**Tillamook County Communities of Barview/Twin Rocks, Cape Meares, Oceanside, Netarts, Cape Lookout State Park, Sand Lake, Tierra Del Mar, Pacific City/Woods, and Neskowin**

**Tsunami Evacuation**   
**Facilities Improvement Plan (TEFIP)**

**1st Draft – June 2019**

**Reviewed and Approved by:**

**Date:**

**Plan Development**

This plan was developed with help from Ecology and Environment, Inc. and the Oregon Department of Land Conservation and Development. Input was received from:

**Tillamook County**

* …

**Cape Lookout State Park**

* …

**Cape Meares**

* …

**Neskowin**

* …

**Netarts**

* …

**Oceanside**

* …

**Pacific City/Woods**

* …

**Sand Lake**

* …

**Tierra Del Mar**

* …

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**List of Acronyms and Abbreviations**

BTW Beat the Wave

CERT Community Emergency Response Team

County Tillamook County

CSZ Cascadia Subduction Zone

DLCD Oregon Department of Land Conservation and Development

DOGAMI Oregon Department of Geology and Mineral Industries

FEMA Federal Emergency Management Agency

HMA Hazard Mitigation Assistance

mph miles per hour

NTHMP National Tsunami Hazard Mitigation Program

RV recreational vehicle

TEFIP Tsunami Evacuation Facilities Improvement Plan

TIM Tsunami Inundation Map

# 1 Introduction

## 1.1 General Introduction

Communities within Tillamook County (County), including Barview/Twin Rocks, Cape Lookout State Park, Cape Meares, Neskowin, Netarts, Oceanside, Pacific City/Woods, Sand Lake, and Tierra Del Mar; are vulnerable to the effects of a Cascadia Subduction Zone (CSZ) earthquake and tsunami event. In addition to the potentially catastrophic damage caused by the earthquake event itself, the resultant tsunami could inundate portions of the community, and a risk-based and community-specific approach to evacuation will be critical to saving lives. This Tsunami Evacuation Facilities Improvement Plan (TEFIP) is a comprehensive look at existing and potential evacuation routes and needed improvements for this community, and includes identified facility and infrastructure improvement projects and potential financing strategies. This TEFIP is essential to the implementation of evacuation route development and improvement in conjunction with the land use review and approval process.

The Oregon Department of Geology and Mineral Industries (DOGAMI) has identified and mapped the tsunami inundation hazard along the Oregon coast since 1994. DOGAMI developed a series of Tsunami Inundation Maps (TIMs) in 2013 to assist residents and visitors along the coast to prepare for the next CSZ earthquake and tsunami. The TIMs display five scenarios, labeled as “T-shirt sizes” (i.e., S, M, L, XL, and XXL), showing the impact of a CSZ tsunami that reflects the full range of possible inundation. The geologic record shows that the amount of time that has passed since the last great CSZ earthquake (January 26, 1700) is not a reliable indicator of the size of the next one, so the size ranges are intended to be inclusive of the range of scenarios that a community might expect during a CSZ event.

## 1.2 Limitations and Constraints

The purpose of this TEFIP is to provide guidance and recommendations for methods so that all areas within the XXL scenario can be effectively evacuated to protect life safety. This local tsunami is generated by a high magnitude earthquake just off the Oregon Coast and, thus, the inundation area is much larger than for a distant tsunami event. In addition, unlike a distant tsunami that can be predicted several hours prior to its arrival (4 or more hours), this local CSZ tsunami can arrive at coastal beaches within 15 to 20 minutes after the earthquake.

For the purposes of this plan, tsunami evacuation means the immediate movement of people from the tsunami inundation zone to high ground or safety following a local CSZ earthquake. Comprehensive disaster planning for a CSZ earthquake and tsunami event requires a phased and scalable approach to planning and coordination; immediate evacuation for the purposes of life safety is only one phase (albeit a very important one). While this TEFIP does not include planning for earthquake shaking damage mitigation or post-event disaster response and recovery, it is important to note that groundshaking will have an immediate impact on the ability to evacuate due to debris on roadways and sidewalks and damage to critical infrastructure. Other entities at the local, state, and federal level continue to prepare for these additional phases.

## 1.3 Definitions

**Horizontal evacuation** is the preferred response for tsunami evacuation, which is the movement of people to high ground and/or inland away from tsunami waters. In some locations, high ground may not exist, or tsunamis triggered by a local event may not allow sufficient time for communities to evacuate low-lying areas. Where horizontal evacuation out of the tsunami inundation zone is neither possible nor practical, a potential solution is **vertical evacuation[[1]](#footnote-2)** into the upper levels of structures designed to resist the effects of an earthquake as well as a tsunami. A **vertical evacuation structure** is a building or earthen mound that has sufficient height to elevate evacuees above the level of tsunami inundation, and is designed and constructed with the strength and resiliency needed to resist the expected earthquake shaking and the loading due to tsunami waves.

This TEFIP identifies and discusses **tsunami evacuation facilities**, which are defined as places, amenities, infrastructure, or equipment that can be used to assist in tsunami evacuation (horizontally or vertically). Tsunami evacuation facilities generally include (but are not limited to) roads, trails, wayfinding elements (signs, kiosks, trail markers), supply caches, assembly areas, bridges, and vertical evacuation structures. Evacuation improvements for a community may also include education and outreach activities.

## 1.4 Whole Community

Every person who lives in, works in, or visits the County (including access and functional needs populations) shares responsibility for minimizing tsunami risks and vulnerability. These individual responsibilities include tsunami awareness, knowledge of appropriate protective actions, and preparations for personal and family safety. Knowledgeable residents and visitors who are prepared to take care of themselves and their families, and to assist neighbors in the early phases of a tsunami flooding event can make a significant contribution towards survival and community resiliency.

The development of this TEFIP involved a range of stakeholders, including the public, scientific community, local government, and community-based organizations.

# 2 Tsunami Risk and Vulnerability

*See Appendix C for the full Tsunami Risk and Vulnerability Assessment.*

## 2.1 Hazard Identification

The hazard being addressed by this TEFIP is a tsunami event that results in the need for community evacuation. A tsunami affecting the County would be the result of an earthquake from one of two categories:

* **Local Tsunami:** Generated by an earthquake immediately offshore of the Oregon Coast (e.g., a CSZ earthquake) and would result in a tsunami coming onshore within 20 to 25 minutes following the earthquake.
* **Distant Tsunami:** Generated by a distant earthquake (e.g., large event occurring off a distant coastline, such as Japan) and would result in a tsunami coming onshore 4 hours or more following an earthquake on another subduction zone.

A local earthquake resulting in a tsunami is likely to generate additional hazards that may further hinder an individual’s ability to evacuate and may increase the time needed to evacuate. Such examples include:

* **Damage to buildings:** Severe shaking, especially in areas of poor soils, will damage buildings, making it difficult to evacuate. Homes built before 1974 may not be tied to foundations and can shift off foundations. Unreinforced masonry buildings and under-reinforced concrete buildings will be severely damaged or collapsed. Furnishings and equipment not securely fastened can cause injuries.
* **Damage to infrastructure:** Severe shaking and areas of poor soils will result in infrastructure failures. Infrastructure systems that may cause barriers to evacuation are water, wastewater, and stormwater facilities; liquid fuel and natural gas tanks and lines; electrical systems; bridges; and embankments and roads. Shaking damage may result in fallen electrical lines, damaged gas lines, tank and pipeline failures and leaks, and bridge failures, as well as physical interruptions in the surface transportation system due to slope failures and ground failures.
* **Landslides:** Landslides and ground movement may present added barriers to evacuation resulting in blocked roads, bridges, and walking trails.
* **Fires:** Fires from damaged electrical lines or propane may result in injuries that hinder an individual’s ability to evacuate.
* **Liquefaction:** Similar to landslides, liquefied soils may result in damaged and unstable roads, bridges, and walking trails that present added barriers to an individual’s ability to evacuate, especially those who experience access and functional needs.
* **Vehicular accidents and traffic jams:** Individuals may attempt to evacuate in personal vehicles en masse and push their vehicles to cover unusual terrain either due to damaged infrastructure or in an attempt to bypass typical infrastructure to save time. This may result in accidents and traffic jams that prevent individuals from reaching higher ground. Vehicular evacuation is not recommended and likely will not be possible following a local earthquake and tsunami event.

## 2.2 Beat the Wave Analysis

The “Beat the Wave” (BTW) analysis developed by the DOGAMI is the primary source of information for the identification of areas subject to tsunami inundation. DOGAMI produced a number of products depicting tsunami inundation for the County, including the TIMs, Tsunami Evacuation Brochures, and, more recently, BTW maps. Throughout this plan, these products and analyses are referenced and they identify areas within the County that are subject to potential life safety risk and that need to be evacuated during a local CSZ tsunami event.

*The focus of this TEFIP is primarily an XXL tsunami event*

Studies completed by DOGAMI show the impact of the earthquake that effect tsunami evacuation, including information on building damage and ground disturbance.

### 2.2.1 Tsunami Inundation Maps

The TIM series depicts the projected tsunami inundation zone from five different magnitude seismic events. These events are categorized as small, medium, large, extra-large, and extra extra-large (S, M, L, XL, XXL) tsunami inundation events. These different modeled events reflect the full range of earthquake and tsunami events experienced in the past and what will be encountered in the future. The amount of time that has passed since the last great Cascadia earthquake (January 26, 1700) is not a reliable indicator of the size of the next one, so the size ranges are intended to fully bracket what might happen next.

*See* [*http://www.oregongeology.org/tsuclearinghouse/pubs-inumaps.htm*](http://www.oregongeology.org/tsuclearinghouse/pubs-inumaps.htm) *for more information.*

### 2.2.2 Tsunami Evacuation Brochures

The Tsunami Evacuation Brochures are public products designed to direct visitors and residents away from low-lying areas in the event of a tsunami. They depict three color zones: orange for the largest expected distant tsunami, yellow for the largest expected local tsunami, and green for safety (or high ground).

*See* [*http://nvs.nanoos.org/TsunamiEvac*](http://nvs.nanoos.org/TsunamiEvac) *and* [*www.oregontsunami.org*](http://www.oregontsunami.org) *for more information.*

### 2.2.3 Beat the Wave Maps

DOGAMI has also recently completed (in 2018) the BTW tsunami evacuation modeling for the County, which provides additional detail on estimated evacuation clearance times and evacuation needs. The results of this mapping have been used in this plan to identify evacuation deficiencies, as well as potential evacuation improvements. These maps will be discussed in greater detail in Section 3.

*See Appendix A and DOGAMI’s* [*Tsunami Evacuation Analysis of Tillamook County, Oregon*,](https://www.oregongeology.org/pubs/ofr/p-O-18-06.htm) *for more information.*

### 2.2.4 Earthquake Damage Maps

Studies completed by DOGAMI provide detailed risk assessments for natural hazards affecting coastal Tillamook County (the County), including a CSZ earthquake and tsunami. Results include estimates of building damage and loss as well as population impacts (i.e., displacement of permanent residents) due to earthquake shaking, earthquake liquefaction, and tsunami inundation.

*See DOGAMI’s Natural Hazard Risk Report for Coastal Portions of Tillamook County, Oregon for more information.*

## 2.3 Populations at Risk

The purpose of this section is to determine the overall numbers of people and identify, to the extent possible, access and functional needs populations that are within the tsunami inundation zone areas. The goal is to estimate how many people will need to be evacuated, and to identify the characteristics and locations of populations that may have specific additional needs or requirements for evacuation.

*Refer to Tillamook County Tsunami Risk and Vulnerability Assessment for more information.*

### 2.3.1 Critical/Essential Facilities

The following critical/essential facilities are within the XXL model:

* Public facilities and infrastructure
  + General facilities
    - Rockaway Beach City Hall and Public Works
  + Law Enforcement
    - Coast Guard Station – Tillamook
    - Rockaway Beach Police Department
  + Fire Services
    - Nestucca RFPD Neskowin #84
    - Nestucca RFPD Pacific City Station #82
    - Nehalem Volunteer Fire Department/City Hall
  + Water treatment
    - Bay City Water Treatment
    - Rockaway Beach Water Treatment Plant
  + Major transportation facilities
    - Bay City Public Works

### 2.3.2 Demographics

According to Portland State University’s Population Research Center, 26,395 people lived in the County in 2018[[2]](#footnote-3) and there is expected to be a slight increase (0.6%) in the Average Annual Growth Rates for the County through 2035[[3]](#footnote-4).

A report developed by the Department of Human Services (2018)[[4]](#footnote-5) compiled information on the characteristics and economic and health indicators of each county in Oregon. The following information was compiled for the whole County and may have relevance to tsunami evacuation improvement needs:

* Poverty rate: 17.4% (statewide rate: 16.2%)
* Unemployed rate: 4.8% (statewide rate: 7.0%)
* Rate of homeownership: 72.4% (statewide rate: 61.3%)
* Persons with self-reported disability: 18% (statewide rate: 14.4%)
* Households with retirement income: 25.6% (statewide rate: 19.2%)
* Households with social security income: 45.9% (statewide rate: 32.2%)

### 2.3.3 Population Estimates

Tsunami evacuation is of greatest concern to populations residing or working within the inundation zone. Table 1 illustrates the estimated populations within the inundation zone.

Table 1 Population Estimates

| **Community** | **Total Population** | **Population  within XXL** | **Population over 65** |
| --- | --- | --- | --- |
| Bay City | 1,590 | 291 | 64 |
| Bayside Gardens | 739 | 404 | 110 |
| Cape Meares\* | 115 | 81 | 36 |
| Garibaldi | 833 | 317 | 80 |
| Idaville | 296 | 116 | 41 |
| Manzanita | 263 | 375 | 150 |
| Neahkahnie | 72 | 53 | 25 |
| Nehalem | 463 | 65 | 8 |
| Neskowin\* | 193 | 120 | 49 |
| Netarts\* | 881 | 193 | 64 |
| Oceanside\* | 330 | 15 | 7 |
| Pacific City\* | 964 | 656 | 195 |
| Rockaway Beach | 1,303 | 1,220 | 378 |
| Tillamook | 5,078 | 976 | 163 |
| Tillamook County | 343 | 2,112 | 567 |
| Wheeler | 1,590 | 58 | 12 |
| \*Communities included in this TEFIP. | | | |

Because population estimates are based on census data, only resident populations are reflected and not transient populations (e.g., second homes, recreational vehicle [RV] parks).

### 2.3.4 Access and Functional Needs Populations

Access and functional needs populations (also referred to as vulnerable populations and special needs populations) are members of the community who experience physical, mental, or medical care needs and who may require assistance before, during, and after an emergency incident after exhausting their usual resources and support network. In the case of evacuations, examples of individuals who have access and functional needs that may make evacuation challenging include, but are not limited to:

* Individuals who experience mobility challenges (e.g., those with physical disabilities, the elderly, children)
* Individuals who are blind or have low vision
* Individuals with limited-English proficiency
* Individuals who are deaf or hard of hearing
* Individuals who have been injured during the earthquake

Tsunami evacuation requires the ability to move from the inundation zone to high ground (or safety) in a timely matter. Due to this short onset time, individuals who experience access and functional needs may lack the resources to travel such distances. The vast majority of access and functional needs facilities are located outside of the inundation zone. Nonetheless, the location of these facilities can only serve as a proxy for the presence of access and functional needs populations. It is highly probable that access and functional needs populations live and work within the inundation zone.

DOGAMI has recently completed a socioeconomic analysis of the tsunami inundation zone within the County. The research identified numbers of permanent residents, employment statistics, numbers of individuals with disabilities, and those with limited-English proficiency.

*Refer to Appendix D for additional information.*

### 2.3.5 Housing

According to the 2017 Tillamook County Multi-Jurisdictional Hazard Mitigation Plan[[5]](#footnote-6), 66.1% of the housing stock in Tillamook County was built pre-1990, before seismic standards were put into place. This could have implications for sheltering needs after a CSZ earthquake and tsunami event, meaning more people could be displaced following an event beyond those in the tsunami inundation zone due to extensive earthquake damage in the communities.

## 2.5 Conclusions

Vulnerability related to loss of life to a tsunami in the County is relatively low in some areas (e.g., Oceanside), while relatively high in other areas (Neskowin, Pacific City). Those that occupy the zone may require additional infrastructure improvements to ensure they have enough time to reach high ground before the first tsunami wave, and the majority of critical facilities are located outside of the zone.

Additionally, the County experiences high numbers of visitors and tourists, who are unfamiliar with the landscape and tsunami hazards and may need additional assistance in evacuating effectively. Successful evacuations will be challenging because visitors and tourists need to understand the threat, recognize signs of imminent waves, and take self-protective action. Evacuees will also need to overcome sudden obstacles that arise as a result of the earthquake (e.g., fallen trees or buildings, liquefaction, landslides).

Education efforts that recognize demographic differences (e.g. age, living situation, and resident vs. tourist) may be the best course of action for the County and its communities. Specifically, evacuation improvement efforts focused on communicating to and supporting visitors and populations over 65 years of age would be the most beneficial strategies for these communities.

# 3 Evacuation Facility Assessments and Recommendations

The process of evaluating existing evacuation facilities and identifying prioritized improvement recommendations involved three phases:

* **Existing facility assessments:** The planning team engaged in a desktop analysis of existing facilities to determine gaps. This was followed up by a site visit conducted by the planning team to ensure all existing facilities had been accounted for.
* **Identification of needed improvements:** The site visit also served to assess gaps in existing facilities to determine locations requiring improvements. This task led to an initial list of potential projects that underwent comparison and scrutiny to existing studies, including DOGAMI’s BTW modeling, to ensure project need and feasibility.
* **Prioritization of needed improvements:** Following the identification of needed improvements, the planning team reviewed the list of proposed projects and prioritized them (high, medium, low) based upon the project’s perceived effectiveness and feasibility (measured by capacity, administrative control, and political considerations). This resulted in the prioritized project alternatives identified in the rest of this section.

**Considering Co-Benefits**

The most cost-effective and successful projects generate benefits outside of their intended purpose. For example, a tsunami evacuation route sign provides lifesaving guidance following an earthquake, but it also increases overall hazard awareness and personal preparedness. The Community-Specific Annexes highlight recommended evacuation improvement projects throughout the communities. In addition, the recommendations also identify co-benefits created through the implementation of each project, which may support the identification of additional partners and funding opportunities. The co-benefits identified in this plan are as follows:

* Hazard Awareness and Education
* Personal Preparedness
* Health and Wellness
* Transportation Effectiveness
* Asset Protection
* Economic Development
* Environmental Protection

*See Community-Specific Annexes for more information about Evacuation Facility Assessments and Recommendations.*

# 4 Implementation Resources and Evacuation Projects

## 4.1 Design and Construction Standards

Below is a list of resources related to Evacuation Facility Design and Construction Standards, applicable for a variety of projects suggested in the sections above:

* Bicycle and pedestrian design:
  + Oregon Department of Transportation. 2011. Oregon Bicycle and Pedestrian Design Guide, 3rd Edition. Oregon Highway Design Manual Appendix L.
* Design requirements and ideas for wayfinding signage:
  + Portland Urban Architecture Research Lab. 2014. "Up and Out" Oregon Tsunami Wayfinding Research Project: Final Project Report and Guidance Document.
  + Portland Urban Architecture Research Lab. 2015. "Up and Out 2" Oregon Tsunami Wayfinding Research Project: A Study in Seaside and Warrenton.
  + DOGAMI. 2003. OFR-03-06 Tsunami Sign Placement Guidelines.
  + Office of Emergency Management and DOGAMI. 2018. Oregon Tsunami Evacuation Wayfinding Guidance.
* Vertical evacuation structures:
  + Applied Technology Council. 2012. FEMA Guidelines for Design of Structures for Vertical Evacuation from Tsunamis, Second Edition. Prepared for the Federal Emergency Management Agency and National Oceanic and Atmospheric Administration. FEMA P-646. April 2012.
  + Chock, G. 2016. Design for Tsunami Loads and Effects in the ASCE 7-16 Standard. Journal of Structural Engineering: 142 (11). (International Building Code standards)
  + Applied Technology Council. 2009. Vertical Evacuation from Tsunamis: A Guide for Community Officials. Prepared for the Federal Emergency Management Agency, National Oceanic and Atmospheric Administration. June 2009.

## 4.2 Tsunami Evacuation Wayfinding Signage

A tsunami escape wayfinding system informs people what to do and when to do it. The system is designed to make the process clear and efficient before, during, and after a tsunami. Prime elements to include in wayfinding improvements are:

* Awareness kiosks
* Tsunami hazard zone signs
* Tsunami evacuation route signs
* Zone thresholds (entering/leaving)
* Assembly areas

For different populations, such as people with disabilities and the many unprepared tourists during the spring and summer seasons, special escape sequences and patterns provide innovative wayfinding solutions for tsunami evacuation. These populations include elderly, disabled, children, visitors in hotels, RV park visitors, etc.

For implementation of any wayfinding improvements, it is important to consider:

* Cost
* Ease of construction/implementation
* Aesthetic style
* Complexity of technological requirements
* Media
* Purpose

Tsunami Escape Wayfinding is Human Wayfinding in high stress situations that requires additional instruments, means, and techniques to find safe ground in a limited period of time, potentially at night or during difficult weather conditions.

### 4.2.1 Sign Type Selection

Signage can be two-dimensional, but also can include technological/sensory signals (e.g., sound, light)—an important concept when considering access and functional needs populations. When selecting a sign as a part of a signage system, the following elements should be considered:

* Basic function and visibility of signage
* Signage technology applied
* Position in space, method of fixing
* Size in relation to reading distance
* Illumination
* Requirements for impaired users
* Level of vandal resistance

*Refer to Community-Specific Annexes for locations of existing signage.*

## 4.3 Financing Strategies

Cost estimates for the tsunami evacuation improvement projects identified in this plan are general and may not reflect precise costs. Resources to develop facility improvement cost estimates can be found at the following links:

* American Association of Cost Engineers – requires membership or payment (<https://web.aacei.org/resources>)
* Whole Building Design Guide – Cost Estimating (<http://www.wbdg.org/design/dd_costest.php>)
* American Association of State Highway and Transportation Officials - Practical Guide to Cost Estimating, requires membership or payment (<https://bookstore.transportation.org/collection_detail.aspx?ID=122>)
* FEMA Cost Estimating Format (<https://www.fema.gov/public-assistance-cost-estimating-format-standard-operating-procedure>)
* Disaster Recovery Reform Act (<https://www.fema.gov/news-release/2018/10/05/disaster-recovery-reform-act-2018-transforms-field-emergency-management>)

### 4.3.1 Questions to Ask

In identifying projects to move forward with, it is important to bear in mind the following questions:

* Do citizens consider this to be an important public issue that requires a public remedy?
* Who directly benefits from the design, construction, and operation of these assets?
* Who indirectly benefits from the presence of these assets when not needed for an emergency?
* Do citizens have a preference among the various options available to finance the infrastructure investment?
* Is the scale of the need within the means of the community to finance or is outside assistance necessary?
* Should different strategies be used to elicit funding from seasonal vs. year-round residents?
* Is needed infrastructure within the jurisdiction/control of the community, or is there a need to engage other units or levels of government?
* Is there a way to fit improvements into existing programs or needs?

The following tools are most likely to succeed for enhancing a community’s evacuation route system[[6]](#footnote-7):

* Using existing rights-of-way,
* Negotiating/purchasing easements, and
* Purchasing new rights-of-way.

In addition, the construction of evacuation facilities should consider the following:

* Determining the most effective location,
* Determining co-benefits to access additional funding streams, and
* Determining design and construction standards applicable to specific project.

# 5 Education, Outreach, and Training

In tsunami areas, it is crucial to support an ongoing sustained tsunami public education program in order to ensure effective evacuation and save lives. This section presents guidance for creating pre-disaster education and outreach activities to educate the public about appropriate actions to take when natural signs (i.e., ground shaking) indicate a tsunami is imminent or when a tsunami warning message has been issued.

Residents, homeowners, business owners, and tourists alike benefit from educational activities that increase their awareness of local hazards. These educational activities can and should be combined with other, existing hazard education programs, such as earthquake preparedness, when possible.

## 5.1 News and Social Media

Traditional local media outlets (TV, radio, newspaper, etc.), public social media accounts, and other local websites (e.g., the Chamber of Commerce) should be utilized as appropriate to announce community training events and provide public service announcements (PSAs) regarding tsunami evacuation.

### 5.1.1 News Organizations

Developing a working relationship with local newspapers and radio is an effective mode of communicating with the public.

#### Recommended Action

* Work with additional local newspapers and radio stations to announce tsunami awareness events and provide community education information and resources. Additional local service providers include the following:

| **Source** | **Service Provider** | **Setting** |
| --- | --- | --- |
| Radio | * KCST (106.9 FM) – Coast Radio * KTCB (89.5 FM) – Coast Community Radio * K282BV (104.3 FM) – Coast Community Radio | ✓ Pre-Incident  ✓ Post-Incident |
| Television | * Standard television stations (PBS, ABC, CBS, NBC, FOX) | ✓ Pre-Incident  ✓ Post-Incident |
| Newspaper | * Tillamook Headlight Herald (weekly) | ✓ Pre-Incident |
| Websites and Social Media | * Tillamook County Website and Social Media * Tillamook County Pioneer (daily news) | ✓ Pre-Incident  ✓ Post-Incident |
| Community Boards | * Post Office * Public Library * Events Center * Justice Center * City Hall | ✓ Pre-Incident  ✓ Post-Incident |

#### Resources

* Tsunami Emergency Guidebook for Oregon Mass Media, Oregon Emergency Management, September 2007: <http://www.oregongeology.org/tsuclearinghouse/resources/pdfs/OregonTsunamiMediaBinder_final_6_20_07.pdf>

### 5.1.2 Social Media



A tsunami-related post that was shared on the City of Cannon Beach’s Facebook page.

Social media’s role in emergency communication has grown over the past several years, not only as a major channel for broadcasting emergency information but also as a means of engaging and conversing with the public during all emergency mission phases (i.e., protection, preparedness, mitigate, response, and recovery).

#### Recommended Action

* Consistently incorporate tsunami education information into social media accounts, including the graphics used on tsunami evacuation signs. Social media accounts should be monitored to manage misinformation and rumor control.
* Develop working relationships with local bloggers and businesses to utilize their social media presence to retweet or copy posts so they reach a larger audience.
* Link social media accounts to OEM, FEMA, other County and Community sites so that there is continued information and feeds that help with keeping posts new and relevant.

#### Resources

* FEMA Social Media and Emergency Preparedness Press Release: <https://www.fema.gov/news-release/2018/04/16/social-media-and-emergency-preparedness>
* FEMA Social Media in Emergency Management Training: <https://training.fema.gov/is/courseoverview.aspx?code=IS-42>
* The Department of Homeland Security’s Innovative Uses of Social Media in Emergency Management: <https://www.dhs.gov/sites/default/files/publications/Social-Media-EM_0913-508_0.pdf>

**Sample Social Media Posts**

The following sample social media posts have been developed by the National Weather Service and edited for use by the County and local communities.

**Facebook**

* A tsunami can strike our coast at any time throughout the year. While they don’t happen very often, they pose a major threat to coastal communities within Tillamook County. Check out this video for things you can do to prepare: <https://youtu.be/x0GX_kc7JZo> #TsunamiPrep
* A tsunami can be very dangerous to life and property on the coast. It can produce strong and dangerous currents, rapidly flood the land and cause great destruction. Even small tsunamis can be dangerous. Strong currents can injure and drown swimmers and damage and destroy boats in harbors. Visit <http://www.nws.noaa.gov/om/Tsunami/about.shtml> #TsunamiPrep
* Because tsunamis are a threat in our community, you should include tsunami-specific preparations in your emergency plan. Learn the evacuation routes, identify safe places and practice evacuating. Visit <http://www.nws.noaa.gov/om/Tsunami/before.shtml> #TsunamiPrep
* Do you live, work or play on the coast? Do you know our community’s tsunami risk? Our community has identified and mapped tsunami hazard and evacuation zones. Check out links to tsunami maps on this page [http://nws.weather.gov/nthmp/maps.html](https://nws.weather.gov/nthmp/maps.html) or ask your local/state emergency management office or your local NWS forecast office for more info. #TsunamiPrep
* Official tsunami warnings are broadcast through local radio and TV, marine radio, wireless emergency alerts, NOAA Weather Radio, and National Oceanic and Atmospheric Administration (NOAA) websites. They may also come through outdoor sirens, local officials, text message alerts and telephone notifications. Learn about the four levels of tsunami alerts for the U.S. at: <http://www.nws.noaa.gov/om/Tsunami/alerts.shtml>. #TsunamiPrep

**Twitter**

* If you live, work or play on the coast, you should prepare for a #tsunami <https://youtu.be/x0GX_kc7JZo> #TsunamiPrep
* A #tsunami, which may resemble a fast-rising flood, can be very dangerous to life & property <http://www.nws.noaa.gov/om/Tsunami/about.shtml> #TsunamiPrep
* At risk from #tsunamis? Plan for and practice evacuation. <http://www.nws.noaa.gov/om/Tsunami/before.shtml> #TsunamiPrep
* Live, work or play on the coast? Know your #tsunami risk & evacuation zones [https://nws.weather.gov/nthmp/maps.html](http://nws.weather.gov/nthmp/maps.html) #TsunamiPrep
* Tsunami alerts come from many sources like @NOAA websites & @NOAA Weather Radio <http://www.nws.noaa.gov/om/Tsunami/alerts.shtml> #TsunamiPrep

### 5.1.3 Websites

Websites continue to play a large role in providing information and outreach activities to residents and tourists.

#### Recommended Action

* Include tsunami awareness information on Community websites in a prominent location, and use the website to announce tsunami-related community activities. Consider linking to relevant webpages from DOGAMI, Oregon Department of Land Conservation and Development (DLCD), NOAA, etc., rather than recreating the information.
* Develop working relationships with local businesses and organizations to include a link back to tsunami information to increase the website’s reach.

## 5.2 Community Activities

Community activities are a vital part of public education and outreach.

#### Recommended Actions

* Hold at least one community-wide outreach or education activity annually.
* Provide educational and evacuation information at every State and County park.
* Develop community outreach materials, such as the following, to be distributed at community events:
  + Brochures containing zone and route information
  + Refrigerator magnets with preparedness information
  + Maps to be printed in phonebooks
  + Permanent posted material for hotels, rentals, restaurants, and other businesses

### 5.2.1 Door-to-Door Education and Community-wide Evacuation Drills

The National Tsunami Hazard Mitigation Program studied which educational strategies work best for tsunami awareness in Seaside, Oregon (Connor 2005). Door-to-door outreach and evacuation drills were the most effective techniques according to polls for this study. This has been confirmed during recent events in Japan and Mexico where earthquake and evacuation drills are routinely used as a training technique.

#### Recommended Action

* Develop Volunteer Educators who can go door-to-door to discuss tsunami awareness and safety with residents. These volunteers would be trained by and given brochures to hand out to residents.
* Conduct a community-wide tsunami evacuation drill using the Oregon Office for Emergency Management [Tsunami Evacuation Drill Guidebook](https://www.oregon.gov/oem/Documents/Tsunami_Evacuation_Drill_Guidebook.pdf) as a reference.

#### Resources

* The Oregon Office for Emergency Management’s Tsunami Evacuation Drill Guidebook: <https://www.oregon.gov/oem/Documents/Tsunami_Evacuation_Drill_Guidebook.pdf>

### 5.2.2 Run/Walk Event

Events like the Cannon Beach Race the Wave provided an opportunity to build awareness of tsunami routes. Participants in the 5K and 10K Race the Wave fun run/walk/roll started on the beach, followed a scenic tsunami evacuation route through the City, and reached the finish line out of the tsunami inundation zone. A preparedness fair was held near the finish line for all participants and included food, games, and giveaways.

#### Recommended Action

* Host a run/walk event that has participants race a tsunami evacuation route as a fun awareness event.
* Hold a preparedness fair at the end of the race. See section 5.2.3 below for additional information on preparedness fairs.

#### Resources

* <https://www.fema.gov/news-release/2015/09/08/know-your-tsunami-evacuation-routes-race-wave-cannon-beach-or-sept-13>
* Up and Out Oregon Tsunami Wayfinding Research Project Final Project Report & Guidance Document: <https://www.oregon.gov/oem/Documents/Up_And_Out_Phase1.pdf>

### 5.2.3 Preparedness Fairs/Booth

An emergency preparedness fair or a tsunami preparedness-focused booth at a community event can help educate community members and visitors about tsunami evacuation. A preparedness fair can feature many booths and activities. It can be held separately or combined with another event, such as a 5K run/walk, farmers market, or festival.

#### Recommended Action

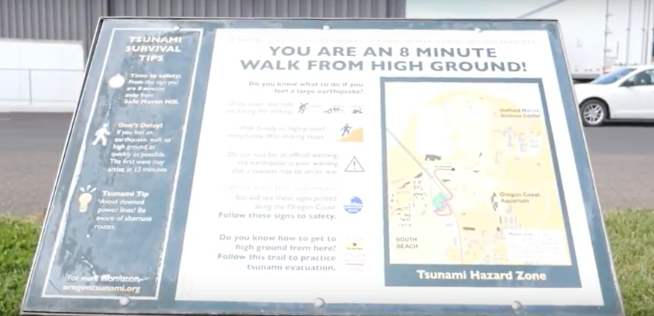
* Set up a booth about tsunami preparedness at local community events.

#### Resources

* The American Red Cross and California Emergency Management Agency’s Disaster Preparedness Event Toolkit: <https://www.redcross.org/content/dam/redcross/atg/Chapters/Division_2_-_Media/Bay_Area/Bay_Area_-_PDFs/Preparedness_Event_Toolkit.pdf>

### 5.2.4 Tsunami Quests

A Tsunami Quest is an educational activity for families and children to learn about tsunamis and tsunami evacuation routes in a clue-directed hunt format. The Oregon Sea Grant is already using Tsunami Quests in Clatsop, Lincoln, and Coos Counties to help residents and visitors prepare for a major earthquake and tsunami. The “hunt” culminates in discovery of a box that holds a guest book so participants can record their achievement at completing the Quest. The goal is to encourage people to explore these routes for fun, so that they will be familiar with them in the event of a tsunami.



A sample Tsunami Quest placard with map and tsunami survival tips (Oregon Sea Grant 2017).

#### Recommended Action

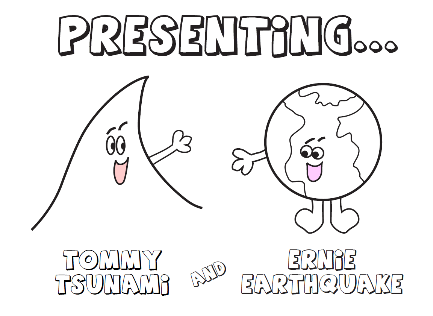
* Invite the Oregon Sea Grants Quest Coordinator to hold a workshop like the one highlighted in this video: <https://youtu.be/TQvgSMiby7k>.
* Develop a map and a series of educational clues that, when followed, lead the walkers to higher ground.
* Engage elementary or middle school students to develop the clues as a class exercise.
* Consider incorporating geocaches with preparedness information.

#### Resources

* The 2017-18 Oregon Coast Quests Book: <https://seagrant.oregonstate.edu/sgpubs/2017-18-oregon-coast-quests-book>
* A video that describes the quest concept and how quests are used to teach coastal visitors and locals what to do in the event of a tsunami: <https://youtu.be/TQvgSMiby7k>.

## 5.3 Schools and Childcare Facilities

Empowering children with knowledge about tsunami hazards and evacuation routes can be an excellent motivator for families to become more aware and prepared. Tsunami education efforts can be incorporated into existing emergency exercises and trainings.



The cover of the Tommy Tsunami Coloring book, available at: https://www.tsunami.noaa.gov/pdfs/tommy\_tsunami\_coloring\_book.pdf.

### 5.3.1 Child-Appropriate Trainings

Many materials are available online for teachers to use in educating children about tsunamis. The Tommy Tsunami Coloring Book from the National Tsunami Warning Center is one example.

#### Recommended Action

* Work with teachers to develop tsunami curriculum that is age appropriate.

#### Resources

* The Washington Military Department, Emergency Management Division’s booklet “How the Smart Family Survived a Tsunami” for elementary children (K-6): <https://www.mil.wa.gov/uploads/pdf/Publications/HowtheSmartFamilySurvivedaTsunami.pdf>
* The Tommy Tsunami Coloring Book from the National Tsunami Warning Center: <https://www.tsunami.noaa.gov/pdfs/tommy_tsunami_coloring_book.pdf>
* San Diego County used an animated short film to educate kids about tsunamis: <https://www.youtube.com/watch?v=UzR0Rt3i4kc>
* NOAA’s Tsunami Education website: <https://www.tsunami.noaa.gov/education.html#kids>
* OEM’s Without Warning: <https://www.oregon.gov/newsroom/pages/NewsDetail.aspx?newsid=1396>

### 5.3.2 Parent/Guardian Trainings and Workshops

Children are not the only audience that can be reached through school activities—parents and guardians attend many events at schools, providing ample opportunities to reach them with the tsunami preparedness message.

#### Recommended Action

* Encourage schools to incorporate tsunami information into their back-to-school nights or other gatherings where parents/guardians are present.

### 5.3.3 Evacuation Drills

Evacuation drills are effective in training students and children on what to do in the event of a tsunami.

#### Recommended Action

* Encourage schools and childcare facilities to conduct evacuation drills, in conjunction with their earthquake drills, in the mapped tsunami evacuation zone.

#### Resources

* The Oregon Office for Emergency Management’s Tsunami Evacuation Drill Guidebook: <https://www.oregon.gov/oem/Documents/Tsunami_Evacuation_Drill_Guidebook.pdf>

## 5.4 Senior Facilities

Empowering seniors and their caregivers with knowledge about tsunami hazards and evacuation routes is important to ensure those who may have a tougher time evacuating due to physical limitations understand the importance of evacuating without delay and connecting with their neighbors for support.

### 5.4.1 Senior Facility Workshops

Senior facilities and their employees need tsunami evacuation education and training to ensure everyone knows when and how to evacuate in the event of a local earthquake and tsunami.

#### Recommended Action

* Work with the senior facilities to host regular training sessions for employees and the seniors they care for.

#### Resources

* Natural Disaster Awareness for Caregivers of Senior Citizens: Building Senior Resilience: <http://centennialadultcare.com/wp-content/uploads/2015/03/Natural-Disaster-Awareness-for-Caregivers-of-Senior-Citizens.pdf>
* Disaster Preparedness Guide for Seniors and Caregivers: <https://www.seniorliving.org/research/disaster-preparedness/>

## 5.5 Businesses

CERT members trained under the WLEOG Public Outreach Program currently provide on-site training to local businesses and fraternal/faith based groups.

### 5.5.1 Business Workshops

Businesses in the hazard zones may be owned, staffed, or frequented by customers who, like visitors, live outside the community and may not have been reached by the local outreach activities. Therefore, employers and their employees need tsunami evacuation education and training to ensure everyone knows when and how to evacuate in the event of a local earthquake and tsunami.

#### Recommended Action

* Work with the Chamber of Commerce to host regular training sessions for business owners, sharing information with them, so they, in turn, could return to their businesses and host in-house training.
* Develop Volunteer Educators to conduct in-house trainings at local businesses for staff.
* Encourage businesses to perform seismic upgrades.

#### Resources

* How to Prepare Your Business for the Next Tsunami (Hawaii specific, but useful information): <http://tsunami.org/1about/pdfs/how_to_prepare_your_business_for_the_next_tsunami.pdf>

### 5.5.2 Tsunami Quests for Businesses

Tsunami Quest activities are not just for families and children, they can be used by businesses to educate their employees about tsunami preparedness.

#### Recommended Action

* Encourage local businesses to utilize the Tsunami Quest activity (described above) as a “wellness event” for their employees. The activity may need to be adapted to be more appropriate for businesses.

#### Resources

* The 2017-18 Oregon Coast Quests Book: <https://seagrant.oregonstate.edu/sgpubs/2017-18-oregon-coast-quests-book>
* A video that describes the quest concept and how quests are used to teach coastal visitors and locals what to do in the event of a tsunami: <https://youtu.be/TQvgSMiby7k>.
* Effective Emergency Preparedness Planning: Addressing the Needs of Employees with Disabilities: <https://www.dol.gov/odep/pubs/fact/effective.htm>

## 5.6 Visitors/Recreationists

Visitors and recreationists may spend a limited amount of time in tsunami prone communities, but they are still at risk. There are many ways to provide these temporary residents with some education about the possibility of a tsunami and what to do if one happens.

### 5.6.1 Education Materials

The brochures and other handouts developed for community activities can be used to educate visitors about what to do and why.

#### Recommended Action

* Place materials at the following locations:
  + Visitor centers
  + Information kiosks
  + Trail markers
  + Signs on beaches (particularly areas that are hard to evacuate from or in which the direction you need to evacuate to is not obvious)

If printing materials on this scale is prohibitive, consider developing a catchy phrase and website link that individuals can go to in order to download the files.

#### Resources

* The Disaster Response Guidebook for Hotels and Motels on Washington’s Coast, published by the Washington Military Department Emergency Management Division, includes information about a variety of disasters, including tsunamis: <https://www.mil.wa.gov/uploads/pdf/emergency-management/haz_hotelmotel_guidebook.pdf>
* FEMA Website tsunami page with information about recognizing the signs: <https://www.ready.gov/tsunamis>

### 5.6.2 Hotels, Motels, and Bed and Breakfasts

Visitors staying overnight for the weekend or on an extended vacation may be unfamiliar with tsunamis. The handouts used for preparedness fairs and other events hold valuable information about tsunami evacuation that can be shared with temporary residents.

The “Tsunami, The Great Waves” glossy educational brochure is available in a number of languages online at: http://itic.ioc-unesco.org/index.php?option=com\_content&view=article

#### Recommended Action

* Provide tsunami evacuation literature to local hospitality businesses. Request that they be permanently displayed in the lobby and hotel rooms, informing tourists of evacuation routes and general earthquake/tsunami awareness.

#### Resources

* A glossy brochure is available in many languages from UNESCO, at: <http://itic.ioc-unesco.org/index.php?option=com_content&view=article&id=1169&Itemid=2017>
* Disaster Response Guidebook for Hotels and Motels on Washington’s Coast: <https://www.mil.wa.gov/uploads/pdf/emergency-management/haz_hotelmotel_guidebook.pdf>

## 5.7 Access and Functional Needs Populations

You will need unique means of warning your community’s non-English speaking and deaf populations, and people with health or mobility issues may need to be transported out of the hazard area in a far-field event.

### 5.7.1 Mobility Challenges

Within mobility disabilities, there are several subcategories that should be taken into account when planning for tsunami evacuations, including: wheelchair users, ambulatory mobility disabilities, respiratory issues, and young children.

#### Recommended Action

* Encourage residents to get to know their neighbors and whether they will need assistance evacuating.
* Encourage hospitals, doctors, and clinics to provide tsunami evacuation materials to their patients.
* Incorporate evacuation planning into CERT training.

#### Resources

* To Define, Locate, and Reach Special, Vulnerable, and At-risk Populations in an Emergency: This CDC workbook is intended to provide public health and emergency preparedness planners with better ways to communicate health and emergency information to at-risk individuals with access and functional needs for all-hazards events through step-by-step instructions, resources guides and templates. <https://emergency.cdc.gov/workbook/pdf/ph_workbookfinal.pdf>
* This guidance from the U.S. Department of Health & Human Services Office of the Assistant Secretary for Preparedness and Response will introduce and connect you to available resources and inclusive strategies for integrating the access and functional needs of at-risk individuals into emergency preparedness, response, and recovery planning at all jurisdictional levels. <https://www.phe.gov/Preparedness/planning/abc/Pages/afn-guidance.aspx>
* Preparing for Disaster for People with Disabilities and other Special Needs <https://www.fema.gov/media-library/assets/documents/897>

### 5.7.2 Vision Impairment

Individuals who experience partial or total vision loss, including night vision challenges, rely on their sense of touch and hearing to perceive their environment. After a CSZ event, when physical obstructions such as debris, road or sidewalk damage, and liquefaction changes the lay of the land, those who experience vision impairment may find it difficult to navigate to a location outside the tsunami zone without assistance.

#### Recommended Action

* Incorporate lighting and reflective material on evacuation signs.
* Produce community information in larger text options.

#### Resources

* American Council for the Blind: <http://www.acb.org/large-print-guidelines>
* American Foundation for the Blind: http://www.afb.org/info/reading-and-writing/making-print-more-readable/35

### 5.7.3 Limited-English Proficiency

Key to an individual’s ability to evacuate is access to information. Individuals with limited English proficiency may require additional guidance in their native language.

#### Recommended Action

* Incorporate communication education materials, in appropriate native languages, into community events and websites.

#### Resources

* The U.S. Department of Justice’s 2016 Tips and Tools for Reaching Limited English Proficient Communities in Emergency Preparedness, Response, and Recovery: <https://www.justice.gov/crt/file/885391/download>
* The U.S. Department of Health & Human Services’ Emergency Preparedness Resources for Persons with Limited English Proficiency (LEP): <https://www.hhs.gov/civil-rights/for-individuals/special-topics/emergency-preparedness/limited-english-proficiency/index.html>

### 5.7.4 Deaf or Hard of Hearing

Individuals who are deaf or hard of hearing may not respond to verbal direction or hear warning sirens.

#### Recommended Action

* Work with organizations who provide services to those who are deaf or hard of hearing to recognize the signs of a possible tsunami (i.e., ground shaking) and the necessity of evacuating immediately after the ground stops shaking.
* Encourage residents to get to know their neighbors and whether they will need non-verbal communication assistance.

#### Resources

* Emergency Preparedness for Individuals with Hearing Loss: A Family Guide, from the Vanderbilt Kennedy Center for Excellence in Developmental Disabilities: <https://vkc.mc.vanderbilt.edu/assets/files/tipsheets/emprephearinglosstips.pdf>
* The American Red Cross and NTID’s Disaster Preparedness and the Deaf Community — For the Deaf, Hard of Hearing and Latened Deaf: <http://www.cidrap.umn.edu/sites/default/files/public/php/332/332_brochure.pdf>

## 5.8 Training and Exercises

Trainings and exercises are an excellent tool to help solidify provided educational materials into action.

#### Recommended Action

* Conduct yearly exercises with staff to encourage awareness around their responsibilities during and after a tsunami event.
* Conduct community exercises.
* Offer frequent trainings to local businesses and community organizations.

## 5.9 Measuring Success

Learning what the community’s awareness is about tsunamis through community surveys is an informative way to help guide education efforts.

#### Recommended Action

* Distribute questionnaires bi-annually to measure the baseline of public awareness and preparedness and subsequent changes to determine program effectiveness and to revise efforts. Consider encouraging participation by utilizing a raffle prize related to emergency preparedness.

#### Resources

* A sample Community Tsunami Awareness Survey is available here: <http://kejian1.cmatc.cn/vod/comet/emgmt/community/media/documents/survey.pdf>.

# 6 Appendices

* Appendix A – Tsunami Risk and Vulnerability Assessment (includes Survey #1 results)
* Appendix B – Survey Results
* Appendix C – Evacuation Improvement Project Identification Table
* Appendix D – DOGAMI Socioeconomic Analysis Summary
* Appendix E – Beat the Wave Maps

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