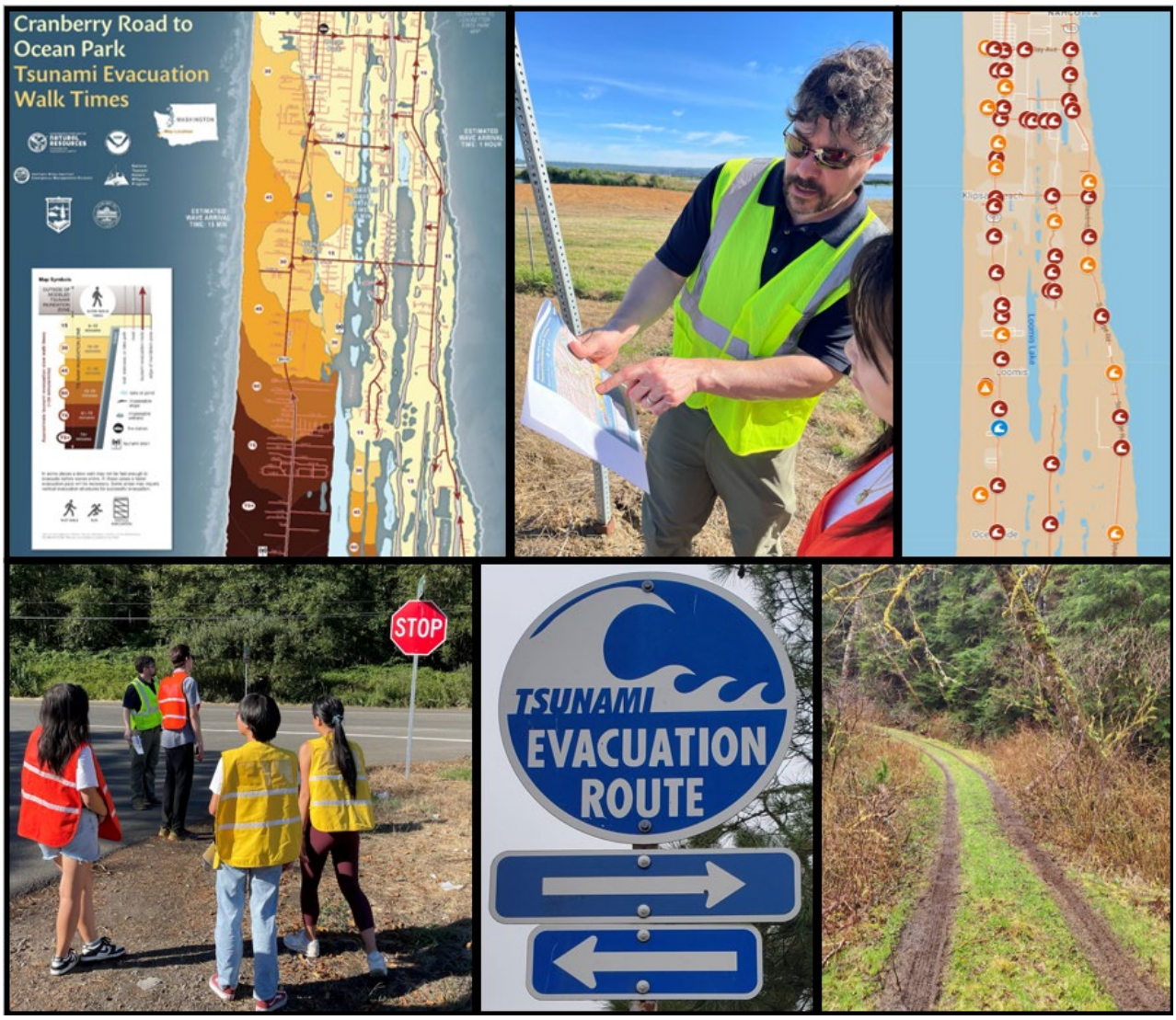
Washington State Tsunami Wayfinding Guide

Version 1.0



Acknowledgements

University of Washington Project Team

Bob Freitag, Principal Investigator

Jeana Gomez, Project Manager

Eddie De La Fuente, Graduate Student

Max Fuangaromya, Graduate Student

Alina Doan, Undergraduate Student

Janice Ton, Undergraduate Student

Shirley Yao, Undergraduate Student

Washington Emergency Management Division

Elyssa Tappero, Tsunami Program Manager

Ethan Weller, Tsunami Program Coordinator

Danté DiSabatino, Tsunami Program Coordinator

Maximilian Dixon, Hazards and Outreach Program Supervisor

Washington Geological Survey

Daniel Eungard, Tsunami Hazards Geologist

Alex Dolcimascolo, Tsunami Geologist

Corina Allen, Chief Hazards Geologist

This item was funded in part by NOAA awards NA21NWS4670014 and NA22NWS4670021. This does not constitute an endorsement by NOAA.

Institute for Hazard Mitigation Planning and Research
Resilient and Safe Communities

Contents

Tsunami Wayfinding Overview 4
What is Wayfinding? 4
Tsunami Evacuation Wayfinding and Signage in Washington State 5
Tsunami Wayfinding in Washington State 8
How to Use this Document 10
Section 1: Getting Started 11
Getting Started: The Wayfinding Mindset 11
Getting Started: Partners and Resources 12
Getting Started: Fieldwork Considerations 13
Getting Started: Wayfinding Safety 14
Getting Started: Documentation 14
Section 2: In the Field 17
In the Field: Choosing Locations of New Signs 17
In the Field: Recording Locations of Current Signs 18
In the Field: Assessing Route Accessibility and Other Challenges 20
In the Field: Tips for Wayfinding Without Pre-Established Evacuation Routes 22
Section 3: Taking Action 26
Taking Action: Data Consolidation 26
Taking Action: Installing New or Replacement Signs 28
Taking Action: Incorporating Tsunami into Broader Wayfinding Efforts 29
Taking Action: Thinking Beyond Classic Wayfinding 30
Appendix A – Resources and Contacts 35
Resource Links 35
State Agency Contacts 37

Tsunami Wayfinding Overview

What is Wayfinding?

Wayfinding as a concept includes the methods by which humans orient themselves in a physical space and navigate from one place to another. We interact with wayfinding elements every day in our built environment, from directional signs in public buildings and road signs along the highway to navigation apps on smartphones and complex networks of streetlights controlling the flow of traffic. These wayfinding systems are vital for ensuring we navigate our world in a safe, orderly manner, especially when we are unfamiliar with an area or do not have a strong sense of direction. When we become lost or are in a stressful situation from which we want to remove ourselves, we look to wayfinding markers for both direction and comfort.

Effective wayfinding requires the cohesive use of intentional design elements such as color, text, and iconography when providing information in the form of maps, signs, digital platforms, and other wayfinding resources. Signage is the most visual part of wayfinding and plays a vital role in helping people navigate public spaces. The four types of signs most commonly used to provide information and navigation include:

- **Informational:** Informational signs provide useful information for a location such as accessibility, hours of operation, location of restrooms, Wi-Fi code, etc.
- **Identification:** Identification signs are used to indicate a destination, such as entrances to buildings, parking lots, emergency services, parks, and other public spaces.
- **Regulatory:** Regulatory signs identify what can or cannot be done in a given location. Examples include "no smoking" and “no trespassing” signs.
- **Directional:** Directional signs assist people in physical navigation using arrows or other iconography, most often at decision points along the route like intersections. Examples include highway signs and emergency exit signs.

All four kinds of signs, along with other wayfinding tools, can and should be utilized when developing evacuation routes for hazards such as building fires, hurricanes, floods, volcanic lahars, and tsunamis. The principles of effective wayfinding are especially important for evacuation wayfinding, as many hazards provide little to no warning and evacuees may only have minutes to ascertain the closest route to safety. When every second counts, evacuees may not have time to analyze a complex building map, pull up directions on their smartphone, or consult a guidebook to find the closest meeting place. This is certainly the case when it comes to local tsunami hazards, where the first waves can arrive in just minutes. Clear and concise evacuation signage can make the difference between life and death.

Figure 1 Large, bright arrows clearly direct evacuees toward the closest exit during a building fire (Markus Spiering, 2011).

Tsunami Evacuation Wayfinding and Signage in Washington State

Washington State's 3,000+ miles of coastline are at risk for both distant and local tsunamis, with local tsunamis posing a much greater threat of inundation (on-land flooding) and requiring swift evacuation of those within the inundation zone. Washington's local tsunami hazards stem primarily from crustal faults along the inner coast and the Cascadia Subduction Zone along the outer Pacific Coast, all of which have in the past produced catastrophic earthquakes and will again in the future. It is therefore necessary to assume that evacuation for tsunamis generated by these earthquakes will have to take place on foot, as roads are likely to be impassable due to the secondary hazards of earthquakes such as liquefaction, downed power lines and trees, landslides, and other barriers. The placement of signage leading to high ground must consider that evacuees will be on foot, which greatly reduces both the speed at which they can move and the distance they can see, necessitating signs that are closer together than traditional road signs.

Tsunami wayfinding signs come in all shapes and sizes. As there are currently no national-level rules or requirements for tsunami wayfinding in the United States, sign designs can vary across states and territories. Blue and white are the generally accepted colors for most tsunami signs, as these colors have been in use for many decades and have successfully saturated much of the public consciousness as "tsunami" colors. These colors are also rarely used for other kinds of official wayfinding signage, at least along transportation corridors, so they are typically available to use.

Six types of official tsunami signs are currently in use across Washington State:

Figure 2 Tsunami sign designs used in Washington State as of 2024 (Kolob Industries, 2024).

- **Tsunami Evacuation Route** – A round white and blue sign with a series of waves in the background and the words "Tsunami Evacuation Route" stretched across the bottom half of the sign. This sign indicates an official tsunami evacuation route that leads either to

the closest high ground or inland out of the inundation zone. These signs have a 24-inch diameter with 3-inch text.

- **Rectangular Arrow** (not shown above) – A small, rectangular blue sign with a white arrow that pairs with the Tsunami Evacuation Route sign to provide directionality out of the inundation zone. These signs can face right, left, straight up, or at an angle depending on the position of the evacuation route and location of the sign.
- **Tsunami Hazard Zone Sign** – A large, rectangular blue sign with the text "Tsunami Hazard Zone" printed across the top, a series of waves with a person running to high ground, and text along the bottom that reads "In case of earthquake, go to high ground or inland". This sign is used in public areas to provide awareness that people are located within the tsunami inundation zone. The sign is 30 inches wide and 24 inches tall, with the text either 2 or 1.75 inches.
- **Assembly Area Sign** – A small, white rectangular sign with a group of people on top of a hill above a series of waves. The bottom of the sign has blue text that reads "Assembly Area". These signs are used to identify official tsunami assembly areas within communities. Assembly area signs are 12 inches wide and 18 inches tall, with 1.625-inch text.
- **Entering Tsunami Hazard Zone** – A large, hexagonal sign with an orange background and black trim. Printed across the top half of the sign in blue and black text is "Entering Tsunami Hazard Zone". Below the text is a series of blue waves and a small black hill. This sign is intended to notify the public that they are entering into the tsunami inundation zone. The dimensions are 30 inches wide and 30 inches tall with text sizes of 2.5 and 3 inches.
- **Leaving Tsunami Hazard Zone** – A large, hexagonal sign with a white background and black trim. Printed across the top half of the sign in blue and black text is "Leaving Tsunami Hazard Zone". Below the text is a series of blue waves and a small black hill. This sign is intended to notify the public that they are leaving the tsunami inundation zone. The dimensions are 30 inches wide and 30 inches tall with text sizes of 2.5 and 3 inches.

These signs are provided by the Washington State Emergency Management Division (WA EMD) tsunami program at no cost to local jurisdictions as funding allows and can also be purchased directly by local jurisdictions if desired. It is the responsibility of the local jurisdiction to ensure signs being installed on state highways adhere to any applicable rules as outlined in the Washington State Department of Transportation's (WSDOT) Sign Fabrication Manual, as well as any other local regulations that may apply.

History of Tsunami Wayfinding in Washington State

Tsunami wayfinding plays a vital role in helping the public become better aware when they are in a tsunami hazard zone and to clearly identify evacuation routes so they can reach safe high ground, when necessary, before tsunami waves arrive. Unlike evacuation signage for a single building, tsunami signage must be sufficient to guide someone from their location in the hazard zone inland to safe high ground – a route that may extend a mile or more, with many twists and turns to confuse an unfamiliar evacuee. It is therefore critical that tsunami evacuation routes have enough signage to ensure continual line of sight, so that someone on a route will always have an evacuation sign within their sightline to guide them forward. At no point should someone lose sight of any signage and have to guess which direction to go next.

The goal of tsunami wayfinding is to get people to safety in an efficient and effective manner; we increase this possibility by saturating our evacuation routes with signage and addressing accessibility issues along those routes. Over the last several decades, Washington's coastal communities have worked hard to distribute tsunami signage along evacuation routes, but these efforts are ongoing and major gaps remain due to lack of capacity and funding. Some overarching issues identified include:

- Signs installed in past decades may not align with more recently established tsunami evacuation routes and therefore direct people the wrong direction.

- Signs installed in past decades were installed with vehicular evacuation in mind, not pedestrian, so signs are far apart and hard to see from a pedestrian perspective.
- Most signs are only on major roads; communities lack signage on side roads, private roads, community trails and other pedestrian paths, forestry roads, beaches, marinas, and state parks.
- Many identified evacuation routes have accessibility issues that need to be addressed, such as: locked gates or fences, private property or no trespassing signs, vegetation overgrowth, lack of paving, muddiness and washouts, and steep, uneven ground.

These pervasive issues inspired WA EMD's tsunami program to partner with the University of Washington's (UW) Institute for Hazard Mitigation Planning and Research to conduct a two-year tsunami evacuation route wayfinding project using grant funding provided by the National Tsunami Hazard Mitigation Program. The project, which spanned the summers of 2022 and 2023,

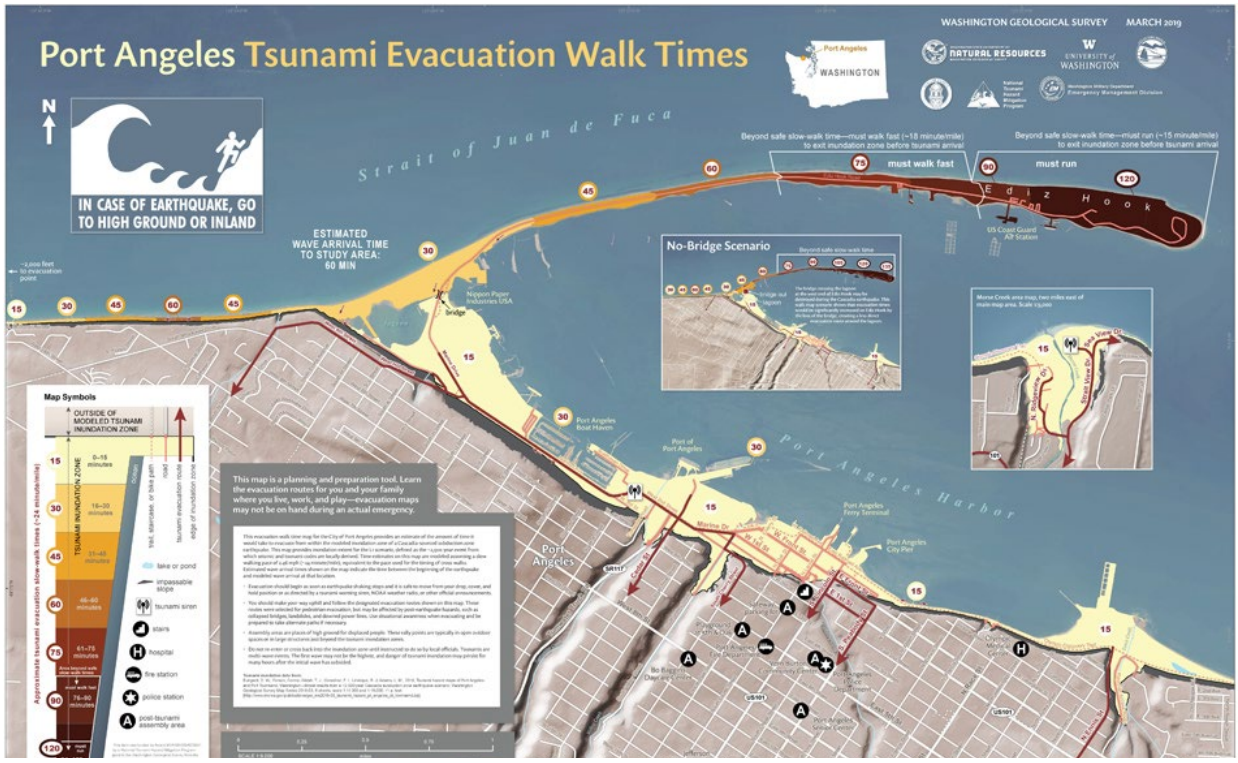


Figure 3 The tsunami evacuation walk map for the city of Port Angeles, WA (WA Geological Survey, 2019).

targeted coastal Washington communities with tsunami pedestrian evacuation walk maps published by the Washington Geological Survey.

Twenty-eight communities and over 1,055 miles of evacuation routes were walked by groups of UW graduate and undergraduate students, who collected a wealth of data regarding the placement of current tsunami signage and recommendations for new signage. Unsurprisingly, the project revealed that just these 28 communities combined need thousands of new signs to fully cover their mapped evacuation routes and ensure people in the inundation zone can quickly find their way to safety. The results of Washington's wayfinding project do not just benefit the original 28 communities targeted, however. They also extend to the creation of this Tsunami Wayfinding Methodology document, which synthesizes the best practices and lessons learned from the wayfinding project and other coastal states and territories who have undertaken similar work.

How to Use this Document

By following the wayfinding methodology outlined in the following sections of this document, your community can begin and/or expand your own tsunami wayfinding efforts. This document is broken into three main sections - Section 1: Getting Started, Section 2: In the Field, and Section 3: Taking Action - which walk you through the wayfinding process from start to finish. Appendix A includes resource links and state agency contacts to further assist your wayfinding efforts.

Whether you are starting 'from scratch' with no tsunami signs in your jurisdiction or have some signs and want to know where your current gaps are before you install more, this document will help you approach tsunami wayfinding with a clear, actionable plan.

Section 1: Getting Started

This section covers the initial questions and planning concepts to think about when you want to evaluate your community's gaps and needs in tsunami signage and evacuation. The following subsections discuss the mindset for successful wayfinding, resources and partners to access for support, things to keep in mind when you're in the field, and what information you should plan to collect when in the field.

Getting Started: The Wayfinding Mindset

Assessing your community's tsunami wayfinding needs starts with understanding who may be utilizing your signs and what their circumstances might be when they need those signs most. Imagine you are a first-time visitor to your community, someone completely unfamiliar with the area and even with the tsunami threat. If you are standing at Point A in the inundation zone – perhaps a marina or a popular beach trailhead – can you easily recognize from signage alone what path you need to take to get to safety at Point B? And can you follow that signage on foot without getting lost, even if you might be stressed and having trouble thinking strategically? If you can, that means the evacuation route is well-saturated with signage. If you can't, then you have some opportunities for improvement!

Figure 4. If you know the area well, a sign with arrows pointing in two different directions might make sense; but what if someone is new to the area? Will they know which direction to choose? (WA EMD, 2022).

Getting into the mindset of a potential evacuee can help you see the land around you with new eyes. What might seem obvious to someone familiar with the area might not be to someone who has never been there before. When

walking your evacuation routes (or scoping out potential routes), remain open to how someone might misinterpret signage, mistake one path for another, or otherwise take a wrong turn somewhere that adding another sign could clarify. Enlisting community members to assist in this process is helpful, especially those with access and functional needs – someone who is nearsighted, for example, may have trouble seeing signs that are spaced too far apart, while someone who is unfamiliar with the area may not be able to anticipate the next turn in a route without clear signage.

Getting Started: Partners and Resources

A great way to ensure that you cover all planning considerations in your community is to start with who should be included in the project. When evaluating your mapped evacuation routes, identify key persons associated with the land – whose property does the route cross through? Does it coincide with any WSDOT owned roads? WSDOT has their own requirements for sign installation that can be found in their Sign Fabrication Manual. Also think about what other tools may be available to you throughout the process. For example, Public Works Departments may have the capacity or funding to assist you with sign installation. Washington Emergency Management Division has yearly grant funding available for ordering signs and may have additional funds available for installation.

In addition to this guide, Oregon's Department of Emergency Management has a Tsunami Wayfinding Guide that can also be a valuable resource. If you are unsure where to begin, or would like some guidance on the wayfinding process, reach out to Washington Emergency Management Division for support. More resources, contacts, and information are included in Appendix A of this document.

Getting Started: Fieldwork Considerations

The goal of tsunami wayfinding is to get people to safety in an efficient and effective manner. Since their evacuation will likely be preceded by a major earthquake that damages local infrastructure, they need to be able to do so on foot. This means an evacuee should never lose sight of tsunami signage as they are evacuating – they should be able to see the last sign they passed and the next sign they are approaching so they never have to guess which direction to go. If the evacuation route ever deviates in such a way that their line-of-sight between signs is broken, such as when the route turns a corner or is blocked by trees or buildings, another sign is needed to ensure that visibility remains. This is one reason why the best tsunami wayfinding is done on foot, with volunteers walking the routes in the perspective of an evacuee.

Another reason wayfinding on foot is valuable is that many routes may be inaccessible to vehicles – or, alternately, may be accessible by vehicle but not easily by foot. It is important to walk the routes evacuees will be taking so you directly experience any navigational challenges like overgrown vegetation, fallen trees, deep mud, or steep slopes. Many evacuation routes either begin or end as unpaved trails or walking paths, which may become hazardous in wetter months or have staircases or small bridges which can be damaged by local hazards. Assessing routes solely by vehicle does not always reveal some of these issues in the same way that facing them firsthand on foot can.

Getting Started: Wayfinding Safety

When out in the field, be sure everyone involved in the wayfinding efforts is properly equipped for the environment and the project at hand. Safety vests are recommended since people will likely be walking along busy roads. Safety vests or other matching/branded clothing also help indicate group cohesion and intention, which is especially helpful in more populated areas where passersby may wonder what the group is doing. Having business cards or other information on hand also helps in case anyone approaches with questions about the project.

Figure 5 WA EMD employees and students from the University of Washington walk tsunami evacuation routes wearing bright vests to ensure visibility. (WA EMD, 2022)

Because WA EMD had university students walking evacuation routes, oftentimes without a representative from WA EMD with them, the project team chose to have the student groups walk only the parts of routes on public land. Any routes that led onto private property or other areas where the ownership of the land was uncertain were skipped. If your volunteers will be walking on private property, it is important to speak with property owners beforehand to obtain permission. Even if volunteers will only be walking on public land, people in the area may still have questions or be concerned about potential trespassing. Prepare your volunteers beforehand for how they should answer these questions and make sure they know who they can direct the public to for more information.

Getting Started: Documentation

Before embarking on your wayfinding efforts in the field, it is important to decide what information you will collect, how you will collect it, and what you will do with it once collected.

Deciding these things beforehand will save time, ensure the same type of data is collected for each location, and allow you to consolidate and process the data collected in a format that allows it to be both useful and actionable.

Data you will want to collect in the field may include, but is not limited to:

- **Currently existing signs**
  - Type of sign (evacuation route, hazard zone, assembly area, etc.)
  - Location by latitude and longitude, as well as other nearby landmarks (intersection name, property name, etc.)
  - Condition (good, fair, bad) and any maintenance needs (sign replacement, new pole, removal of graffiti, vegetation trimming for visibility, etc.)
  - Photos of front and back of sign
  - Potential recommendations for moving the sign to another location if it does not adhere to the identified evacuation route
- **New recommended signs**
  - Type of sign (evacuation route, hazard zone, assembly area, etc.)
  - Location by latitude and longitude, intersection name, etc.
  - Cardinal direction any associated arrow signs should point
  - Photos of the recommended location with something to indicate location of the sign and which direction it should face (orange traffic cones work well for this)
  - Whether the sign will be located on public or private property (if known)
  - Opportunities for simplifying sign installation (nearby poles or posts already in use that a sign could be added to)
- **Other evacuation route/wayfinding information**
  - Locations and photos of any manmade physical barriers blocking the evacuation route (locked gates, fences, 'no trespassing' signs or other indications of private property, etc.)

- Locations and photos of any natural accessibility concerns requiring maintenance or greater mitigation efforts (washouts, overgrown vegetation, erosion, fallen trees or branches, extreme muddiness, etc.)
- Locations and photos of potential assembly areas, or current conditions of assembly areas that have already been identified (including degree of accessibility, any supplies stored there, etc.)
- Locations and photos of any opportunities to provide other earthquake/tsunami information to the public such as public billboards and bulletin boards, informational kiosks, trailheads, public parking lots, etc.

Section 2: In the Field

Now that you have created a solid plan for data collection and understand the frame of reference that will ensure a successful field trip, this section will help guide you through the decisions to make when you are on the ground walking your evacuation routes. This section provides guidance on how to choose and record locations of potential new signs, record the locations of current signs, account for accessibility along the routes, and how to approach the wayfinding process without pre-established routes.

In the Field: Choosing Locations of New Signs

As you walk your evacuation routes or walk through the inundation zone in general, the following methodology will help you recognize good locations for new signage to ensure route saturation. Each recommendation includes the kind of tsunami sign that could be used, as a variety of signs will best ensure the public is both aware of the local tsunami risk and knowledgeable about the evacuation routes.

Record potential locations for new signs anywhere:

- Mapped tsunami evacuation routes begin or end (tsunami evacuation route sign)
- Line of sight from the last sign is broken due to distance, a rise or fall in the route, or a turn in the route (tsunami evacuation route sign)
- People may congregate such as trail heads, boardwalks, public parking lots for beaches, parks, marinas, etc. (tsunami hazard zone sign, entering/leaving tsunami hazard zone signs, tsunami evacuation route sign)
- The next direction to take for an evacuation route is unclear, such as anywhere you turn off the current path, intersections, places where the route leaves a main road, or densely vegetated areas where vision is limited (tsunami evacuation route sign)

- A major road or evacuation route moves in and out of the inundation zone, especially if the road is heavily trafficked (entering/leaving tsunami hazard zone signs)
- Official tsunami assembly areas (tsunami assembly area sign, leaving tsunami hazard zone sign)
- Convenient locations for additional tsunami information such as public restrooms, informational kiosks in parks, public gathering places (any signs as applicable, or other tsunami information like printed and laminated evacuation route maps, QR codes to maps, etc.)

To ensure your recommendations will be actionable, take pictures of the location of the recommended sign using a marker such as a person or traffic cone to indicate where the sign should go. Be sure to note which direction the sign needs to face and the cardinal direction any accompanying arrow sign should point. Do not assume it will be obvious from the picture; when in doubt, the more information documented the better.

Figure 6 Having a person in the picture helps orient the viewer and ensures the location and direction of the sign will be understood once it comes time for installation. (WA EMD, 2023)

In the Field: Recording Locations of Current Signs

As you assess your routes, it is also important to record the locations and conditions of any pre-existing tsunami signs. Over time pre-existing signs may have been damaged, defaced, or may no longer be placed correctly according to your official evacuation routes. This is a great opportunity to ensure current signs are in good condition, where they need to be, and listed on a tracker so you can revisit them annually for upkeep.

As you come across existing tsunami signs, record at least the following data:

- Type of sign
- Location by latitude and longitude, intersection name, etc.
- Cardinal direction of any associated arrow signs
- Condition (good, fair, bad) and any maintenance needs (sign replacement, new pole, removal of graffiti, vegetation trimming for visibility, etc.)
- Photos of front and back of sign
- Potential recommendations for moving the sign to another location if it does not adhere to the identified evacuation route

Figure 7 A bent and dirty tsunami evacuation route sign shows how wear and tear reduce effectiveness. (WA EMD, 2022)

In the Field: Assessing Route Accessibility and Other Challenges

Figure 8 This tsunami evacuation route leads along a muddy path crumbling into the water, making it difficult to navigate. (WA EMD, 2023)

When walking mapped evacuation routes, be mindful of potential obstacles that those with accessibility needs may encounter. Areas that are muddy, overgrown by vegetation, or too steep may be difficult for different community members to access, if not outright impossible for those relying on wheelchairs, walkers, canes, or strollers. Some routes may include small foot bridges, makeshift stairs, or other features common to pedestrian paths that are not easily navigable for all members of the public. Evacuees may also run into other issues along mapped routes such as fences, locked gates, or 'private property' and 'no trespassing' signs. These challenges could cause evacuees to hesitate, wasting valuable evacuation time, or even leave the route completely if they fear legal ramifications. When assessing your routes, be sure to make note of any such issues that may prevent people from quickly navigating on foot.

Figure 9 This tsunami evacuation route leads to a locked gate and private property. This impacts accessibility and may prevent evacuees from going farther if they are concerned about trespassing. (WA EMD, 2022)

Other than the existing physical barriers and accessibility issues that may exist along your evacuation routes, the conditions of your evacuation routes may also change drastically in a major earthquake. Trees and power lines may fall onto the path, sidewalks or roads may crack from liquefaction, bridges may partially or fully fail, and landslides may wipe away whole sections of route. Informal pedestrian pathway modifications, such as makeshift stairs and small foot bridges, are even less likely to survive. If your route relies on a section of infrastructure likely to fail during strong ground shaking, you may need to send evacuees in a different direction under the assumption they will not be able to take this route.

Local earthquakes can cause significant damage to evacuation routes, just as with any other infrastructure. However, proper route maintenance and route hardening can increase the chances of a route being navigable post-earthquake. Removing barriers like fences and locked gates, trimming back vegetation, and laying down gravel are easy ways to maintain an evacuation route. Larger projects, like paving roads, retrofitting bridges and roadways, and rerouting paths away from areas of concern may require more effort and funding but will save lives in the long run.

In the Field: Tips for Wayfinding Without Pre-Established Evacuation Routes

If your community is just starting out with tsunami evacuation planning, you may not have evacuation routes established yet. As mentioned above, the goal of tsunami wayfinding is to get people to safety in an efficient and effective manner. This requires knowing the extent of the tsunami inundation zone in your area and then identifying the best routes for evacuees to take out of the inundation zone, typically either inland or to high ground, whichever is closest and/or most expeditious. This process is broken down into the following steps:

1. **Identify your tsunami inundation zone and where it intersects with your target area.**

You can find maps of your community's inundation zone online on the Washington Geological Survey's tsunami hazard page. These maps not only show the extent of mapped tsunami inundation for your community, but also the estimated arrival time of the first tsunami waves – or how much time people in this area will have to get safely out of the inundation zone. The amount of time people have to evacuate will also determine if your routes need to lead to the closest high ground (if there is little time) or farther inland to more centralized assembly points (if there is more time). For example, on Washington's outer coast, where the waves of a local tsunami can arrive within 10-20 minutes, evacuation routes need to guide people to the closest high ground, no matter how small it may be. For the inner coast, where the same waves may take hours to arrive, evacuation routes can be longer and lead farther inland.

If you have questions about the maps or cannot find one for your community, reach out to the Washington Geological Survey tsunami program and they will be able to assist you.

2. **Identify highly trafficked "beginning points" close to the waterfront for the start of evacuation routes.**

Areas by the water with consistent foot traffic, such as harbors or marinas, parks, waterfront shopping areas, and workplaces should be prioritized for initial sign placement. It is important to understand where people spend their time in the tsunami inundation zone to ensure that evacuation signs have high visibility, no matter the time of day.

3. **Identify the closest high ground and/or safe ending points in public spaces that are big enough to safely gather large groups of people.**

As stated above, if evacuees will not have much time to get to safety before the first waves arrive, you will want to direct evacuation routes to the closest high ground. This might mean sending people to small 'pockets' of high ground that lack adequate cover or facilities for long-term response. This is okay – once the last tsunami waves have subsided and it is safe for those gathered to move again, they can head to a more centralized location with supplies and shelter. The goal of evacuation is to save lives by directing people out of the inundation zone for the duration of the tsunami (typically 12-24 hours, but sometimes longer).

If evacuees have more time to get out of the inundation zone, it is appropriate to send them along potentially longer routes that culminate in an assembly area. Areas clearly out of the inundation zone with either large open space or shelter facilities are great places for people to gather. Some good examples may be schools, hospitals, parks, malls, or other buildings with large parking lots or fields nearby. Some communities mark these spaces as official tsunami assembly areas and install signage to signify that evacuees have reached a safe place.

4. **Use a map to identify a few potential routes connecting the identified beginning and end points.**

Now that you have identified the start and end points of a potential evacuation route, take a look at maps available of your jurisdiction and work to identify multiple good paths (if possible) that connect the beginning and end points of your evacuation route. These will likely be along roads, though you may also utilize community footpaths, trails, and other less 'official' pathways. Keeping in mind multiple options for routes when you go out in the field to collect data will allow you to easily identify the strengths and weaknesses of each potential route to make the best decision for your community.

5. **Test the routes in the field. Walk each route and evaluate potential issues or challenges that come up from start to finish.**

Using the guidance outlined above, walk each route with your map in hand. As you walk each route, make sure to keep an eye out for good locations to install signs, keeping in mind that the line of sight from one sign location to the next is clear and easy to identify. Stay aware of your surroundings as well. Bridges and overpasses may not withstand the earthquake, unreinforced masonry buildings are more likely to crumble, and steep or muddy terrain may be prone to landslides and difficult for members of the community to climb. It is always better to have more options for evacuation available in case any obstacles block the evacuation route after the earthquake.

6. **Adjust the routes as needed.**

After you get back from the field, take time to adjust the routes using the information you gathered. Perhaps you ran into a locked gate or found that a path goes through private property. Maybe one of the paths you evaluated is the most accessible. Making small adjustments or even combining potential routes will make significant differences in ensuring the greatest number of

people are able to evacuate in a safe and timely manner. The following section provides additional guidance for how to utilize your data in an effective, comprehensible manner.

Section 3: Taking Action

Once you have gathered all of the necessary data to make effective decisions on the type and location of signs, this section provides guidance on how to incorporate that data into smart decision-making practices. This section covers how best to consolidate data, utilizing a simple mapping program called Google MyMaps, steps to take for sign installation and tips for incorporating tsunamis into broader wayfinding efforts, and ideas for moving beyond signage in tsunami wayfinding.

Taking Action: Data Consolidation

Now that you have collected your field data, it is time to consolidate it in a format most useful to your wayfinding needs. This format will vary across jurisdictions but since evacuation route wayfinding primarily involves locational information, you will likely find building your data into a map or other interactive platform to be most helpful. Mapping and GIS software applications such as ArcGIS are best for this and come in a variety of capabilities and costs. The US territory of Puerto Rico uses ArcGIS to host an interactive online map showing the locations of tsunami signs and where more signs are needed. Free online platforms, such as Google MyMaps, are another easily accessible way to create maps based on your data. Your jurisdiction may also utilize software like this already for other purposes, in which case creating a new map or new layers in this platform should be a simple process.

Depending on how many points (existing signs, recommended signs, and other data) you will be including in your map, you may want to differentiate between them visually using different colors and/or icons. This will make it easier to identify the different types of recommendations just by looking at the map, instead of having to click on each individual point to see the information associated with it. For example, when WA EMD conducted its wayfinding project for mapped coastal communities, Google MyMaps was used to consolidate the data and different icons and colors were chosen to differentiate between types of signs and priority areas. The result is a map

where the viewer can easily distinguish not only which types of signs are located/recommended where, but which signs are highest priority for replacement/installation. See figures 10 and 11 below for a comparison of the Cosmopolis, WA tsunami evacuation map and its corresponding Google MyMaps map.

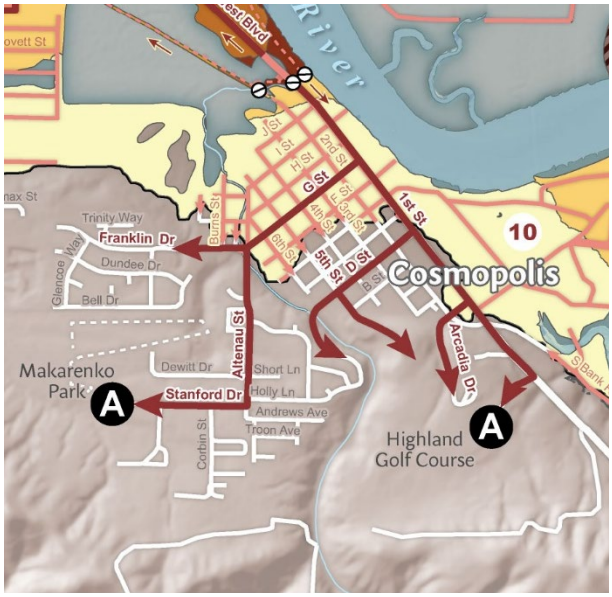


Figure 10 A screenshot from the Aberdeen, Hoquiam, Cosmopolis tsunami pedestrian evacuation walk map, showing the Cosmopolis area's tsunami evacuation routes in red (WA DNR).

Figure 11 A screenshot from the Cosmopolis Google MyMaps page showing the locations of current and recommended tsunami signs.

When evaluating which signs you may want to prioritize for initial installation, you will want to consider several factors to ensure that the most impactful signs are the first ones to be installed. WA EMD recommends signs at starting and ending points along mapped evacuation routes, all incorrect or damaged existing signs, connection points or locations where you lose line of sight, and locations for informational kiosks should be prioritized for installment. The signs at these locations were labeled as Tier 1 and given a red icon in the example above. The next highest priority signs to install would be additional signs along the mapped evacuation routes, alternative sign location options on mapped routes, and other key areas. These signs were labeled as Tier 2 and assigned an orange icon in the example above. The lowest priority of signs includes sign locations that are not along main evacuation routes or other signs that can fill the gaps in a

community and may be nice to have if funding is still available. These sign locations were labeled as Tier 3 and assigned a yellow icon in the example map above. The last set of icons contained on the maps were the existing signs, which were given the color blue.

Color is not the only essential identifier featured in the Google MyMaps system. The table below gives a full outline of the colors and icons utilized as part of this project. Icons represent the type of sign that either exists or should be installed at the location identified in MyMaps and then are assigned a color based on their priority. The meanings of the colors and icons are outlined in the tables below.

Color	Meaning
Red	Tier 1: Highest Priority
Orange	Tier 2: Middle Priority
Yellow	Tier 3: Lowest Priority
Blue	Existing Signage

Icon	Meaning
	Informational Kiosk
	Tsunami Evacuation Route
	Assembly Area
	Entering/Leaving Hazard Zone; Tsunami Hazard Zone

Taking Action: Installing New or Replacement Signs

Utilizing the resources you evaluated in the Getting Started section, gather a list of which signs you identified as high priority (or Tier 1). If you do not have any signs on hand and do not have someone within your jurisdiction with the ability to make road signs, reach out to the Washington Emergency Management Division tsunami program. They often have grant funds to spend on ordering new signs and may have existing stock in-house of some signs. In addition, the Washington Emergency Management Division Hazard Mitigation Program team can assist you with identifying potential grant funding for purchasing signs, as well as submitting grant applications.

Another consideration to keep in mind before installing new signs is to determine if any other agencies or community members need to be involved in the process, especially if you are installing signs on WSDOT-owned roads or private property. Gathering feedback or other input from community members or planning officials will ensure that the installation process goes smoothly and is accepted by those that the signs will have the most impact on.

As you are working through this process and signs start to pop up throughout your community, you may receive questions from community members about the signs and why they are being installed. Conducting simple outreach about the tsunami hazard and your community's risk will bring awareness to the hazard and demonstrate your community's efforts in preparing for a tsunami. If needed, WA EMD's tsunami program is available to present to the community with advanced notice. The tsunami program is a great resource throughout this entire process. Whether you are trying to figure out where to install signs, what signs are needed for your community, or want feedback on installation or a presentation on the tsunami hazard, WA EMD's tsunami program is happy to support.

Taking Action: Incorporating Tsunami into Broader Wayfinding Efforts

Depending on the size of your community, you may already have a broader wayfinding strategy or program intended to holistically integrate different aspects of wayfinding across the jurisdiction. For example, the City of Seattle has the Seamless Seattle wayfinding strategy which sets standards for all aspects of pedestrian wayfinding in the city to ensure a distinctive, accessible, and inclusive wayfinding format that residents and visitors alike can easily navigate. Legible London, the City of London's wayfinding program, has seen a 16% improvement in timesaving for pedestrian journeys and a 60% decrease in reports of pedestrians feeling lost.

Programs of this size establish design standards for day-to-day navigation information such as for public transportation routes, historical markers, public parks and parking lots, and other points of interest. By incorporating emergency information like evacuation routes and assembly areas

into a broader wayfinding strategy, communities ensure the public becomes acclimated to its presence and can readily access this information when necessary. This also expands the forms this information can take, as shown in the image below (figure 12) from the Seamless Seattle strategy of various sign typology planned for use in the city.

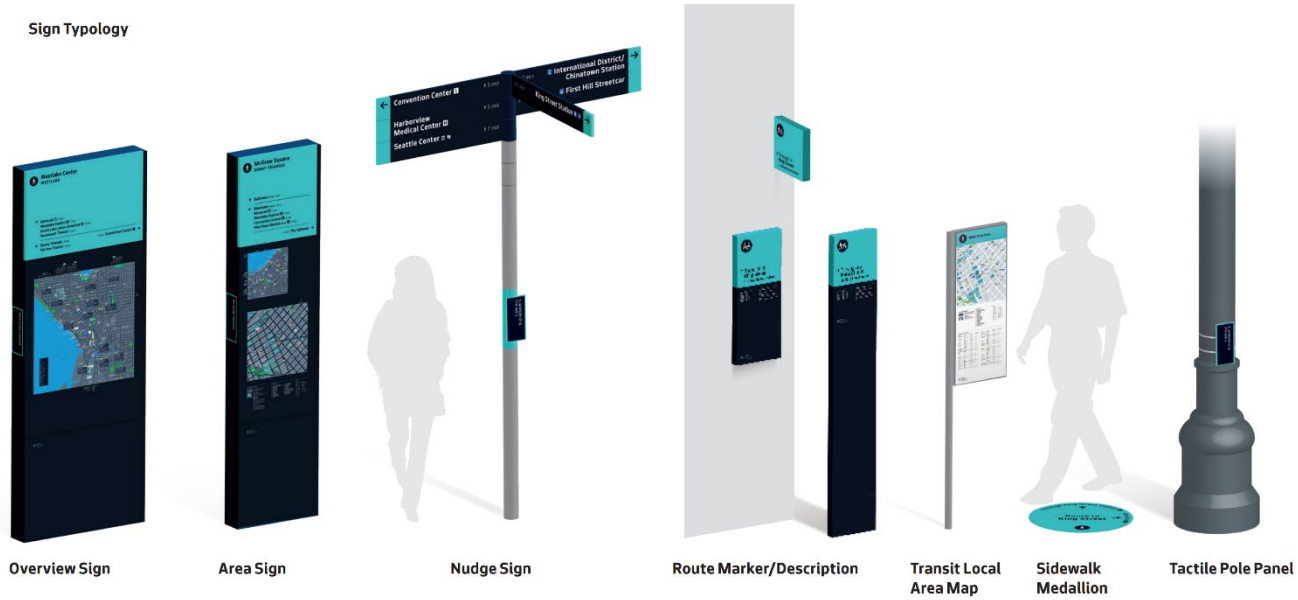


Figure 12 A variety of signs, route markers, and other wayfinding tools used in the City of Seattle, all of which bear similar design qualities to ensure pedestrians can easily recognize their function (Seamless Seattle, 2019).

Taking Action: Thinking Beyond Classic Wayfinding

Lastly, it is important to recognize that wayfinding is not always a "one-size-fits-all" approach. With over 3,000 miles of coastline in Washington, the characteristics and topography of each coastal community vary greatly, as do the stylistic preferences and needs of the community. In addition to effective tsunami road signage, at-risk communities across the nation are identifying creative solutions to ensure that their public can easily identify tsunami evacuation routes. Washington's communities can and should take inspiration from these efforts and see tsunami wayfinding as an opportunity to think creatively about how evacuation routes and information can be incorporated into their community's overall sense of place.

For example, Oregon's Tsunami Evacuation and Wayfinding Guide describes how communities in this state have used road paint to help assist evacuees in recognizing tsunami evacuation routes and the boundary between the inundation zone and safe high ground (see figure 13). This "blue line project" reduces reliance on road signs, which can clutter the field of vision, while ensuring routes are still highly visible. Some kinds of road paint are also highly reflective, meaning they will likely show up in the darkness as long as there is sufficient light from an evacuee's flashlight, nearby ambient light, or a strong full moon.

Figure 13 Tsunami Blue Line Project: 'You have to know your route to high ground' (nbc16.com).

An alternative to road paint, thermoplastic material is a kind of plastic that becomes pliable at elevated temperatures and solidifies upon cooling. Thermoplastics can be used in the same manner as road paint to mark wayfinding symbology directly onto concrete or asphalt, but with much greater visibility and durability. Preformed thermoplastics, or thermoplastic cut into final shapes by the manufacturer and ready to position onto a chosen surface, are easy to use and eliminate the need for stencils and on-site melters. Puerto Rico uses preformed thermoplastic designs like the one in figure 14 to install tsunami evacuation route wayfinding markers directly onto roads and other suitable surfaces. While thermoplastics may be a more expensive option than traditional road paint, their durability (Puerto Rico's were guaranteed for a minimum of 10 years) and visibility may ultimately make this option more cost-effective than road paint in the long run.

Figure 14 A preformed thermoplastic design of a tsunami evacuation route intended for use on asphalt roads in Puerto Rico (copyright PPG.com).

Oregon's first vertical evacuation structure, the Gladys Valley Marine Studies Building (GVMSB) located on Oregon State University's Hatfield Marine Science Center campus, utilizes internal and external wayfinding signage to familiarize staff, students, and visitors with the local tsunami hazard and nearby evacuation options. This includes informational and directional signage unique to the campus and surrounding community, and tailored to the particular complexities of building evacuation since the roof of the building serves as high ground (see figure 15). The GVMSB is a great example of how internal and external wayfinding strategies can work together to give people a comprehensive understanding of what to do in an emergency. Oregon Sea Grant even includes this location in their Oregon Coast Quests program, which provides self-guided Quests for visitors to explore parks, trails, and other outdoor spaces in new ways and at their own pace. At the end of each interpretive Quest, participants find a hidden box containing a logbook to sign and a hand-carved stamp to mark their accomplishment. The Hatfield Marine Science Center Tsunami Building Quest utilizes the wayfinding signage onsite to educate visitors about the local tsunami risk and ultimately guides them to the top of the vertical evacuation structure.

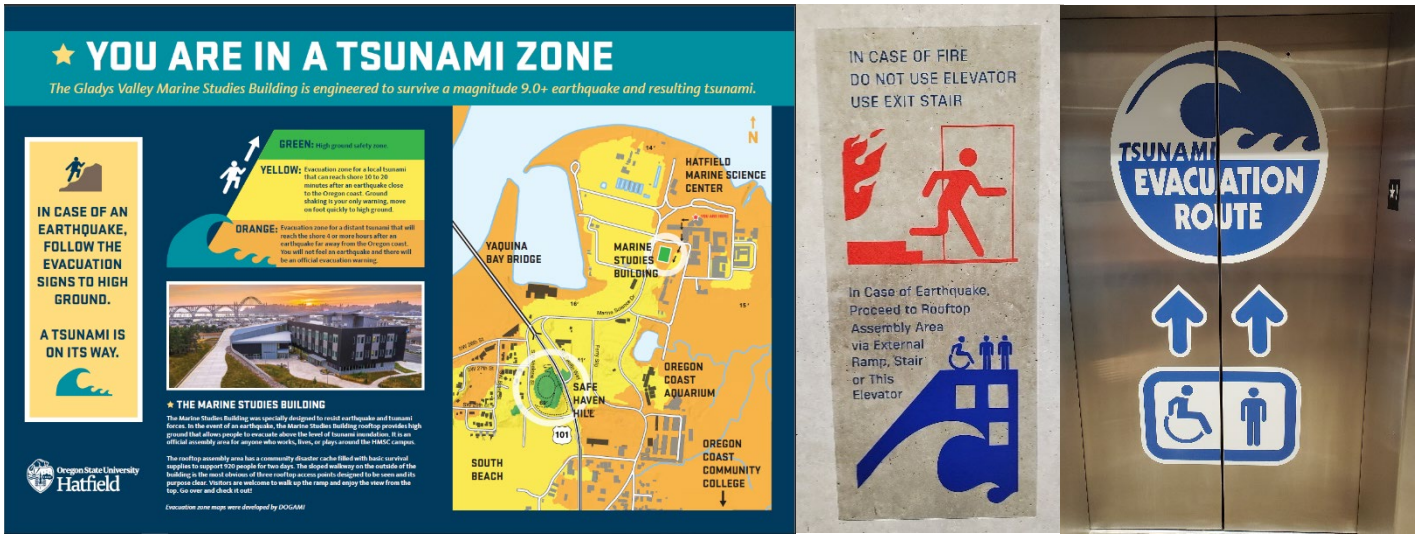


Figure 15 Wayfinding signage from the Gladys Valley Marine Studies Building at Oregon State University's Hatfield Marine Science Center. Left image is an information sign including the history of the building, a tsunami inundation map of the campus and surrounding area, and basic tsunami protective actions. Middle image is a sign near the building elevators directing occupants to take different protective actions depending on the kind of emergency (building fire versus earthquake and tsunami). Right image is signage on the elevator doors directing people to take the elevator to the roof of the building when evacuating for a tsunami (images copyright OSU hmsc.oregonstate.edu/vertical-evacuation).

In Puerto Rico, communities are incorporating tsunami evacuation route directions into local murals, resulting in a beautiful intersection of function and art (see figure 16). These murals not only help people become familiar with their local tsunami risk and nearest evacuation routes, but they also foster a sense of pride and connection in the community. Murals like this may be less likely to experience the destruction or graffitiing regular signs face, especially if the mural artists themselves come from the community, or the community has a voice in designing the mural. They also help ground the tsunami hazard within its greater community and geographical context, thus taking away a bit of the fear and mystery and helping both residents and visitors alike understand tsunamis are simply part of coastal living.

Figure 16 Mural unveiled to raise awareness about eviction route (Primera Hora).

Many communities are utilizing a new format for public art, utility box wraps, to provide the public with easily accessible maps. Much like large decal wraps seen on buses and cars, similar adhesive wraps can be designed to fit over outdoor infrastructure such as electrical and utility boxes. Like murals, these weatherproof wraps are less likely targets of graffiti than plain wayfinding signs and can be customized with any image desired. Cities like Fort Lauderdale are using custom wraps to not only beautify otherwise unattractive infrastructure in public spaces, but provide durable, eye-catching maps of city streets, subway lines, and bus lines (see figure 17). A coastal community could easily utilize these wraps to provide tsunami evacuation route maps, directional arrows, or other hazard information to the public.

No matter what wayfinding tools your community prefers, remember that your design elements should be as easy to understand as possible. This includes using simple, clear iconography, limited colors, and large, legible text. When in doubt, take it to your community – wayfinding design elements made with community input and support are much more likely to be retained in the long term and may even become a destination in and of themselves.

Figure 17 City of Fort Lauderdale utility box wrap project (FortLauderdale.gov).

Appendix A – Resources and Contacts

Resource Links

Washington State Tsunami Maps & Other Resources

The WA EMD Tsunami Resources website includes direct links to all published tsunami inundation and evacuation maps, as well as older brochures and other mapping resources for communities that do not yet have updated evacuation maps through the Washington Geological Survey.

Washington Geological Survey Tsunami Hazards

The Washington Geological Survey Tsunami Hazards page includes direct links to all published tsunami inundation and evacuation maps, as well as the downloadable GIS data behind the maps and for modeling which does not have map plates associated with it.

Washington State Dept of Transportation Sign Fabrication Manual

The Washington State Department of Transportation's Sign Fabrication Manual assists public and private sign fabricators in maintaining a uniform appearance of official highway signs. The highway signs illustrated within represent the signs currently in use in Washington State. Included are the signs contained in the Federal Standard Highway Signs Book and additional signs approved for use within the state. A section has also been included, for use in conjunction with the Manual on Uniform Traffic Control Devices, to assist designers with sign layouts.

Oregon Tsunami Evacuation Wayfinding Guidance

The Oregon Tsunami Evacuation Wayfinding Guidance document includes guidelines and guidance for tsunami wayfinding in the state of Oregon and is a useful resource for communities in Washington looking to expand on the forms of wayfinding used in Washington.

Washington State Hazard Mitigation Grants Program

Hazard Mitigation Assistance Grants are provided to Washington State jurisdictions and tribal governments to reduce the effects of natural hazards and mitigate vulnerability to future disaster damage. The purchase and installation of tsunami signage has been successfully funded by previous grant rounds in other coastal communities and is therefore a good option for Washington communities looking to fund their own wayfinding efforts here in the state. The WA EMD Hazard Mitigation Grants Program staff are available to discuss funding options and assist with the application process for those interested.

Seamless Seattle Wayfinding Strategy

Seamless Seattle is the City of Seattle's standard for pedestrian wayfinding. This Wayfinding Strategy established an inclusive approach to delivering wayfinding in Seattle intended to improve accessibility, prioritize and optimize movement networks, reduce congestion and street clutter, support local communities, and connect parts of the city within a coherent vision of place. The Strategy is a great resource for other communities considering wayfinding improvements or for those who simply want to know more about what factors impact wayfinding and how communities can create holistic, accessible, and engaging wayfinding systems.

State Agency Contacts

Elyssa Tappero
Tsunami Program Manager
Washington Emergency Management Division
elyssa.tappero@mil.wa.gov | 253-512-7067

Matthew Lebens
Hazard Mitigation Grant Supervisor
Washington Emergency Management Division
matthew.lebens@mil.wa.gov

Daniel Eungard
Tsunami Hazards Geologist
WA Dept. of Natural Resources
daniel.eungard@dnr.wa.gov | 360-463-2648