

1 BOARD OF COMMISSIONERS

2 COOS COUNTY

3 STATE OF OREGON

4 In The Matter of Amending language in the Coos County ORDINANCE NO.: 19-12-010PL
5 Comprehensive Plan Volume 1 Part II Section 3.9 Natural
6 Hazards and the Implementing standards found in Coos
7 County Zoning and Land Development Ordinance
8 (CCZLDO) Article 4.11 Special Development
9 Consideration. File Number AM-19-005

10 SECTION 1. TITLE

11 This Ordinance shall be known as the "Coos County Ordinance No. 19-12-0##PL".

12 SECTION 2. AUTHORITY

13 This ordinance is enacted pursuant to the provisions of but not limited to ORS Chapter 215
14 Sections 215.060 & ORS 215.223;

15 SECTION 3. PURPOSE

16 The purpose of this Ordinance is to amend the Coos County Comprehensive Plan and
17 Implementing Ordinance. This ordinance amends Coos County Ordinances 85-03-005L, 84-5-016L and 82-12-
18 022L which adopted the Coos County Comprehensive Plan;

19 SECTION 4. FINDINGS

20 The Hearings Body reviewed this matter in accordance with Article 5.1 of the Coos County
21 Zoning and Land Development Ordinance. The Board of Commissioners reviewed the matter on December 18,
22 2019 and suggested minor changes. The Board of Commissions recognizes the need to update the Natural
23 Hazards Section Comprehensive Plan to include the newest information available along with the tsunami
24 evacuation plan. The county staff worked with Meg Reed, DLCD Coastal Shores Specialist to put the plan and
25 ordinance language together. The final language is found at Attachment "A" of this document. The process in
26 Section 5.1.120 was followed. The Board of Commissioners made a motion to consider that the text
27 amendments were appropriate through the local legislative process.
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29
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SECTION 5. AMENDMENT TO THE COOS COUNTY ORDINANCE

Exhibit "A", attached hereto and incorporated herein by this reference, is adopted as amendment to Ordinances 85-03-005L, 84-5-016L and 82-12-022L.

SECTION 6. SEVERANCE CLAUSE

If any section, subsection, provision, clause or paragraph of this ordinance shall be adjudged or declared by any court of competent jurisdiction to be unconstitutional or invalid, such judgment shall not affect the validity of the reaming portions of this ordinance; and it is herby expressly declared that every other section, subsection, provision, clause or paragraph of this ordinance enacted, irrespective of the enactment or validity of the portion thereof declared to be unconstitutional or invalid, is valid.

SECTION 7. REPEAL OF INCONSISTENT ORDINANCES

Coos County Ordinances 85-03-005L, 84-5-016L and 82-12-022L are repealed to the extent that they are in conflict with this ordinance. Coos County Ordinances 85-03-005L, 84-5-016L and 82-12-022L shall remain in full force and effect in all other respects.

SECTION 8. EMERGENCY CLAUSE

The Board of Commissioners for the County of Coos deems this Ordinance necessary for the immediate preservation and protection of the public peace, safety, health and general welfare for Coos County and declares an emergency exists, and this Ordinance shall be in full force and effective upon its passage.

Dated this 18th day of December

BOARD OF COMMISSIONERS

ATTEST

Michelle Berglund
Recording Secretary

JRW
Chair

Approved as to form:

Nathaniel Johnson
Office of Legal Counsel

Mad AM
Vice Chair

Absent
Commissioner

First Reading: December 18, 2019

Effective Date: December 18, 2019

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and substantial improvements. The determination of whether a property is located in one of the above referenced potentially hazardous areas shall be made by the reviewing body (Planning Director, Planning Commission, Board of Commissioners, or any designee based upon adopted inventory mapping). A specific site may not include the characteristics for which it is mapped. In these circumstances staff shall apply §5-11-100.2.m ***4.11.132.ii.2m.***

~~Hazard review shall not be considered applicable to any application that has received approval and is requesting an extension to that approval, or any application that was deemed completed as of the date this ordinance effective (need date). If a land use authorization has expired the applicant will be required to address any applicable hazards.~~

- a. Flooding: Coos County shall promote protection of valued property from risks associated with river and coastal flooding along waterways in the County through the establishment of a floodplain overlay zone (/FP) ***that conforms to the requirements for participation in the National Flood Insurance Program. See Sections 4.11.211-257 for the requirements of this overlay zone.***

- ~~a. Landslides: Areas subject to landslides (mass movement) include active landslides, inactive landslides, earth flow and slump topography, and rockfall and debris flow terrain as identified on the 2015 Coos County Comprehensive Plan Hazards Map (mapped as the very high existing landslides).~~

~~Coos County shall permit the construction of new structures in an inventoried Landslide hazard area (earth flow/slump topography/rock fall/debris flow) through a conditional use process subject to a geological assessment review as set out in Article 5.11.~~

b. Landslides and Earthquakes

Landslides: Coos County shall promote protection to life and property in areas potentially subject to landslides. New development or substantial improvements proposed in such areas shall be subject to geologic assessment review in accordance with section 4.11.150. Potential landslide areas subject to geologic assessment review shall include all lands partially or completely within "very high" landslide susceptibility areas as mapped in DOGAMI Open File Report O-16-02, "Landslide susceptibility map of Oregon."

Earthquakes: Coos County shall promote protection of life and property in areas potentially subject to earthquake hazards. New development or substantial improvements in mapped areas identified as potentially subject to earthquake induced liquefaction shall be subject to a geologic assessment review as set out in this section. Such areas shall include lands subject to "very high" and "high" liquefaction identified in DOGAMI Open File Report O-13-06, "Ground motion, ground deformation, tsunami inundation, co-seismic subsidence, and damage potential maps for the 2012 Oregon Resilience Plan for Cascadia Subduction Zone Earthquakes."

Coos County shall continue to support Oregon State Building Codes to enforce any structural requirements related to landslide and earthquakes. Staff will notify Oregon State Building Codes by providing a copy of the geologic assessment report with the Zoning Compliance Letter.

- c. Tsunamis: Coos County shall promote increased resilience to a potentially catastrophic Cascadia Subduction Zone (CSZ) tsunami through the establishment of a Tsunami Hazard Overlay Zone

SECTION 4.11.125 Special Development Considerations:

The considerations are map overlays that show areas of concern such as hazards or protected sites. Each development consideration may further restrict a use. Development considerations play a very important role in determining where development should be allowed in the Balance of County zoning. The adopted plan maps and overlay maps have to be examined in order to determine how the inventory applies to the specific site.

4.11.126 Mineral & Aggregate Plan Implementation Strategies (Balance of County Policy 5.5)

4.11.127 Water Resources (Balance of County Policy 5.8)

4.11.128 Historical, Cultural and Archaeological Resources, Natural Areas and Wilderness (Balance of County Policy 5.7)

4.11.129 Beaches and Dunes (Policy 5.10)

4.11.130 Non-Estuarine Shoreland Boundary (Balance of County Policy 5.10)

4.11.131 Significant Wildlife Habitat (Balance of County Policy 5.6)

4.11.132 . Natural Hazards (Balance of County Policy 5.11)

The Natural Hazards Map *Coos County* has inventoried the following *natural* hazards:

- Flood Hazards
 - Riverine flooding
 - Coastal flooding
- Landslides *and Earthquakes*
- ~~Earthquakes~~
 - *Landslide Susceptibility*
 - Liquefaction potential
 - ~~Fault lines~~
- Tsunamis
- Erosion
 - Riverine streambank erosion
 - Coastal
 - Shoreline and headlands
 - Wind
- Wildfire
 - ~~High Wildfire hazard~~
 - ~~Gorse fire~~

Purpose Statements:

Coos County shall regulate development in known areas potentially subject to natural disasters and hazards, so as to minimize possible risks to life and property. Coos County considers natural disasters and hazards to include river and coastal flooding, landslides, liquefaction potential due to earthquakes, fault lines, tsunamis, river bank erosion, coastal erosion along shorelines and headlands, coastal erosion due to wind, and wildfires, including those areas affected by gorse.

This strategy shall be implemented by enacting special protective measures through zoning and other implementing devices, designed to minimize risks to life and property associated with new development

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(THO) in the Balance of County Zoning. See Sections 4.11.260-270 for the requirements of this overlay zone.

- d. ~~Earthquakes: Areas subject to earthquakes include fault lines and liquefaction potential, as identified on the 2015 Coos County Comprehensive Plan Natural Hazards Map.~~

~~Coos County shall permit the construction of new structures in known areas potentially subject to earthquakes (fault line and liquefaction potential) through a conditional use process subject to a geologic assessment review as set out in Article 5.11. Coos County shall support Oregon State Building Codes to enforce any structural requirements related to earthquakes. Staff will notify Oregon State Building Codes by providing a copy of the geologic assessment report at the time of review. RESERVED~~

- e. Erosion: Coos County shall promote protection of property from risks associated with shoreline, headland, and wind erosion/~~deposition~~ *and deposition* hazards.

Coos County shall promote protection of property from risks associated with bank erosion along rivers and streams through necessary erosion-control and stabilization measures, preferring non-structural solutions when practical.

Any proposed structural development within a wind erosion/deposition area, within 100 feet of a designated bank erosion area, or on a parcel subject to wave attack, including all oceanfront lots, will be subject to a geologic assessment review as set out in *Section 4.11.150*. *There is a setback of 100 feet from any rivers or streams that have been inventoried in the erosion layer. If a variance is requested, a geologic assessment will be required.*

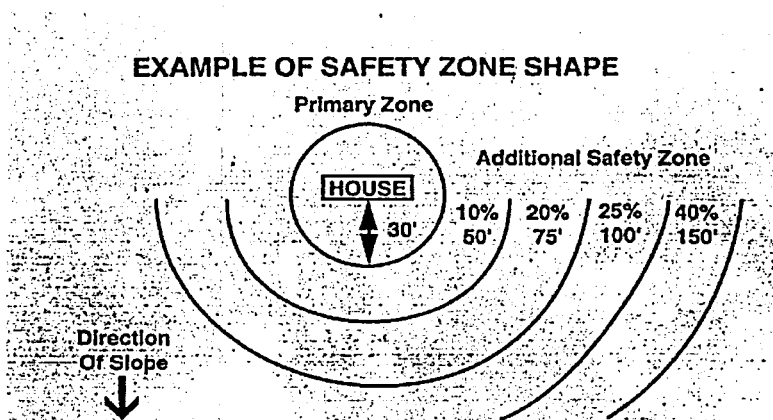
- f. Wildfires: Coos County shall promote protection of *life and* property from risks associated with wildfires ~~and gorse fires by requiring all new dwellings, permanent structures, and replacement dwellings and structures. New development or substantial improvements shall, at a minimum, meet the following standards, on parcels designated or partially designated as "High" or "Moderate" risk on the Oregon Department of Forestry 2013 Fire Threat Index Map for Coos County or as designated as at-risk of fire hazard on the 2015 Coos County Comprehensive Plan Natural Hazards Map:~~ shall at a minimum, meet the following standards on every parcel designated or partially designated as at-risk of fire hazard on the 2015 Coos County Comprehensive Plan Natural Hazards Map:

1. The dwelling shall be located within a fire protection district or shall be provided with residential fire protection by contract. If the dwelling is not within a fire protection district, the applicant shall provide evidence that the applicant has asked to be included within the nearest such district or is provided fire protection by contract.
2. When it is determined that these standards are impractical, the Planning Director may authorize alternative forms of fire protection that shall comply with the following:
 - a. The means selected may include a fire sprinkling system, onsite equipment and water storage or other methods that are reasonable, given the site conditions, as established by credible documentation approved in writing by the Director;
 - b. If a water supply is required for fire protection, it shall be a swimming pool, pond, lake, or similar body of water that at all times contains at least 4,000 gallons per dwelling or a stream that has a continuous year round flow of at least one cubic foot per second per dwelling;

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- c. The applicant shall provide verification from the Water Resources Department that any permits or registrations required for water diversion or storage have been obtained or that permits or registrations are not required for the use; and
 - d. Road access shall be provided to within 15 feet of the water's edge for firefighting pumping units. The road access shall accommodate the turnaround of firefighting equipment during fire season. Permanent signs shall be posted along the access route to indicate the location of the emergency water source.
3. Fire Siting Standards for New Dwellings:
- a. The property owner shall provide and maintain a water supply of at least 500 gallons with an operating water pressure of at least 50 PSI and sufficient $\frac{3}{4}$ inch garden hose to reach the perimeter of the primary fuel-free building setback.
 - b. If another water supply (such as a swimming pool, pond, stream, or lake) is nearby, available, and suitable for fire protection, then road access to within 15 feet of the water's edge shall be provided for pumping units. The road access shall accommodate the turnaround of firefighting equipment during the fire season. Permanent signs shall be posted along the access route to indicate the location of the emergency water source.
4. Firebreak:
- a. A firebreak shall be established and maintained around all structures, including decks, *on land owned or controlled by the applicant* for a distance of at least 30 feet in all directions.
 - b. This firebreak will be a primary safety zone around all structures. Vegetation within this primary safety zone shall be limited to mowed grasses, low shrubs (less than ground floor window height), and trees that are spaced with more than 15 feet between the crowns and pruned to remove dead and low (less than 8 feet from the ground) branches. Accumulated needles, limbs and other dead vegetation should be removed from beneath trees.
 - c. Sufficient garden hose to reach the perimeter of the primary safety zone shall be available at all times.
 - d. The owners of the dwelling shall maintain a primary fuel-free break area surrounding all structures and clear and maintain a secondary fuel-free break on land surrounding all structures that is owned or controlled by the owner in accordance with the provisions in "Recommended Fire Siting Standards for Dwellings and Structures and Fire Safety Design Standards for Roads" dated March 1, 1991, and published by Oregon Department of Forestry and shall demonstrate compliance with Table 1.

Table 1 – Minimum Primary Safety Zone



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Slope	Feet of Primary Safety Zone	Feet of Additional Primary Safety Zone Down Slope
0%	30	0
10%	30	50
20%	30	75
25%	30	100
40%	30	150

- e. All new and replacement structures shall use non-combustible or fire resistant roofing materials, as may be approved by the certified official responsible for the building permit.
 - f. If a water supply exceeding 4,000 gallons is suitable and available (within 100 feet of the driveway or road) for fire suppression, then road access and turning space shall be provided for fire protection pumping units to the source during fire season. This includes water supplies such as a swimming pool, tank or natural water supply (e.g. pond).
 - g. The structure shall not be sited on a slope of greater than 40 percent.
 - h. If the structure has a chimney or chimneys, each chimney shall have a spark arrester.
 - i. Except for private roads and bridges accessing only commercial forest uses, public roads, bridges, private roads, and driveways shall be constructed so as to provide adequate access for firefighting equipment. Confirmation shall be provided from the Coos County Road Department or local fire protection district that these standards have been met.
5. Wildfires inside urban growth boundaries. Certain areas inside urban growth boundaries may present special risks and may be made subject to additional or different standards and requirements jointly adopted by a city and the county in the form of code requirements, master plans, annexation plans, or other means.

4.11.150 GEOLOGICAL HAZARDS SPECIAL DEVELOPMENT REVIEW STANDARDS

(NOTE TO READER THIS SECTION WAS MOVED FROM ARTICLE 5.11 WHICH WILL BE DELETED AND LEFT WITH A RESERVED ONCE APPROVAL IS GRANTED)

Applications for a geologic hazard review may be made concurrently with any other type of application required for the proposed use or activity. A review of the property must be conducted prior to any ground disturbance. All geologic hazard assessment reports shall include a description of the qualification of the licensed professional or professionals that prepared the assessment.

The applicant shall present a geologic hazard assessment report (geologic assessment) prepared by a qualified licensed professional competent in the practice of geosciences, at the applicant's expense, that identifies site specific geologic hazards, associated levels of risk, and the suitability of the site for the use and/or activity in view of such hazards. *The geologic assessment shall include the required elements of this section and one of the following:*

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- a. A statement that the use and/or activity can be accomplished without measures to mitigate or control the risk of geologic hazard to the subject property resulting from the proposed use and/or activity;
- b. A statement that there is an elevated risk posed to the subject property by geologic hazards that requires mitigation measures in order for the use and/or activity to be undertaken safely sited on the property; or
- c. A certification that there are no **high or very high** geological hazards present on site. If such is certified by a licensed profession then an application is not required. Coos County is not liable for any type of certification that a geological hazard is not present on site.

4.11.155 GEOLOGICAL ASSESSMENT REVIEW

Geologic Assessment Review: The applicant(s) shall complete the following review to determine compliance with this section. This type of review requires a conditional use application and shall follow the administrative procedures for conditional uses found in Article 5 of the CCZLDO.

1. *Except for activities identified in Subsection 2 of this section, as exempt, any new development or substantial improvement in an area subject to the provisions of this section shall require a Geologic Assessment Review.*
2. *The following development activities are exempt from the requirement for a Geologic Assessment Review:*
 - a. *Maintenance, repair, or alterations to existing structures that do not alter the building footprint or foundation and do not constitute substantial improvement as defined in Chapter II.*
 - b. *An excavation and/or fill which is less than two feet in depth, or which involves less than twenty-five cubic yards of volume;*
 - c. *Exploratory excavations under the direction of a certified engineering geologist or registered geotechnical engineer;*
 - d. *Construction of structures for which a building permit is not required;*
 - e. *Yard area vegetation maintenance and other vegetation removal on slopes less than 25%;*
 - f. *Forest operations subject to regulation under ORS 527 (the Oregon Forest Practices Act);*
 - g. *Maintenance and reconstruction of public and private roads, streets, parking lots, driveways, and utility lines, provided the work does not extend outside of the previously disturbed area;*
 - h. *Maintenance and repair of utility lines, and the installation of individual utility service connections;*
 - i. *Emergency response activities intended to reduce or eliminate an immediate danger to life, property, or flood or fire hazard;*
 - j. *Construction/erection of beachfront protective structures subject to regulation by the Oregon Parks and Recreation Department under OAR 736, Division 20; and*
 - k. *Any development or activity to be conducted on a site for which a certified engineering geologist has determined that there are no high or very high geologic hazards present. Coos County is not liable for any type of certification that a geologic hazard is not present on site.*

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3. *Application, review and appeals for a Geologic Assessment Review shall be in accordance with the requirements for administrative conditional use review as set forth in Article 5.2. Applications for a Geologic Assessment Review may be made prior to or concurrently with any other type of application required for the proposed use or activity. Geologic Assessment Review shall be completed prior to any ground disturbance.*
4. *All applications for Geologic Assessment Review shall be accompanied by an engineering geologic report prepared by a certified engineering geologist at the applicant's expense.*

A. ENGINEERING GEOLOGIC REPORTS

1. *Engineering geologic reports required pursuant to this section shall be prepared by a certified engineering geologist licensed in the State of Oregon. Such reports shall be prepared consistent with standard geologic practices and employing generally accepted scientific and engineering principles. The content of such reports shall be generally consistent with the applicable provisions of "Guideline for Preparing Engineering Geologic Reports," 2nd Edition, 5/30/2014, published by the Oregon Board of Geologist Examiners.*
2. *Properties abutting the ocean shore that are located in a mapped regulated hazard area shall include the following additional information :*
 - a. *Site description:*
 - i. *The geological history and stabilization measures of the site including any previous riprap or dune grading, erosion events, or exposed trees on the beach.*
 - ii. *Topography, including elevations and slopes on the property itself.*
 - iii. *Vegetation cover.*
 - iv. *Subsurface materials – the nature of the rocks and soils.*
 - v. *Conditions of the seaward front of the property, particularly for sites having a sea cliff.*
 - vi. *Description of streams or other drainage that might influence erosion or locally reduce the level of the beach.*
 - vii. *If the site is located on or adjacent to a estuarine water body or Coastal Lake including the Coastal Shoreland Boundary the following additional information shall be included:*
 1. *Presence of drift logs or other flotsam on or within the property.*
 2. *Proximity of nearby headlands that might block the longshore movement of beach sediments, thereby affecting the level of the beach in front of the property.*
 3. *Description of any shore protection structures that may exist on the property or on nearby properties.*
 4. *Presence of pathways or stairs from the property to the beach.*
 5. *Existing development including modification of soil or vegetation on the site, particularly any which might alter the resistance to wave attack.*
 6. *Average widths of the beach during the summer and winter.*
 7. *Median grain size of beach sediment.*
 8. *Average beach slopes during the summer and winter.*
 9. *Elevations above mean sea level of the beach at the seaward edge of the property during summer and winter.*
 10. *Presence of rip currents and rip embayments that can locally reduce the elevation of the fronting beach.*
 11. *Presence of rock outcrops and sea stacks, either offshore or within the beach zone.*

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12. Information regarding the depth of beach sand down to bedrock at the seaward edge of the property.

- b. Analyses of Erosion and Flooding Potential on the site:**
 - i. Analysis of DOGAMI beach monitoring data for the site (if available,) all activities affecting shoreline erosion and possible mass wasting, including weathering processes, land sliding or slumping.**
 - ii. Calculation of wave run-up beyond mean water elevation that might result in erosion of the sea cliff or foredune (see Stockdon, 2006).¹**
 - iii. Evaluation of frequency that erosion-inducing processes could occur, considering the most extreme potential conditions of unusually high water levels together with severe storm wave energy.**
 - iv. For areas subject to dune-backed shorelines, use an established geometric model to assess the potential distance of property erosion, and compare the results with direct evidence obtained during site visits, aerial photo analysis, or analysis of DOGAMI beach monitoring data.**
 - v. For bluff-backed shorelines, use a combination of published reports, such as DOGAMI bluff and dune hazard risk zone studies, aerial photo analysis, and fieldwork to assess the potential distance of property erosion.**
 - vi. Description of potential for sea level rise, estimated for local area by combining local tectonic subsidence or uplift with global rates of predicted sea level rise.**
 - c. Determination of legal restrictions of shoreline protective structures (Goal 18 prohibition, local conditional use requirements, priority for non-structural erosion control methods).**
 - d. Assessment of potential reactions to erosion events, addressing the need for future erosion control measures, building relocation, or building foundation and utility repairs.**
 - e. The assessment should include recommendations:**
 - i. Use results from the above analyses to establish setbacks (beyond any minimums set by this section or the underlying zone), building techniques, or other mitigation measures to ensure an acceptable level of safety and compliance with all local requirements.**
 - ii. Recommend a foundation design, or designs, that render the proposed structures readily moveable.**
 - iii. Recommend a plan for preservation of vegetation and existing grade within the setback area, if appropriate.**
 - iv. Include consideration of a local variance process to reduce the building setback on the side of the property opposite the ocean, if this reduction helps to lessen the risk of erosion, bluff failure or other hazard.**
 - v. Recommend methods to control and direct water drainage away from the ocean (e.g. to an approved storm water system); or, if not possible, to direct water in such a way so as to not cause erosion or visual impacts.**
- 3. Engineering geologic reports required by this section shall include a statement from the preparer of the report that all of the applicable content requirements of this subsection have**

¹ Stockdon, H. F., Holman, R. A., Howd, P. A. and Sallenger, A. H., 2006, Empirical parameterization of setup, swash, and runup: Coastal Engineering, 53, p 573-588.

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been addressed or are not applicable to the review.

- 4. Engineering geologic reports required by this section shall be valid for a period of five years from the date of preparation of such report. No extensions to this time line shall be granted.*

B. DECISIONS ON GEOLOGICAL ASSESSMENT REVIEWS

A decision on a Geologic Assessment Review shall be based on the following standards:

- 1. The engineering geologic report shall meet the content standards set forth in within this Section.*
- 2. In approving a Geologic Assessment Review, the decision maker may impose any conditions which are necessary to ensure compliance with the provisions of this section or with any other applicable provisions of the Coos County Zoning and Land Development Ordinance.*
- 3. In the event the decision maker determines that additional review of the engineering geologic report by an appropriately licensed and/or certified professional is necessary to determine compliance with this section, Coos County may retain the services of such a professional for this purpose. The applicant shall be responsible for all costs associated with the additional review. The results of that evaluation shall be considered in making a decision on the Geologic Assessment Review.*

C. DEVELOPMENT STANDARDS FOR USES SUBJECT TO GEOLOGIC ASSESSMENT REVIEW

In addition to the conditions, requirements and limitations imposed by a required engineering geologic report, all uses subject to a geologic assessment review shall conform to the following requirements:

- 1. Historical, Cultural, and Archaeological Resources: All activities and uses subject to Geologic Assessment Reviews proposed for areas of historical, cultural, or archaeologically sensitive areas, as identified on the Coos County Comprehensive Plan Map, shall require consultation with the appropriate local Tribe prior to the commencement of any and all ground disturbing activity. Proof of this consultation shall be provided as a part of application submission.*
- 2. Hazard Disclosure Statement: All applications for new development or substantial improvements subject to Geologic Assessment Review shall provide a Hazard Disclosure Statement signed by the property owner that acknowledges:*
 - a. The property is subject to potential natural hazards and that development thereon is subject to risk of damage from such hazards;*
 - b. The property owner has commissioned an engineering geologic report for the subject property, a copy of which is on file with Coos County Planning Department, and that the property owner has reviewed the engineering geologic report and has thus been informed and is aware of the type and extent of hazards present and the risks associated with development on the subject property;*
 - c. The property owner accepts and assumes all risks of damage from natural hazards associated with the development of the subject property.*
- 3. Mitigation measures: If on-site structural mitigation measures are required as a condition of approval, the applicant shall, prior to the issuance of a zoning compliance letter, record on the title to the subject property a notification that includes a description of the measures or improvements and that also specifies the obligation of the property owners to refrain from interfering with such measures or improvements and to maintain them.*
- 4. Safest site requirement: All new structures shall be located within the area most suitable for development based on the least exposure to risk from hazards as determined by an engineering geologist as part of an engineering geologic report prepared in accordance with Section 4.11.150 through 4.11.155. Notwithstanding the provisions of the underlying zone, as necessary to comply with this requirement, any required yard or setback may be reduced by up to 50% without a variance.*

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5. *Certification of compliance: Permitted development shall comply with the recommendations in the required engineering geologic report. Certification of compliance shall be provided to the director by the applicant as follows:*
- a. *Plan Review Compliance: Building, construction or other development plans shall be accompanied by a written statement from a certified engineering geologist stating that the plans comply with the recommendations contained in the engineering geologic report for the approved Geological Assessment Review.*
 - b. *Inspection Compliance: Upon the completion of any development activity for which the engineering geologic report recommends an inspection or observation by a certified engineering geologist, the applicant shall provide to the director a written statement from the certified engineering geologist indicating that the development activity has been completed in accordance with the applicable engineering geologic report recommendations.*
 - c. *Final Compliance: Upon completion of development requiring an engineering geologic report, the applicant shall submit to the director:*
 - i. *A written statement by a certified engineering geologist indicating that all performance, mitigation, and monitoring measures specified in the report have been satisfied; and,*
 - ii. *If mitigation measures incorporate engineering solutions designed by a licensed professional engineer, a written statement of compliance by the design engineer.*

OVERLAY ZONE:

- **SECTION 4.11.200 Purpose:**
- **OVERLAY ZONE: FLOODPLAIN**
- **DESIGNATION: /FP**
- **SECTION 4.11.211 AUTHORIZATION**
- **SECTION 4.11.212 FINDINGS OF FACT**
- **SECTION 4.11.214 METHODS OF REDUCING FLOOD LOSSES**
- **SECTION 4.11.220 DEFINITIONS**

SECTION 4.11.231 LANDS TO WHICH THIS OVERLAY ZONE APPLIES

- **SECTION 4.11.232 BASIS FOR ESTABLISHING THE AREAS OF SPECIAL FLOOD HAZARD**
- **SECTION 4.11.233 INTERPRETATION**

SECTION 4.11.235 ESTABLISHMENT OF DEVELOPMENT PERMIT

1. Application

An application shall be made on the forms furnished by the Planning Department and may include, but not be limited to, plans in duplicate drawn to scale showing the nature, location, dimensions, and elevations of the area in question; existing or proposed structures, fill, storage of materials, drainage facilities, and the location of the foregoing. Specifically, the following information is required:

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- a. Elevation in relation to mean sea level, of the lowest floor (including basement) of all structures which may be submitted by a registered surveyor;
- b. Elevation in relation to mean sea level of floodproofing in any structure;
- c. Certification by a registered professional engineer or architect that the floodproofing methods for any nonresidential structure meet the floodproofing criteria in Section 4.11.252; and
- d. Description of the extent to which a watercourse will be altered or relocated as a result of proposed development.
- e. Plot plan drawn to scale showing the nature, location and dimensions and elevation referenced to mean sea level, or NAVD 88, whichever is applicable, of the area in question including existing and proposed structures, fill, storage of materials, and drainage facilities. Applicants shall submit certification by an Oregon registered professional engineer or land surveyor of the site's ground elevation and whether or not the development is located in a flood hazard area. If so, the certification shall include which flood hazard area applies, the location of the floodway at the site, and the 100 year flood elevation at the site. A reference mark shall be set at the elevation of the 100 year flood at the site. The location, description, and elevation of the reference mark shall be included in the certification; and
- f. Any other information required to ~~make a determination~~ *to show compliance.*
- g. *Applications for variance, water course changes or staff determinations will be noticed with an opportunity to appeal in the same manner as a conditional use (see Chapter V). Non discretionary determination of compliance with the standards will be processed in the same manner as a Compliance Determination (see Article 5.10)*

SECTION 4.11.242 DESIGNATION OF THE LOCAL ADMINISTRATOR

The Coos County Planning Director *or designated staff* is hereby appointed to administer and implement this ordinance by granting or denying development permit applications in accordance with its provisions. The Floodplain Administrator may delegate authority to implement these provisions.

- **SECTION 4.11.243 DUTIES AND RESPONSIBILITIES OF THE FLOODPLAIN ADMINISTRATOR**
- **SECTION 4.11.244 VARIANCE PROCEDURE**
- **SECTION 4.11.251 GENERAL STANDARDS**
- **SECTION 4.11.253 BEFORE REGULATORY FLOODWAY**
- **SECTION 4.11.254 FLOODWAY**
- **SECTION 4.11.255 STANDARDS FOR SHALLOW FLOODING AREAS (AO ZONES)**
- **SECTION 4.11.256 COASTAL HIGH HAZARD AREAS**
- **SECTION 4.11.257 CRITICAL FACILITY**

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TSUNAMI HAZARD OVERLAY ZONE:

4.11.260 Tsunami Hazard Overlay Zone (Background)

The Tsunami Hazard Overlay zone is designed to serve as the principal implementation mechanism for land use measures addressing tsunami risk. As the name indicates, it is designed to be applied in the form of an overlay zone, i.e. in combination with underlying base zones. The boundaries of the overlay would correspond to the area of the jurisdiction subject to inundation from a local source tsunami indicated in § 4.11.265 below.

Oregon Statewide Planning Goal 7 envisions a process whereby new hazard inventory information generated by federal and state agencies is first reviewed by the Department of Land Conservation and Development (DLCD). DLCD then notifies the County of the new information, and the County has three years to respond to the information by evaluating the risk, obtaining citizen input, and adopting or amending implementation measures to address the risk. The County has not received notice from DLCD but has taken the proactive role in working with DLCD to address tsunami hazards.

This section of the ordinance places restrictions and limitations on certain categories of uses. These limitations apply primarily to uses which present a high potential for life safety risk, or to uses which provide an essential function during and after a disaster event. ORS 455, which is implemented through the state building code, currently prohibits certain facilities and structures in the tsunami inundation zone as defined by the Oregon Department of Geology and Mineral Industries as indicated in Section 4.11.265 below. The overlay incorporates the requirements that can be limited through the land use program. Nothing in this ordinance is meant to conflict with the State Building Code but will focus on integration of development and improvement of evacuation infrastructure into the land use and development review process.

Coos County does not house the building codes program and; therefore, Coos County lacks certain enforcement authority over the Oregon Structural Specialty Code as explained in OAR 632-005-0070 exemption responsibility. This section of the ordinance is not meant to obstruct the authority of the structural code.

These provisions establish requirements to incorporate appropriate evacuation measures and improvements in most new development, consistent with ~~an overall evacuation plan for the community. It is important to note that effectiveness of this component to the overlay is largely dependent up on the development and adoption of an Evacuation Route Plan~~ **the Coos County's Tsunami Evacuation Facilities Improvement Plan**. Coos County Planning has worked with Coos County Emergency Management in planning for emergency preparedness and developing hazard mitigation plans.

The maps that will be used to implement this section of the Coos County Zoning and Land Development ordinance are the 2012 [Tsunami Inundation Maps](#) produced by Oregon Department of Geology and Mineral Industries. The maps will be printed and filed as part of the Coos County Comprehensive Plan.

The series of maps consists of a Small (S), Medium (M), Large (L), Extra Large (XL) and Extra-Extra Large (XXL), with the XXL indicating the worst case scenario. When a size is identified in the section it includes all smaller sizes. For an example if a facility is regulated ~~in~~ **within** an L tsunami inundation event then it includes all M and S tsunami inundation mapped areas.

4.11.265 Tsunami Hazard Overlay (THO) Zone (Definitions)

Attachment A

Definitions ~~these are~~ applicable to the tsunami hazard overlay zone

As used in ~~tsunami hazard overlay zone~~ **Section 4.11.270:**

1. "Essential Facilities" means:
 - a. Hospitals and other medical facilities having surgery and emergency treatment areas;
 - b. Fire and police stations;
 - c. Tanks or other structures containing, housing or supporting water or fire-suppression materials or equipment required for the protection of essential or hazardous facilities or special occupancy structures;
 - d. Emergency vehicle shelters and garages;
 - e. Structures and equipment in emergency preparedness centers;
 - f. Standby power generating equipment for essential facilities; and
 - g. Structures and equipment in emergency preparedness centers.
2. "Hazardous facility" means structures housing, supporting or containing sufficient quantities of toxic or explosive substances to be of danger to the safety of the public if released.
3. "Special occupancy structures" means:
 - a. Covered structures whose primary occupancy is public assembly with a capacity greater than 300 persons;
 - b. Buildings with a capacity of greater than 250 individuals for every public, private or parochial school through secondary level or child care centers;
 - c. Buildings for colleges or adult education schools with a capacity of greater than 500 persons;
 - d. Medical facilities with 50 or more resident, incapacitated persons not included subsection (a);
 - e. Jails and detention facilities; and
 - f. All structures and occupancies with a capacity of greater than 5,000 persons. ~~(Note: The above definitions are taken from~~ *see* ORS 455.446)
4. "Substantial improvement" means any repair, reconstruction, or improvement of a structure which exceeds 50 percent of the real market value of the structure.
5. "Tsunami vertical evacuation structure" means a building or constructed earthen mound that is accessible to evacuees, has sufficient height to place evacuees above the level of tsunami inundation, and is designed and constructed with the strength and resiliency needed to withstand the effects of tsunami waves.
6. "Tsunami Inundation Maps (TIMs)" means the map, or maps in the DOGAMI Tsunami Inundation Map (TIM) Series, published by the Oregon Department of Geology and Mineral Industries, which cover(s) the area within Coos County.

4.11.2570 Tsunami Hazard Overlay Zone (Purpose, Applicability and Uses)

1. Purpose
The purpose of the Tsunami Hazard Overlay Zone is to increase the resilience of the community to a local source (Cascadia Subduction Zone) tsunami by establishing standards, requirements, incentives, and other measures to be applied in the review and authorization of land use and development activities in areas subject to tsunami hazards. The standards established by this section are intended to limit, direct and encourage the development of land uses within areas subject to tsunami hazards in a manner that will:
 - a. Reduce loss of life;
 - b. Reduce damage to private and public property;
 - c. Reduce social, emotional, and economic disruptions; and
 - d. Increase the ability of the community to respond and recover.

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Significant public and private investment has been made ~~in development~~ *to developed* areas which are now known to be subject to tsunami hazards. It is not the intent or purpose of this section to require the relocation of or *to* otherwise regulate existing development within the Tsunami Hazard Overlay Zone. However, it is the intent of this section to control, direct and encourage new development and redevelopment such that, ~~overtime~~ *over time*, the community's exposure to tsunamis will be reduced.

2. Applicability of Tsunami Hazard Overlay Zone

The Tsunami ~~Inundation~~ *Hazard Overlay* Zone is applicable to all Balance of County Zoning Districts and any zoning districts located within the Coos Bay Estuary and Coquille Estuary Management Plans when the Estuary Policies directly reference this section. *Areas of inundation depicted on the* Tsunami Inundation Map(s) (TIM) published by the Oregon Department of Geology and Mineral Industries (DOGAMI) are subject to the requirements of this section *as follows*:

- a. Except as provided in subsection (b), all lands identified as subject to inundation from the XXL magnitude local source tsunami event as set forth on the applicable Tsunami Inundation Map(s) (TIM) published by the Oregon Department of Geology and Mineral Industries (DOGAMI) are subject to the requirements of this section.
- b. Lands within the area subject to inundation from the XXL magnitude local source tsunami event as set forth on the applicable Tsunami Inundation Map(s) (TIM) published by the Oregon Department of Geology and Mineral Industries (DOGAMI) that have a grade elevation, established by fill or other means, higher than the projected elevation of the XXL magnitude local source tsunami event are exempt from the requirements of this section. Grade elevations shall be established by an elevation survey performed by a Professional Land Surveyor licensed in Oregon.

3. Uses

In the Tsunami Hazards Overlay Zone, except for the prohibited uses set forth in subsection 5 4, all uses permitted pursuant to the provisions of the underlying zone map *may* be permitted, subject to the additional requirements and limitations of this section. *The Tsunami Hazard Overlay Zone does not establish any new or additional review processes. Application of the standards and requirements of the Tsunami Hazard Overlay Zone is accomplished through the applicable review processes of the underlying zone.*

4. Prohibited Uses

Unless authorized in accordance with subsection 4 5, the following uses are prohibited in the specified portions of the Tsunami Hazard Overlay Zone:

- a. In areas identified as subject to inundation from the L magnitude local source tsunami events set forth on the TIM, the following uses are prohibited:
 - i. Hospitals and other medical facilities having surgery and emergency treatments areas as;
 - ii. Fire and police stations;
 - iii. Hospital and other medical facilities having surgery and emergency treatment areas;
 - ~~iv. Fire and police stations;~~
 - v. Structures and equipment in government communication centers and other facilities required for emergency response;
 - vi. Buildings with a capacity greater than 250 individuals for every public, private or parochial school through secondary level or childcare centers;
 - vii. Buildings for colleges or adult education schools with a capacity of greater than 500 persons; and

Attachment A

- viii. Jails and detention facilities.
- b. In areas identified as subject to inundation from the M magnitude local source tsunami event as set forth on the Tsunami Inundation Map (TIM), the following uses are prohibited:
 - i. Tanks or other structures containing, housing or supporting water or fire-suppression materials or equipment required for the protection of essential or hazardous facilities or special occupancy structures;
 - ii. Emergency vehicle shelters and garages;
 - iii. Structures and equipment in emergency preparedness centers;
 - iv. Standby power generating equipment for essential facilities;
 - v. Covered structures whose primary occupancy is public assembly with a capacity of greater than 300 persons;
 - vi. Medical facilities with 50 or more resident, ~~in-capacitated~~ *incapacitated* patients;
 - vii. Manufactured home parks, of a density exceeding 10 units per acre; and
 - viii. Hotels or motels with more than 50 units.
- c. Notwithstanding the provisions of Article 5.6 of the Coos County Zoning and Land Development Ordinance, the requirements of this subsection shall not have the effect of rendering any lawfully established use or structure nonconforming. The Tsunami Hazard Overlay is, in general, not intended to apply to or regulate existing uses or development.

5. Use Exceptions

A use listed in subsection (4) of this section ~~maybe~~ *may be* permitted upon authorization of a Use Exception in accordance with the following requirements:

- a. Public schools may be permitted upon findings that there is a need for the school to be within the boundaries of a school district and fulfilling that need cannot otherwise be accomplished.
- b. Fire or police stations ~~maybe~~ *may be* permitted upon findings that there is a need for a strategic location.
- c. Other uses prohibited by subsection (4) of this section may be permitted upon the following findings:
 - i. There are no reasonable, lower-risk alternative sites available for the proposed use;
 - ii. Adequate evacuation measures will be provided such that life safety risk to building occupants is minimized;
 - iii. The buildings will be designed and constructed in accordance with the Oregon Structural *Specialty* Code to minimize the risk of structural failure during the design earthquake and tsunami event; and
 - iv. Developers of new essential facilities, hazardous facilities, ~~and~~ major structures, and special occupancy structures that are located in an identified tsunami inundation zone, as described in subsection (1)(a)(E), (b) and (c) of ORS 455.447 and new special occupancy structures described in subsection (1)(e)(A), (D) and (F) of ORS 455.447 that are located in an identified tsunami inundation zone shall consult with the State Department of Geology and Mineral Industries for assistance in determining the impact of possible tsunamis on the proposed development and for assistance in preparing methods to mitigate risk at the site of a potential tsunami. Consultation shall take place prior to submittal of design plans to the building official for final approval. ~~The process for construction of certain facilities and structures in tsunami inundation zones including establishment of zones, rules and exceptions are set out in~~ ORS 455.446. The provision of ORS 455.446 does not apply to water-dependent and water-related facilities, including but not limited to docks, wharves, piers and marinas.

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Decisions made under ORS 455.446 are not land use decisions.

Applications, reviews, decisions and appeals for Use Exceptions authorized by this subsection with the exclusion of subsections iii and iv shall be in accordance with the requirements for an administrative conditional use procedure as set forth in Article 5.2 – Conditional Uses.

6. Evacuation Route Improvement Requirements.

Except single family dwellings on existing lots and parcels, all new development, substantial improvements and land divisions in the Tsunami Hazard Overlay Zone shall incorporate evacuation measures and improvements, including necessary vegetation management, which are consistent with and conform to the adopted Tsunami Evacuation Facilities Improvement Plan. Such measures may include:

a. On-site improvements:

- i. Improvements necessary to ensure adequate pedestrian access from the development site to evacuation routes designated in the Tsunami Evacuation Facilities Improvement Plan in all weather and lighting conditions.*
- ii. Frontage improvements to designate evacuation routes that are located on or contiguous to the proposed development site, where such improvements are identified in the Tsunami Evacuation Facilities Improvement Plan. Such improvements shall be proportional to the evacuation needs created by the proposed development.*
- iii. Where identified in the Tsunami Evacuation Facilities Improvement Plan as the only practicable means of evacuation, tsunami evacuation structure(s) of sufficient capacity to accommodate the evacuation needs of the proposed development.*

b. Off-site improvements: Improvements to portions of designated evacuation routes that are needed to serve, but are not contiguous to, the proposed development site, where such improvements are identified in the Tsunami Evacuation Facilities Improvement Plan. Such improvements shall be proportional to the evacuation needs created by the proposed development.

c. Evacuation route signage consistent with the standards set forth in the Tsunami Evacuation Facilities Improvement Plan. Such signage shall be adequate to provide necessary evacuation information consistent with the proposed use of the site.

d. Evacuation route improvements and measures required by this subsection may include the following:

- i. Improved streets and/or all-weather surface paths of sufficient width and grade to ensure pedestrian access to designated evacuation routes in all lighting conditions;*
- ii. Improved streets and paths shall provide and maintain horizontal clearances sufficient to prevent the obstruction of such paths from downed trees and structure failures likely to occur during a Cascadia earthquake; and*
- iii. Such other improvements and measures identified in the Tsunami Evacuation Facilities Improvement Plan. See Volume I, Part 2 Section 3.9. 400 of the Coos County Comprehensive Plan*

7. Tsunami Evacuation Structures

- a.** All tsunami evacuation structures shall be of sufficient height to place evacuees above the level of inundation for the XXL local source tsunami event.
- b.** Tsunami evacuation structures are not subject to the building height limitations of this chapter.

Attachment A

8. Flexible Development Option

- a. The purpose of the Flexible Development Option is to provide incentives for, and to encourage and promote, site planning and development within the Tsunami Hazard Overlay Zone that results in lower risk exposure to tsunami hazard than would otherwise be achieved through the conventional application of the requirements of this chapter. The Flexible Development Option is intended to:
 - i. Allow for and encourage development designs that incorporate enhanced evacuation measures, appropriate building siting and design, and other features that reduce the risks to life and property from tsunami hazard; and
 - ii. Permit greater flexibility in the siting of buildings and other physical improvements and in the creation of new lots and parcels in order to allow the full realization of permitted development while reducing risks to life and property from tsunami hazard.
- b. The Flexible Development Option may be applied to the development of any lot, parcel, or tract of land that is wholly or partially within the Tsunami Hazard Overlay Zone.
- c. The Flexible Development Option may include any uses permitted outright or conditionally in any zone, except for those uses prohibited pursuant to subsection 5 4 of this section.
- d. Overall residential density shall be as set forth in the underlying ~~one~~ zone or zones. Density shall be computed based on total gross land area of the subject property, excluding street right-of-way.
- e. Yards, setbacks, lot area, lot width and depth, lot coverage, building height and similar dimensional requirements may be reduced, adjusted or otherwise modified as necessary to achieve the design objectives of the development and fulfill the purposes of this section.
- f. Applications, review, decisions, and appeals for the Flexible Development Option shall be in accordance with the requirements for an administrative conditional use procedure as set forth in Article 5 of the Coos County Zoning and Land Development Ordinance.
- g. Approval of an application for a Flexible Development Option shall be based on findings that the following criteria are satisfied:
 - i. The applicable requirements of sub-paragraphs (b) and (d) of this subsection are met; and
 - ii. The development will provide tsunami hazard mitigation and/ or other risk reduction measures at a level greater than would otherwise be provided under conventional land development procedures. Such measures may include, but are not limited to:
 1. Providing evacuation measures, improvements, evacuation way finding techniques and signage;
 2. Providing tsunami evacuation structure(s) which are accessible and provide capacity for evacuees from off-site;
 3. Incorporating building designs or techniques which exceed minimum structural specialty code requirements in a manner that increases the capacity of structures to withstand the forces of a local source tsunami; and
 4. Concentrating or clustering development in lower risk portions or areas of the subject property, and limiting or avoiding development in higher risk areas.

3.9 NATURAL HAZARDS

Introduction

Coos County has inventoried the following natural hazards:

- **Flood Hazards**
 - Riverine flooding
 - Coastal flooding
- **Landslides and Earthquakes**
 - Landslide Susceptibility
 - Liquefaction potential
 - Fault lines
- **Tsunamis**
- **Erosion**
 - Riverine streambank erosion
 - Coastal
 - Shoreline and headlands
 - Wind
- **Wildfire**

Purpose Statements:

Coos County shall regulate development in known areas potentially subject to natural disasters and hazards, so as to minimize possible risks to life and property. Coos County considers natural disasters and hazards to include river and coastal flooding, landslides, liquefaction potential due to earthquakes, fault lines, tsunamis, river bank erosion, coastal erosion along shorelines and headlands, coastal erosion due to wind, and wildfires, including those areas affected by gorse.

This strategy shall be implemented by enacting special protective measures through zoning and other implementing devices, designed to minimize risks to life and property associated with new development and substantial improvements. The determination of whether a property is located in one of the above referenced potentially hazardous areas shall be made by the reviewing body (Planning Director, Planning Commission, Board of Commissioners, or any designee based upon adopted inventory mapping). A specific site may not include the characteristics for which it is mapped.

Goal Requirements

The Statewide Planning Goals require that the comprehensive plan provide protection of life and property from natural disasters and hazards. Specifically, Goal 7 requires that:

Developments subject to damage or that could result in loss of life shall not be planned nor located in known areas of natural disasters and hazards without appropriate safeguards.

Goal 17 (Coastal Shorelands) requires that programs be developed to “reduce the hazard to human life and property...resulting from the use and enjoyment of Oregon’s coastal shorelands.” The goal also requires that land use plans, implementing actions, and permit reviews “include consideration of...the geologic and hydrologic hazards associated with coastal shorelands.”

Goal 18 (Beaches and Dunes) requires the reduction of “the hazard to human life and property from natural or man-induced actions” associated with beach and dune areas.

SECTION 3.9.100 FLOOD HAZARDS

The following section is the flood hazard study completed for Coos County.

NOTICE TO FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study (FIS) report may not contain all data available within the Community Map Repository. Please contact the Community Map Repository for any additional data. The Federal Emergency Management Agency (FEMA) may revise any republish part or all of this FIS report at any time. In addition, FEMA may revise par of this FIS report by the Letter of Map Revision process, which does not involve republication or redistribution of the FIS report. Therefore, users should consult with the community officials and check the Community Map Repository to obtain the most current FIS report components.

Initial Countywide FIS Effective Date: September 25, 2019

Revised County wide FIS Dates: March 17, 2014 and December 7, 2018

December 7, 2018 Volume I

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Exhibit 2 – Flood Insurance Rate Map Index
Flood Insurance Rate Map

SECTION 3.9.200 LANDSLIDES AND EARTHQUAKES

Landslides: New development or substantial improvements proposed in such areas shall be subject to geologic assessment review in accordance with this section. Potential landslide areas subject to geologic assessment review shall include all lands partially or completely within "very high" landslide susceptibility areas as mapped in DOGAMI Open File Report O-16-02, "Landslide susceptibility map of Oregon."

Earthquakes: New development or substantial improvements in mapped areas identified as potentially subject to earthquake induced liquefaction shall be subject to a geologic assessment review as set out in this section. Such areas shall include lands subject to "very high" and "high" liquefaction identified in DOGAMI Open File Report O-13-06, "Ground motion, ground deformation, tsunami inundation, co-seismic subsidence, and damage potential maps for the 2012 Oregon Resilience Plan for Cascadia Subduction Zone Earthquakes."

In the past earthquakes have not been addressed in the mapping as most of those experienced in the county originate on the Mendocino Fault off the northern Californian coast. Earthquakes originating there in 1922, 1923, and 1954 caused no damage here, though buildings swayed and sleepers were awakened in 1922 and shaking was observed in 1954. The potential for damage from earthquakes is greater in the Coos Bay area and southern part of the county, and damage is more likely to be a result of liquefaction and landslides than of faulting. Structural design incorporating seismic considerations is a good response to earthquake potential in all parts of the county. This is especially critical in the Coos Bay/North Bend area because of the greater instability of the older stabilized dunes, former marshes, and fills material that much of the development occurs on. High occupancy and critical use facilities such as schools and hospitals should be located in areas of solid ground conditions.

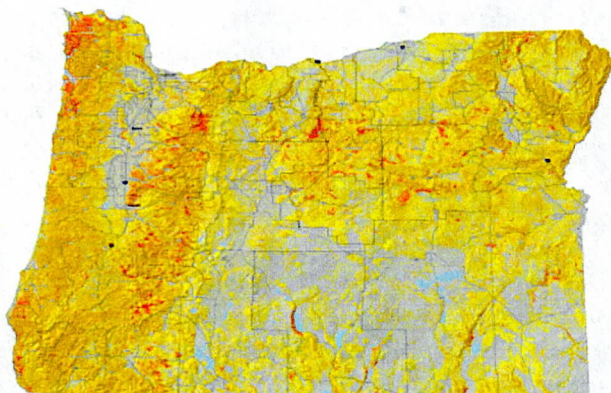
LANDSLIDE REPORT

State of Oregon
Oregon Department of Geology and Mineral Industries
Brad Avy, State Geologist

OPEN-FILE REPORT O-16-02

LANDSLIDE SUSCEPTIBILITY OVERVIEW MAP OF OREGON

By
William J. Burns¹, Katherine A. Mickelson¹, and Ian P. Madin¹



2016

¹Oregon Department of Geology and Mineral Industries, 800 NE Oregon Street, Suite 965, Portland, Oregon 97232

NOTICE

This product is for informational purposes and may not have been prepared for or be suitable for legal, engineering, or surveying purposes. Users of this information should review or consult the primary data and information sources to ascertain the usability of the information. This publication cannot substitute for site-specific investigations by qualified practitioners. Site-specific data may give results that differ from the results shown in the publication.

Oregon Department of Geology and Mineral Industries Open-File Report O-16-02
Published in conformance with ORS 516.030

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EARTHQUAKE REPORT

Coos County has relied on the following report to inventory potential earthquake hazards.

State of Oregon
Oregon Department of Geology and Mineral Industries
Vicki S. McConnell, State Geologist

OPEN-FILE REPORT O-13-06

GROUND MOTION, GROUND DEFORMATION, TSUNAMI INUNDATION, COSEISMIC SUBSIDENCE, AND DAMAGE POTENTIAL MAPS FOR THE 2012 OREGON RESILIENCE PLAN FOR CASCADIA SUBDUCTION ZONE EARTHQUAKES

by Ian P. Madin and William J. Burns
Oregon Department of Geology and Mineral Industries
800 NE Oregon Street, #28, Suite 965, OR 97232



2013

NOTICE

Disclaimer: The Oregon Department of Geology and Mineral Industries is publishing this map because the subject matter is consistent with the mission of the Department. The map is not intended to be used for site specific planning. It may be used as a general guide for emergency response planning. Maps in this publication depict landslide hazard areas on the basis of limited data as described further in the text. **The maps cannot serve as a substitute for site-specific investigations by qualified practitioners. Site-specific data may give results that differ from those shown on the maps.**

Oregon Department of Geology and Mineral Industries Open-File Report O-13-06
Published in conformance with ORS 516.030

For copies of this publication or other information about Oregon's geology and natural resources, contact:

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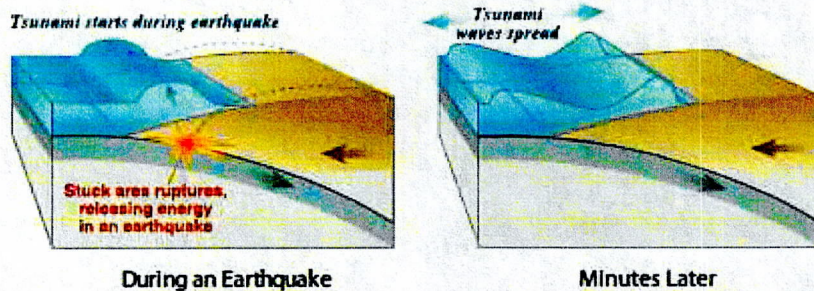
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SECTION 3.9.300 TSUNAMIS

A tsunami is a series of ocean waves most often generated by disturbances of the sea floor during shallow, undersea earthquakes. Less commonly, landslides and volcanic eruptions can also trigger these wave events. Although infrequent in occurrence, tsunamis are the most dangerous natural hazard affecting the Oregon Coast. In the deep water of the open ocean, tsunami waves can travel at speeds up to 800 km (500 miles) per hour and are imperceptible to ships because the wave height is typically less than a few feet.

However, as a tsunami approaches the coast it slows dramatically and its height may multiply by a factor of 10 or more, having catastrophic consequences to people living at the coast. As a result, people on the beach, in low-lying areas of the coast, and near estuary mouths or tidal flats face the greatest danger from tsunamis.



During an Earthquake

An earthquake along a subduction zone happens when the leading edge of the overriding plate breaks free and springs seaward, raising the sea floor and the water above it. This uplift starts a tsunami. Meanwhile, the bulge behind the leading edge collapses, thinning the plate and lowering coastal areas.

Minutes Later

Part of the tsunami races toward nearby land, growing taller as it comes in to shore. Another part heads across the ocean toward distant shores.

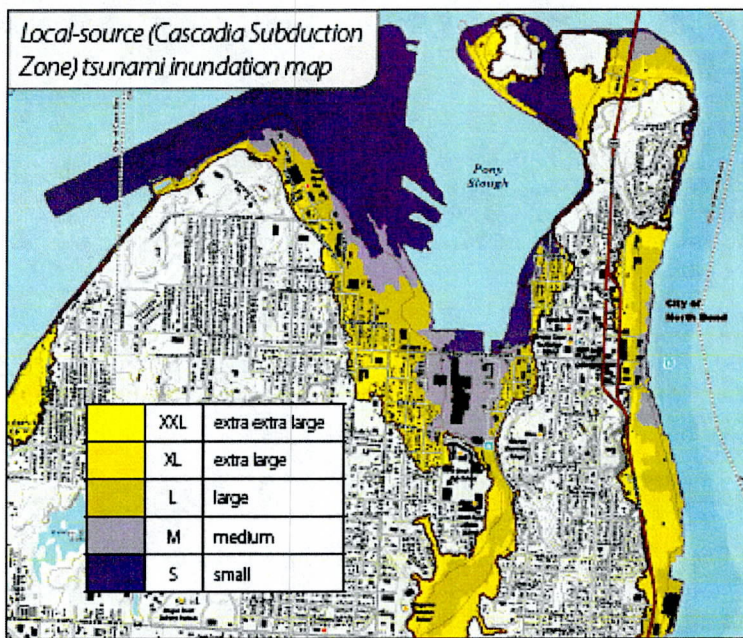
The Oregon coast is a part of the tectonically active Pacific Ring of Fire, posing the risk for both locally and distantly generated tsunamis. The close proximity of the Cascadia Subduction Zone, a 960-km-long (600 mile) earthquake fault zone that sits off the Pacific Northwest coast has the potential to generate earthquakes of magnitude 9.0 or greater. Following the earthquake will be a destructive tsunami, which will reach the coast in 10-20 minutes making the local event the most dangerous type of tsunami for Oregon.

A distant tsunami produced by an earthquake far from Oregon will take 4 or more hours to travel cross the Pacific Ocean, usually allowing time for an official warning and evacuation, if necessary. A distant tsunami will be smaller in size and much less destructive, but it can still be very dangerous.

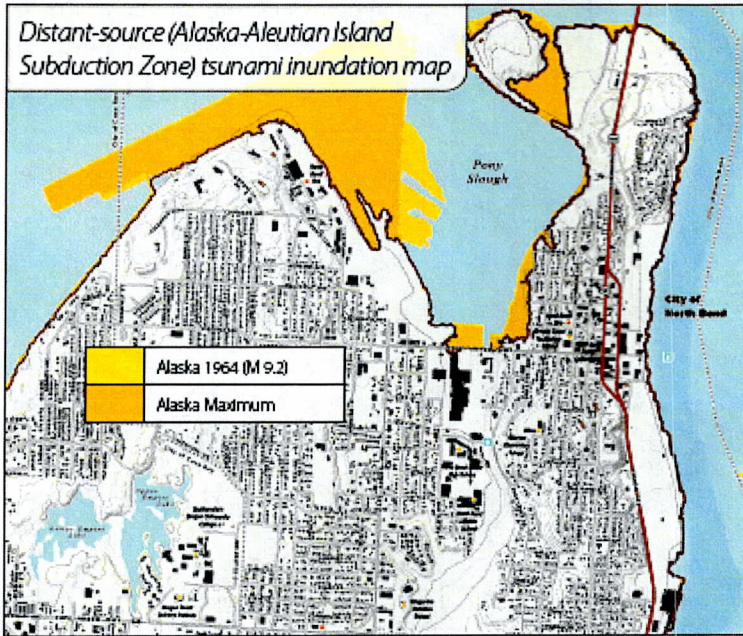
The Oregon Department of Geology and Mineral Industries (DOGAMI) has been identifying and mapping the tsunami inundation hazard along the Oregon coast since 1994. In Oregon, DOGAMI manages the National Tsunami Hazard Mitigation Program, which has been administered by the National Oceanic and Atmospheric Administration (NOAA) since 1995. DOGAMI's work is designed to help cities, counties, and other sites in coastal areas reduce the potential for disastrous tsunami-related consequences by understanding and mitigating this geologic hazard. Using federal funding awarded by NOAA, DOGAMI has developed a new generation of tsunami inundation maps to help residents and visitors along the entire Oregon coast prepare for the next Cascadia Subduction Zone (CSZ) earthquake and tsunami.

TIM series inundation maps incorporate all the best tsunami science that is available today, including recent publications by colleagues studying the Cascadia Subduction Zone, updated computer simulation models using high-resolution lidar topographic data, and knowledge gained from the 2004 Sumatra, 2010 Chile, and 2011 Tōhoku earthquakes and tsunamis.

Each publication includes two plates: one showing local-source (Cascadia Subduction Zone) and one showing distant-source (Alaska-Aleutian Subduction Zone) tsunami inundation scenarios.

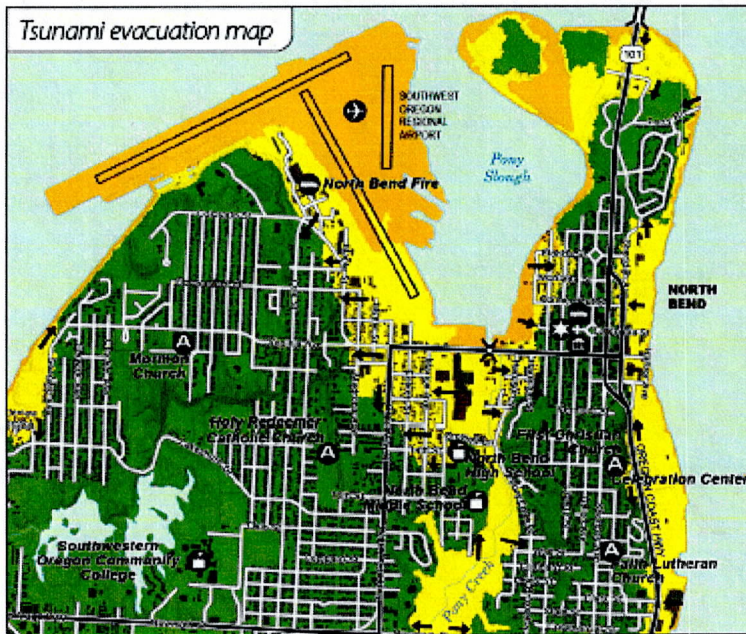


TIM Plate 1 displays five scenarios, labeled as “T-shirt sizes” (S, M, L, XL, and XXL), of the impact of Cascadia Subduction Zone tsunamis that reflect the full range of what was experienced in the past and will be encountered in the future. The geologic record shows that the amount of time that has passed since the last great Cascadia earthquake (312 years since 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.



maximum local source (yellow) maximum distant source (orange)

Combine the maximum tsunami scenario from each map ...



TIM maps include a wealth of information, including projected tsunami wave height time series charts and a measurement of the exposure each community has to the various tsunami scenarios: we count the number of buildings that are inundated by each scenario.

The public, planners, emergency managers and first responders, elected officials, and other local decision makers can use these detailed and innovative map products to mitigate risk and to reduce the loss of life and property.

Coos County has continued to work to reduce the risk in the tsunami areas. This effort has been done through zoning ordinance and developing an evacuation facilities plan. The other effort has been through


TIM Plate 2 shows tsunami inundation scenarios for two distant-source tsunamis that were modeled and originate in Alaska. These distant tsunamis are not nearly as dangerous as the local ones, as Oregonians will have several hours instead of only minutes to evacuate and the tsunamis themselves are much smaller. For these reasons DOGAMI's focus is on the big Cascadia events. If the ground shakes for an extended period of time, don't wait for more warning, evacuate to high ground as fast as possible.

After the inundation maps have been created, the tsunami inundation zones derived from the Cascadia XXL tsunami scenario (yellow area, top figure, left) and the hypothetical maximum Alaska tsunami (orange area, middle figure, left) are put together on one map to create a **tsunami evacuation map**. Green on the evacuation map shows typically higher elevation areas that lie outside the zones prone to tsunami hazard. The purpose of the evacuation map is to help people identify safe evacuation routes, as developed by local emergency authorities.

[All tsunami evacuation maps](#)

the Coos County Hazard Mitigation Plan that Emergency Management updates and implements. Coos County Planning will continue to participate and consult with the Coos County office of Emergency Management to ensure the risks are reduced.

SECTION 3.9.400 TSUNAMI EVACUATION FACILITIES IMPROVEMENT PLAN



Tsunami Evacuation Facilities Improvement Plan (TEFIP)

*For the coastal unincorporated communities of Coos
County, Oregon*

September 2019

TSUNAMI EVACUATION FACILITIES IMPROVEMENT PLAN (TEFIP) FOR THE COASTAL UNINCORPORATED COMMUNITIES OF COOS COUNTY, OREGON
First Edition, September 2019

Plan Development

This plan was developed by the Coos County Planning Department with help from the Coos County Emergency Management Division and the Oregon Department of Land Conservation and Development. Input was received from the Port of Coos Bay, Coos County Roads Department, Oregon Department of Transportation, Oregon Parks and Recreation Department, the Confederated Tribes of the Coos, Lower Umpqua, and Siuslaw, the Coquille Indian Tribe, South Slough Estuarine Research Reserve, and the Charleston Fire Department.

Funding

Financial assistance for this plan was provided in part by the Coastal Zone Management Act of 1972, as amended, administered by the Office for Coastal Management, National Oceanic and Atmospheric Administration, and the Oregon Coastal Management Program, Department of Land Conservation and Development. Federal Grant No. NA15NOS4190118. Financial assistance was also provided in part by a grant from the Federal Emergency Management Agency RiskMAP Program, no. EMS-2016-CA-2008.

Figures

All figures in this document were created by the Oregon Department of Geology and Mineral Industries (DOGAMI). [Open-File Report O-19-07](#), Tsunami evacuation analysis of communities surrounding the Coos Bay Estuary: Building community resilience on the Oregon coast, by Laura L. S. Gabel, Fletcher E. O'Brien, John M. Bauer, and Jonathan C. Allan; 60 p. report.

Additional information can be found at www.oregontsunami.org. For more information about the tsunami evacuation analysis completed by DOGAMI, please contact their Coastal Field Office:

Oregon Department of Geology and Mineral Industries

Newport (Coastal) Field Office

P.O. Box 1033, 313 SW 2nd, Suite D

Newport, OR 97365

Phone: 541-574-6658

Hours: Monday-Friday, 8 a.m. – 5 p.m.

Please call before visiting to check staff availability.

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1. INTRODUCTION

1.1 General

Coastal unincorporated areas of Coos County, OR are vulnerable to the effects of a local Cascadia Subduction Zone (CSZ) earthquake and tsunami event. In addition to the potentially catastrophic damage caused by the earthquake event itself, the resultant tsunami will inundate portions of the community and a risk-based and community-specific approach to evacuation will be critical to save lives. This Tsunami Evacuation Facilities Improvement Plan (TEFIP) is a comprehensive look at existing and potential evacuation routes and needed improvements for these coastal communities, 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, established through Coos County's Tsunami Hazard Overlay Zone (Article 4.11.260-270).** The cities of Coos Bay and North Bend also have tsunami risk but are not included in this plan because they are not within the jurisdiction of the Coos County Planning Department.

The Oregon Department of Geology and Mineral Industries (DOGAMI) has been identifying and mapping the tsunami inundation hazard along the Oregon coast since 1994. DOGAMI developed a series of tsunami inundation maps in 2013 to help residents and visitors along the entire Oregon coast prepare for the next CSZ earthquake and tsunami, called the Tsunami Inundation Maps (TIMs). The TIMs display five scenarios, labeled as "T-shirt sizes" (S, M, L, XL, and XXL), showing the impact of Cascadia Subduction Zone tsunamis that reflect the full range of possible inundation. The geologic record shows that the amount of time that has passed since the last great Cascadia earthquake (in 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

Because life safety risk is present in all areas potentially subject to inundation during a tsunami event, the XXL tsunami scenario is used for evacuation facility planning, so that all areas with the **XXL scenario** can be effectively evacuated. 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. Also, unlike a distant tsunami that can be predicted several hours prior to its arrival (4 or more hours), this local CSZ tsunami can strike the coast within 15 – 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 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 (albeit a very important) phase. This TEFIP does not include planning for earthquake shaking damage mitigation or post-event disaster response and recovery. Other entities at the local, state, and federal level continue to prepare for those 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 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, works, or visits Coos County (including access and functional needs populations) shares responsibility for minimizing tsunami risks and vulnerabilities. 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 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.

1.5 Coordination with the Tsunami Hazard Overlay Zone (Article 4.11.260-270)

Coos County has adopted land use regulations addressing tsunami risk for certain types of new development and substantial improvements. These regulations are implemented through the Tsunami Hazard Overlay Zone, Article 4.11.260-270 of the Balance of County. Except single family dwellings on existing lots and parcels, all new development, substantial improvements and land divisions in the Tsunami Hazard Overlay Zone (everything within the XXL tsunami scenario) are required to incorporate evacuation measures and improvements which are consistent with and conform to this adopted Tsunami Evacuation Facilities Improvement Plan. For purposes of compliance with this TEFIP and the THOZ, applicants should review the entire plan, particularly the following sections as they relate to the proposed development and related evacuation improvements:

¹ Applied Technology Council. April 2012. FEMA Guidelines for Design of Structures for Vertical Evacuation from Tsunamis, Second Edition. Federal Emergency Management Agency, National Oceanic and Atmospheric Administration.

- **Section 3: Evacuation Facility Assessments and Recommendations** – this section is organized into four discrete geographic areas. Review the subsection applicable to the proposed project location for evacuation routes and identified improvement projects.
- **Section 4: Implementation Resources for Evacuation Projects** – this section describes resources related to different types of evacuation improvements. In particular, the *Oregon Tsunami Evacuation Wayfinding Guidance* (Version 05-13-2019) developed by the Oregon Office of Emergency Management and the Department of Geology and Mineral Industries should be reviewed for compliance with evacuation signage standards.
- **Section 5: Education, Outreach, and Training** – this section describes resources related to education, outreach, and training materials and activities for tsunami evacuation. If an applicant is proposing evacuation improvements related to this topic, this section should be consulted for consistency.
- **Appendices A-D as needed.**

2. 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 impacting 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 Cascadia Subduction Zone earthquake) and would result in a tsunami to come onshore within 15-20 minutes following the earthquake.
- **Distant Tsunami:** Generated by a distant earthquake (e.g. large event occurring off a distant coastline such as Japan or Alaska) and would result in a tsunami to come onshore 4 hours or more following an earthquake on another continent.

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 collapse. 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, embankments and roads. Shaking damage may result in fallen electrical lines, damaged gas lines, tank and pipeline failures and leaks, 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 unstable, damaged 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 an attempt to bypass typical infrastructure to save time. This may result in accidents and traffic jams that prevent individuals from reaching higher ground.

*****NOTE: Vehicle evacuation is NOT recommended following a local CSZ event!*****

2.2 Mapping

Mapping produced by the Oregon Department of Geology and Mineral Industries (DOGAMI) is the primary source of information for the identification of areas subject to tsunami inundation.

DOGAMI has produced a number of map products depicting tsunami inundation for the county,

including the Tsunami Inundation Maps (TIMs), Tsunami Evacuation Brochures, and more recently, the “Beat the Wave” (BTW) maps. These map products are referenced throughout this plan and identify areas within Coos County that are subject to potential life safety risk and that need to be evacuated during a local CSZ tsunami event.

2.2.1 Tsunami Inundation Maps

The TIM series depicts the projected tsunami inundation zone from five different magnitude seismic and tsunami events: small, medium, large, extra-large, or extra extra-large (S, M, L, XL, XXL). These different modeled events are associated with differing levels of risk in terms of the relative likelihood of tsunami inundation (Appendix A). These maps are referenced in Chapter IV Balance of County Zones, Overlays & Special Consideration Section 4.11.260 Tsunami Hazard Overlay Zone. The purple zones on these maps show the small and medium earthquake and tsunami events, while the three shades of yellow indicate the large through extra extra-large events.

See <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> and www.oregontsunami.org for more information.

2.2.3 Beat the Wave Maps

DOGAMI has also completed BTW tsunami evacuation modeling for the unincorporated areas of Charleston, Barview, and the North Spit, 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 B for examples of the Beat the Wave map products referenced in this plan. *The final report, once published, will be available on www.oregontsunami.org as an Open File Report.*

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 and thus in harm's way. 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.

Overall, the coastal unincorporated communities of Coos County have a low vulnerability to tsunami risk. There are few critical and essential facilities in the tsunami inundation zone and most areas within the zone have nearby access to high ground. However, there are access and functional

needs populations within the tsunami zones that are addressed in this plan, in order to better support their evacuation success.

2.3.1 Demographics

According to Portland State University's Population Research Center, 25,000 people live in unincorporated Coos County (which also includes non-coastal areas)². These areas are forecasted to stay around the same population or decrease over the next fifty years.

A report developed by the Department of Human Services (2017)³ compiled information on the characteristics and economic and health indicators of each county in Oregon. The following information was compiled for Coos County and may have relevance when considering tsunami evacuation improvements (NOTE: data is for the whole county):

- Poverty rate: 17.8% (statewide rate of 16.2%)
- Unemployment rate: 9.2% (statewide rate of 7.0%)
- Rate of homeownership: 56% (excludes renters)
- Persons with a self-reported disability: 22.9%
- Persons in poverty: 18.3%; Persons under age 18 in poverty: 25.2%
- Households with retirement income: 28.4%
- Households with social security income: 46.4%
- Major employment sectors: Trade, transportation, utilities, education, health, and government

In addition, the Charleston/Barview area is considered a poverty hotspot (geographic concentration of poor residents). The poverty rate for this area is 31% (encompassing approximately 2,654 people and 1,165 households). Approximately 25% of the population in Charleston and Barview has a disability.

2.3.2 Population Estimates

Tsunami evacuation is of greatest concern to populations residing or working within the inundation zone. The following table illustrates the estimated populations and facilities within the LARGE and XXL inundation zone⁴. While some of these numbers are based on the LARGE tsunami event, **everyone within the XXL tsunami hazard zone should evacuate after an earthquake for life safety purposes.**

² PSU Oregon Population Forecast Program. 2018. Preliminary Coordinated Forecasts for Coos County, its Urban Growth Boundaries (UGBs), and the Area Outside UGBs.

³ Office of Business Intelligence & the Office of Forecasting, Research, and Analysis (DHS/OHA). 2017. DHS County Quick Facts. URL: www.oregon.gov/DHS/ABOUTDHS/DataDocuments/County-QuickFacts-2017.pdf.

⁴ Wood, NJ, Jones, J, Spielman, S, and Schmidtlein, MC. 2015. Community clusters of tsunami vulnerability in the US Pacific Northwest. Proceedings of the National Academy of Sciences of the United States of America: 112 (17): 5354–5359.

Population or Asset	#'s in the L tsunami zone	#'s in XXL tsunami zone ⁵
Residents	1,605	3,385
Residents 65 and older	395	861
Employees	152	1,309
Employers	No data	116
Public Venues	3	No data
Dependent-Care Facilities	1	No data
Community Businesses	8	No data

Because population estimates are based on census data, only resident populations are reflected and not transient populations.

2.3.3 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. physical disabilities, 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.

2.3.4 Using Key Locations as a Proxy

Specific information about where or how many access and functional needs individuals would need assistance in an evacuation is not available; however, by identifying key locations that can be used as a proxy for access and functional needs, we can extrapolate where those individuals may be in a CSZ event. In the event of an update more information needs to be obtained regarding tourist facilities, childcare facilities, youth organizations and other meeting facilities that have the ability to high volumes of population to gather.

⁵ Gabel, LS, Bauer, JB, O'Brien, FE, Bauer, JM, and Allan, JC. 2019. OFR O-19-07, *Tsunami evacuation analysis of communities surrounding the Coos Bay Estuary: Building community resilience on the Oregon coast.*

2.3.5 Housing

According to the 2015 Oregon Natural Hazard Mitigation Plan⁶, 78.5% of the housing stock in Coos County was built pre-1990, before seismic building standards were put into place. This could have implications for sheltering needs after a Cascadia 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 community.

2.3.6 Community Sheltering

The following facilities are outside of the XXL tsunami inundation zone and may be used for community sheltering after a CSZ event:

Table 3: Potential Community Shelters

Several facilities were named during the process (Future Coos Head Conference Center, Coquille Tribes Maintenance Building and Former Charleston School Site but the capacity and other factors were not completed through this study and should be considered in an updated revision.

2.4 Conclusions

Tsunami vulnerability for Coos County is relatively low. The coastal areas of the county have: a) relatively low numbers of residents, employees, and customer-heavy businesses in the tsunami hazard zone; and b) those that occupy the zone will likely have enough time to reach high ground before the first tsunami wave (see Section 3 for more information). However, of those people that are in the tsunami hazard zone, there is a relatively high percentage of residents over 65 years old, persons in poverty, and persons with mobility challenges. Additionally, the coastal areas of Coos County experience high numbers of visitors and tourists, who are unfamiliar with the landscape and tsunami hazards. These groups may need additional assistance in evacuating effectively.

Additionally, successful evacuations are not guaranteed in these communities, because individuals still need to understand the threat, recognize signs of imminent waves, and take self-protective action. Education efforts that recognize demographic differences (e.g. age, living situation, and resident vs. tourist) may be the best course of action for these communities. Specifically, evacuation improvement efforts focused on communicating to and supporting visitors and populations over 65 years would be the most beneficial strategies for these communities.

⁶ State Interagency Hazard Mitigation Team. 2015. Oregon Natural Hazards Mitigation Plan.

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 evacuation routes and facilities to determine gaps. This was followed up by a review by the relevant experts from the communities to ensure all existing facilities had been accounted for.
- **Identification of needed improvements:** A meeting with community stakeholders served to assess gaps in existing facilities to determine locations requiring improvements. This meeting, informed by DOGAMI's Beat the Wave modeling results, led to an initial list of potential improvement projects that underwent comparison and scrutiny 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 following sections.

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 before an earthquake. The sections that follow highlight recommended evacuation improvement projects throughout the coastal areas of the County. 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

3.1 North Spit

3.1.1 Community Overview

For this plan, the North Spit is defined as the area from the northern edge of Horsfall Lake south to the southern-most tip of the spit at the north jetty of the Coos Bay estuary. It is bounded on the east by the Coos Bay estuary and on the west by the Pacific Ocean. The area consists mostly of open sand dunes, forested islands, wetlands, and a few developed areas. There are only a few access roads across the spit and the area is primarily used (and zoned) for recreation or industry.

Recreational Uses:

A significant portion of land on the North Spit is federally owned and managed (Bureau of Land Management and the Siuslaw National Forest) and open to recreational uses, including: hiking, horseback riding, sand driving, boating, and fishing. There are three campgrounds along Horsfall Beach Road (two public and one private), and a few Off-Highway Vehicle (OHV) staging areas and day-use parking lots.

Industrial Uses:

Several areas along the eastern shoreline of the North Spit are owned and managed by the International Port of Coos Bay and are utilized as industrial sites by private companies. Currently, there are about 170 employees on the North Spit, working at a few different industrial sites.

3.1.2 Existing Evacuation Facilities Analysis

Tsunami Wave Arrival Time

The first tsunami wave arrives at the western edge of the North Spit between 14 and 16 minutes. The wave crosses the North Spit fairly uniformly, coming across the spit as one wave. It gets to the eastern shore of the southern portion of the spit (near DB Western and Southport Lumber) between 20 and 24 minutes. Bluebill campground gets inundated by 20 to 24 minutes; Roseburg Forest Products is inundated by 24 to 26 minutes; and the eastern edge of the northern portion of the spit is completely inundated by 26 to 30 minutes.

See Appendix B for wave arrival time maps.

Existing Evacuations Routes

Main evacuation routes in the area have been determined for the following locations (see Appendix C):

- For the Horsfall Beach area, the main evacuation route is along Horsfall Beach Road east towards the high dunes near Horsfall Campground.
- The high dunes along the central portion of Trans Pacific Lane serve as the nearest high ground for the industrial sites along Coos Bay estuary and the southern portions of the spit.

Evacuation Speeds

For locations within the central and eastern portions of the North Spit, walking speeds range from a slow walk to a fast walk. Areas along the beach and western portion of the spit reach much higher pedestrian speeds (jog, run, and sprint) because of their distance from high ground. The southern

end of the spit is especially challenging to evacuate with walking speeds of sprint (7-10 mph) and unlikely to survive (>10 mph) near South Dike Lane, DB Western, and Southport Lumber. There is a high dune near DB Western that is safe in a LARGE (L) tsunami scenario but would be overtopped by XL and XXL.

Critical Facilities

The North Spit area is primarily used recreationally and for industry. There are four companies with operations on the spit currently, with potential for growth in the future. While there are no critical facilities on the spit, there are potentially hazardous materials housed within the industrial complexes that will likely be damaged by an earthquake and tsunami event. Additionally, there could be substantial large debris created from the lumber yard. There is one main bridge (via Trans Pacific Lane) east across Coos Bay estuary connecting to Highway 101 (which is also a bridge) that will likely fail or incur significant damage after the earthquake and tsunami, leaving those on the North Spit isolated from other communities.

Conclusions

The people working or recreating in this area could become very isolated in a local earthquake and tsunami event. Additionally, evacuation speeds are quite high in some areas, especially further south on the spit or out on the open sandy beach areas. There is limited high ground and evacuation success could be severely limited under current evacuation conditions. If people have access to their ATV's when evacuation is necessary, they will be able to use those vehicles to more quickly access high ground over potentially challenging terrain. However, anyone on foot will have a much more difficult time evacuating on loose sand. Current signage for tsunami evacuation on the North Spit is sparse. There are currently no designated assembly areas. There is also potential for growth in the industrial sector of the North Spit and so evacuation facilities should anticipate the potential for increased numbers of workers and tourists for this area. Vertical evacuation structures, increased signage and education, and emergency caches are recommended for evacuation facility improvements to this area.

**3.1.3 Evacuation Improvements Project Identification
WAYFINDING & EDUCATION**

Project Name	Priority	Potential Project Partners	Potential Funding Sources	Project Beneficiaries
Evacuation route markers from beach access	High	BLM, County Emergency Management, Campground Managers, Public Works, Road Department	NTHMP (OEM/DOGAMI), FEMA HMA, BLM	Visitors/tourists
Entering/Leaving Signs	High	BLM, County Emergency Management, Campground Managers, Public Works, Road Department	NTHMP (OEM/DOGAMI), FEMA HMA, BLM	Visitors/tourists
Evacuation Training for	High	Industrial facilities, Port of Coos Bay, County	NTHMP, County Emergency	Employers and employees of

Employees		Emergency Management	Management, Industrial Facilities	industrial sites
Informational Kiosks	High	BLM, US Forest Service, Oregon State Parks, County Emergency Management, Campground Managers	NTHMP (OEM/DOGAMI), FEMA HMA, BLM	Visitors/tourists

Problem Statement: Limited existing signage and educational materials may present difficulty to residents and visitors in evacuating from the inundation zone.

Project Descriptions:

- 1. Evacuation route markers along major tsunami evacuation routes starting from beach access points:** Individuals on the beach and other recreational sites on North Spit are challenged to get to high ground during a tsunami event, due to difficult terrain (loose sand) and unclear evacuation routes. There are existing numbered beach access point signs (large neon yellow signs) that could be tied into the tsunami evacuation system. From major beach access points on the North Spit, mark every quarter mile along major evacuation routes to lead people to high ground (safety destination). Major evacuation routes are Horsfall Beach Road and Trans Pacific Lane. Route markers could be small, blue, reflective signs (similar to hiking trail markers) leading the way to high ground. Once trail markers are installed, their description should be tied into the informational kiosks described above and other education efforts so that visitors know what the markings mean and what to do in an earthquake and tsunami event. Evacuation communities (Appendix C) show the flow of people on existing roads to high ground (safety destinations). This concept should be followed when installing tsunami evacuation route markers.
- 2. Entering/leaving tsunami zone signs at high ground intersections along major evacuation routes:** Signs indicating the extent of the XXL tsunami inundation zone should be placed at high dune areas along Horsfall Beach Road and Trans Pacific Lane. See Appendix C (Beat the Wave maps) for locations of the intersection of tsunami zones and high ground (green dots). Entering signs should be placed on the side of the road where travel is moving into the tsunami zone. Leaving signs should be placed on the side of the road where travel is moving out of the tsunami zone. These signs help both to educate people of these zones before an event and to let them know when they've reached safety during an evacuation event.
- 3. Evacuation training for all workers located on the North Spit:** Provide all employers and employees located on the North Spit with tsunami evacuation education and training to ensure everyone knows when and how to evacuate in the event of a local CSZ tsunami event. The County Emergency Management Division does presentations about preparing for a Cascadia subduction zone earthquake and tsunami to various audiences around the County regularly and should be able to provide this training for North Spit employees.
- 4. Information kiosks at every major parking lot and campground entrance on the North Spit:** Create a centralized tsunami information platform for visitors. Develop informational kiosks at the following populated locations:

- a. Parking lots at Horsfall Beach
- b. Old Bark Road OHV Staging Area
- c. Campgrounds: Bluebill, Horsfall, and Box Car Hill

Kiosk messaging should focus on tsunami education and evacuation for visitors and ATV riders. Include information that says “you are x number of minutes from high ground” and maps the route visitors should follow in the event of needed evacuation. Work with the property owner or manager of each site on the best design for a kiosk or to integrate with existing educational information.

CONSTRUCTION

Project Name	Priority	Potential Project Partners	Potential Funding Sources	Project Beneficiaries
Vertical Evacuation Structures for (2) Industrial Sites	Medium	Industrial Facilities, Port Of Coos Bay, County Emergency Management	FEMA HMA, Municipal Financing	Industry Employees, Visitors
Long Term Emergency Cache	High	Industrial Facilities, Port Of Coos Bay, County Emergency Management, Local Food Banks	FEMA HMA, Municipal Financing, Port of Coos Bay, Private Financing	Industry Employees, Visitors

Problem Statement: Two industrial sites on the North Spit are currently very far from high ground, presenting the potential for unsuccessful evacuation prior to the tsunami’s arrival.

Project Descriptions:

1. **Vertical evacuation structure and emergency caches to serve DB Western and southern portion of North Spit:** Because of the high evacuation clearance times required for employees and visitors of the southern end of the North Spit to evacuate in a local tsunami event, a vertical evacuation structure constructed near DB Western would greatly enhance the evacuation success of this area (Appendix C). There is a high dune to the west of DB Western where such a structure could be constructed, since that dune is already of sufficient height to place people above the LARGE tsunami event. A vertical evacuation structure built here would be designed to place evacuees above the XXL tsunami event and would be potentially less intensive to build because of the advantage of the height of the high dune. No other tsunami evacuation improvements have been identified that could improve evacuation success for these communities. A trail or road to access the structure would also have to be designed and built as part of this project. Lastly, the vertical evacuation structure should contain an emergency cache as part of the overall project and design to aid the evacuees once they’ve reached safety.
2. **Vertical evacuation structure and emergency caches to serve Southport Lumber and surrounding area:** Because of the high evacuation clearance times required for employees and visitors of the southern end of the North Spit to evacuate in a local tsunami event, a vertical evacuation structure constructed near Southport Lumber would greatly enhance the evacuation success of this area (Appendix C). A vertical evacuation structure built here would be designed to place evacuees above the XXL tsunami event. No other tsunami evacuation improvements

have been identified that could improve evacuation success for these communities. A trail or road to access the structure would also have to be designed and built as part of this project. Lastly, the vertical evacuation structure should contain an emergency cache as part of the overall project and design to aid the evacuees once they've reached safety.

Considerations: A vertical evacuation refuge from tsunamis 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 effects of tsunami waves. Vertical evacuation refuges can be stand-alone or part of a larger facility. They can be single-purpose refuge-only facilities, or multi-purpose facilities in regular use when not serving as a refuge. In concept, these options are applicable to new or existing structures, but it is generally more difficult to retrofit an existing structure than to build a new tsunami-resistant structure⁷. Loading and other criteria for the design of vertical evacuation structures are provided in Section 4.

NOTE: While building one vertical evacuation refuge would be more efficient and cost-effective than having to build two (one for each industrial facility), the stretch of landscape between Southport Lumber and DB Western is long, low in elevation, and of loose sandy material. A midway point would likely cost too much in terms of engineering and construction compared to locating such structures elsewhere (e.g. closer to one or the other industrial site). A more detailed geotechnical investigation would be required to make an ideal location determination for such a structure.

3. **Long term cache near Roseburg Forest Products:** A community cache would contain supplies to assist the population on the North Spit in surviving immediately after a CSZ tsunami event because this community is likely to be isolated from other communities in Coos County (due to bridge failures and geography). This emergency supply cache would be located in the high dunes near the industrial sites of Roseburg Forest Products and others, and provide shelter and supplies to anyone isolated on the North Spit for at least two weeks (Appendix C).
Considerations: Emergency caches are complex stores of emergency supplies. A community must think about: where to locate the cache; how many people it should serve and for how long; who are the potential users; what and how much of: food, water, shelter, first aid, sanitation, communication, mental health support; access to (and security of) the cache; incident command procedures; camp layout; ownership of the supplies; and a maintenance plan.

⁷ Applied Technology Council. April 2012. FEMA Guidelines for Design of Structures for Vertical Evacuation from Tsunamis, Second Edition.

3.2 Barview

3.2.1 Community Overview

For this plan, Barview is defined as the area from Wisconsin Ave (border of Coos Bay City Limits) south to Giddings Boat Works and the bridge over South Slough. It is bounded on the west by the Coos Bay estuary. The area consists mostly of residential and small commercial development. While much of the residential areas are within the XXL tsunami inundation zone, high ground is immediately nearby as described below.

3.2.2 Existing Evacuation Facilities Analysis

Tsunami Wave Arrival Time

The first wave reaches the southern end of Barview in about 18 minutes. It reaches Cape Arago Highway in about 20 minutes and reaches the extent of inundation by about 26 minutes (up to 30 minutes in the Joe Ney Slough area).

See Appendix B for wave arrival time maps.

Existing Evacuations Routes & Speeds

Most evacuation routes in the area are west to east on existing streets. Evacuation speeds for the community range between a slow walk (0-1.4 mph) and fast walk (2.7-4.1 mph). See Appendix C for Beat the Wave pedestrian speed maps and evacuation communities.

Considerations: There are two reservoirs (4th Creek and Tarheel) in the tsunami inundation area and the reservoir dams may be prone to failure during an earthquake. Dam failure is unlikely to have negative impacts on evacuation success because those areas can be avoided by going on eastbound streets to the south or north of the respective dam. Also, the bridges over South Slough and Joe Ney Slough have not been earthquake retrofitted and will likely fail during an earthquake. The inability to use the bridges as an evacuation route does not impact evacuation speeds for the community in Barview because there is high ground on both sides of the bridges. However, the bridges are important for community connectivity (movement of people and supplies) post-event.

Critical Facilities

The majority of the structures in the tsunami inundation zone consist of residential development or small businesses, as well as some of the Coquille Indian Tribe reservation lands. Charleston Fire District does have one fire station in the Barview tsunami inundation zone. The Coquille Indian Tribal Police Department and the Charleston wastewater treatment facility are also in the inundation zone. No other critical or essential facilities are in the inundation zone.

Future development: A 200-lot RV park is under development in Barview, in the inundation zone. This area may be challenging to evacuate due to its proximity to the river; however, high ground is nearby (to the east) and accessible by foot.

Conclusions

While much of this community is within the XXL tsunami inundation zone, no evacuation routes identified through BTW prevent evacuation clearance, assuming a slow or fast walking speed.

However, additional demographic data indicates that a high percentage of this population is older and mobility-limited, which may make successful evacuation more challenging, especially if road conditions post-earthquake are not accessible to wheelchairs or other walking aid devices (e.g. scooters). Additionally, routes are not currently marked or lit for escape during the night or in poor weather conditions. Current signage for tsunami evacuation in Barview is sparse. There is one Assembly Area at the Baseball Field off Libby Lane. Adding additional assembly areas and signage is suggested.

3.2.3 Evacuation Improvements Project Identification

WAYFINDING & EDUCATION

Project Name	Priority	Potential Project Partners	Potential Funding Sources	Project Beneficiaries
Directional Evacuation Highway Signs	High	Oregon Department Of Transportation, County Roads Department, Public Works	NTHMP (OEM/DOGAMI), FEMA HMA	Residents and Visitors
Entering/Leaving Signs	High	Oregon Department Of Transportation, County Roads Department, Public Works	NTHMP (OEM/DOGAMI), FEMA HMA	Residents and Visitors
Assembly Area Designations	Medium	School Districts, Private Landowners, Coquille Indian Tribe, Confederated Tribes Of Coos, Lower Umpqua, And Siuslaw	County (in-kind)	Residents
Outreach with Schools	High	School districts, County Emergency Management	School Districts, County Emergency Management (In-Kind), OEM	Residents
Community-wide Evacuation Drills	High	School Districts, County Emergency Management, Police And Fire Districts, Public Health Organizations, CERT Or Other Emergency Response Volunteer Groups	County (in-kind)	Residents
Flood Insurance Outreach	Medium	County Emergency Management, DLCD, FEMA, insurance agents	FEMA HMA, OEM, DLCD grants	Residents

Problem Statement: Limited existing signage may present difficulty to residents and visitors in evacuating from the inundation zone.

Project Descriptions:

- 1. Directional evacuation highway signs off Cape Arago Highway towards high ground:**

Tsunami evacuation signs with a directional arrow should be placed along Cape Arago Highway in Barview at the intersections of east/west streets that continue to high ground. In Barview, much of the residential community is in the tsunami zone, but most of the east/west streets continue to high ground, making evacuation fairly straightforward. Signage will help to reinforce this evacuation flow to residents on a daily basis, as well as act as a wayfinding aid during tsunami evacuation. Evacuation communities (see Appendix C) show the flow of people on existing roads to high ground (safety destinations). This concept should be followed when installing new road signs.
- 2. Entering/leaving tsunami zone signs at high ground intersections along major evacuation routes:** Signs indicating the extent of the XXL tsunami inundation zone should be placed along major evacuation routes in Barview. See maps in Appendix C for locations of the intersection of tsunami zones and high ground (green dots). Entering signs should be placed on the side of the road where travel is moving into the tsunami zone. Leaving signs should be placed on the side of the road where travel is moving out of the tsunami zone. These signs help both to educate people before an event and to let them know when they've reached safety during an evacuation event. Blue lines could be used in addition to or instead of signs, but must be easily visible and include public outreach and education about what they mean. OEM has more information about tsunami blue lines.
- 3. Additional assembly area designations:** An assembly point is a location that has been designated by local authorities for residents and visitors to gather AFTER safely reaching their nearest high ground outside the tsunami zone. A person's nearest safety destination (high ground) may not be at an assembly area. Assembly areas are temporary meeting points to meet-up with others during the immediate aftermath of a disaster (12-24 hours later). Currently, there is one assembly area designated at the baseball field off Libby Lane. Additional assembly areas would allow residents to more readily access an area nearby. Identify appropriate sites for a temporary assembly area based on property ownership and accessibility.
- 4. Outreach with area schools:** While no schools are in the tsunami zone, students may live in a tsunami zone. Outreach should be done at all the nearby schools to talk about tsunami hazards, evacuation routes, and the role of schools after a disaster (as assembly areas or long-term shelter facilities).
- 5. Conduct community-wide evacuation drills:** It is important for residents who live in or near tsunami hazard zones to practice evacuating to high ground regularly so they are prepared for an actual evacuation event. The Oregon Office for Emergency Management (OEM) published a "[Tsunami Evacuation Drill Guidebook](#)" as a reference for planning community-wide tsunami evacuation drills, which can serve as a starting point for staging such drills in both Barview and Charleston, and any residential area in Coos County that is within the tsunami hazard zone. A neighborhood-by-neighborhood effort to instigate and carry-out evacuation drills might also be an effective tactic, where a smaller geographic area is targeted and works together to think about evacuation and post-event recovery. CERT (Community Emergency Response Teams) might be a good resource to tap for this kind of event.

6. **Flood insurance outreach for tsunami damage protection:** The National Flood Insurance Program (NFIP) flood insurance covers losses due to flooding, including after a tsunami. Conduct outreach efforts with property owners to encourage the purchase of flood insurance for properties within the tsunami hazard area (but outside of the special flood hazard area outlined in NFIP Flood Insurance Rate Maps). This insurance is offered at a much discounted rate compared to mandatory flood insurance and covers losses from tsunami damage. Contact FEMA NFIP staff for further information. This type of outreach can be done in every residential community in a tsunami hazard area.

CONSTRUCTION

Project Name	Priority	Potential Project Partners	Potential Funding Sources	Project Beneficiaries
Elevated Scooter Trail	High	County Emergency Management, Oregon Department Of Transportation, County Roads Department, Public Works	FEMA HMA, Municipal Financing, Port of Coos Bay, Private Financing	Industry Employees, Visitors
Supply Caches	Medium	County Emergency Management, School Districts, Local Food Banks	FEMA HMA, Municipal Financing, Private financing	Residents, Visitors

Problem Statement: A high percentage of residents in Barview are mobility-challenged and may have difficulty evacuating in a local tsunami event. Additionally, because of the high numbers of homes in the XXL tsunami scenario, many residents will be displaced after a tsunami event and will need supplies and shelter.

Project Descriptions:

1. **Elevated scooter trail (or similar improvement):** Although evacuation speeds for the Barview area range between a slow and fast walk, mobility is an issue for about a quarter of the population living there. Residents may need a centralized infrastructure improvement to withstand earthquake shaking and allow for scooter/wheelchair passage to high ground. This would be a major engineering project and require considerable capital investment. An engineering geologic report would have to be completed to locate the best road to build this improvement on or near, and an engineer to design a concept that might meet the need.
2. **Supply caches for Barview residents and visitors:** A community cache would contain supplies to assist the population in Barview in surviving immediately after a CSZ tsunami event. This community may initially be somewhat isolated from other communities in Coos County (due to transportation network failures). These emergency supply caches would be located in the eastern part of the community above the XXL tsunami zone, at designated areas. Two locations are suggested: at the baseball field off Libby Lane and at the end of Spaw Lane.

Considerations: Emergency caches are complex stores of emergency supplies. A community must think about: where to locate the cache; how many people should it serve and for how long;

who are the potential users; what and how much of: food, water, shelter, first aid, sanitation, communication, mental health support; access to (and security of) the cache; incident command procedures; camp layout; ownership of the supplies; and a maintenance plan (rotation of supplies). It might be beneficial to coordinate with local food banks who could benefit from supplies when they need to be rotated, so nothing goes to waste. Additionally, when siting caches, public property would provide be the most ideal location, especially at an existing office building or heavily used area, so that the supplies could be monitored more easily by the relevant local, state, or federal authorities.

3.3 Charleston

3.3.1 Community Overview

For this plan, Charleston is defined as the area from the mouth of the Coos Bay estuary to Roosevelt Road. It is bounded on the east by the Coos Bay estuary. The area consists of the Oregon Institute for Marine Biology campus, the Charleston Marine Life Center, the Charleston Marina complex, US Coast Guard facilities, and several other small businesses and restaurants. While much of this community is within the XXL tsunami inundation zone, high ground is immediately nearby as described below.

3.3.2 Existing Evacuation Facilities Analysis

Tsunami Wave Arrival Time

The first wave reaches the northern part of Charleston in 16 to 18 minutes and reaches the Oregon Institute for Marine Biology campus by about 20 minutes. The extent of inundation of the first tsunami wave occurs by 24 to 26 minutes.

Existing Evacuations Routes and Speeds

Coos Head Loop is the main evacuation route for the northern part of the community and Cape Arago Highway is the main route for the southern part of the community (Kingfisher Road is the approximate split between evacuation communities). Coos Head Loop is a steep road; however, landslide risk appears to be low in this area. Evacuation speeds for this community range between a slow walk (0-1.4 mph) and fast walk (2.7-4.1 mph). See Appendix C for pedestrian evacuation speeds and evacuation communities.

Critical Facilities

Charleston Fire District has a fire station in the inundation zone (although it only houses equipment, no personnel). The Oregon Institute for Marine Biology campus, the Charleston Marina complex, and the Coast Guard Station are also in the inundation zone. The remaining structures are generally small businesses and light industrial facilities (including a boat fueling facility). The bridge over South Slough has not been earthquake retrofitted and will likely fail during an earthquake. The inability to use the bridge as an evacuation route does not impact evacuation speeds for the community in Charleston, but will impact community connectivity post-event.

Conclusions

While much of this community is within the XXL tsunami inundation zone, no evacuation routes identified through the BTW analysis prevent evacuation clearance, assuming a slow or fast walking speed. However, there is a high percentage of tourists and visitors in this area during certain times of the year, who may not be familiar with the tsunami hazard and evacuation routes. Also, routes are not currently well marked or lit for escape during the night or in poor weather conditions. Evacuation improvements targeted to tourist groups are recommended. Current signage for tsunami evacuation in Charleston is sparse. There are two designated Assembly Areas at Seven Devils Rd and Cape Arago Highway. Adding additional assembly areas (such as at the former Charleston school site) and evacuation signage may be warranted.

3.2.3 Evacuation Improvements Project Identification

WAYFINDING & EDUCATION

Project Name	Priority	Potential Project Partners	Potential Funding Sources	Project Beneficiaries
Directional Evacuation Route Signs	High	Oregon Department Of Transportation, County Roads Department, Public Works	NTHMP (OEM/DOGAMI), FEMA HMA	Residents and Visitors
Entering/Leaving Signs	High	Oregon Department Of Transportation, County Roads Department, Public Works	NTHMP (OEM/DOGAMI), FEMA HMA	Residents and Visitors
Visitor Education	Medium	School Districts, Private Landowners, Coquille Indian Tribe, Confederated Tribes Of Coos, Lower Umpqua, And Siuslaw	County (in-kind)	Residents
Community Outreach 5K	Medium	School districts, County Emergency Management	School Districts, County Emergency Management (In-Kind), OEM	Residents

Problem Statement: Limited existing signage may present difficulty to residents and visitors in evacuating from the inundation zone.

Project Descriptions:

- 1. Directional evacuation highway signs off Cape Arago Highway and Boat Basin Road, towards high ground:** There are two major evacuation routes in Charleston: 1) Cape Arago Highway towards Seven Devils Road, and 2) Coos Head Loop. Tsunami evacuation signs with a directional arrow should be placed along Boat Basin Road and Cape Arago Highway, pointing in the direction of these two main evacuation routes. Increased signage in this area will help to reinforce the evacuation flow to residents, visitors, and businesses on a daily basis, as well as act as a wayfinding aid during tsunami evacuation. Evacuation communities (Appendix C) show the flow of people on existing roads to high ground (safety destinations). This concept should be followed when installing new road signs.
- 2. Entering/leaving tsunami zone signs at high ground intersections along major evacuation routes:** Signs indicating the extent of the XXL tsunami inundation zone should be placed along the two major evacuation routes in Charleston. See Figure 17 for locations of the intersection of tsunami zones and high ground (green dots). Entering signs should be placed on the side of the road where travel is moving into the tsunami zone. Leaving signs should be placed on the side of the road where travel is moving out of the tsunami zone. These signs help

both to educate people of these zones on a daily basis and to let them know when they've reached safety during an evacuation event. Blue lines could be used in addition to or instead of signs, but must be easily visible and include public outreach and education about what they mean. OEM has more information and guidance about tsunami blue lines.

3. **Visitor Education:** Provide educational and evacuation information at the Charleston Marine Life Center and Charleston Welcome Center. This could include evacuation brochures and route maps, background information on the CSZ earthquake and tsunami hazard, and tips for becoming prepared (as a resident or as a visitor). Some of this information could be developed as an interpretive sign or informational kiosk, as well as to be handed out to visitors as brochures.
4. **Community Outreach Event – “Race the Wave 5k”:** Similar to what has been done in Cannon Beach, the community could host a run/walk event that has participants race a tsunami evacuation route as a fun awareness event. An emergency preparedness fair could be incorporated at the event finish to answer questions and give tips on personal preparedness to participants in a fun learning environment. *See maps in Appendix C for potential race routes.*

CONSTRUCTION

Project Name	Priority	Potential Project Partners	Potential Funding Sources	Project Beneficiaries
Bridge Retrofit Over South Slough	Low	ODOT, County Public Works, Confederated Tribes Of The Coos, Lower Umpqua, And Siuslaw	FEMA HMA, Municipal Financing, ODOT, Federal Highway	Residents, Employees, Visitors
Pedestrian Bridge Construction	Low	ODOT, County Public Works, Confederated Tribes Of The Coos, Lower Umpqua, And Siuslaw	FEMA HMA, Municipal Financing, ODOT, Federal Highway	Residents, Employees, Visitors
Trail Improvements for Coos Head	Medium	County Public Works, Confederated Tribes Of The Coos, Lower Umpqua, And Siuslaw, Oregon State Parks	ODOT, Recreational Trail Grants	Residents, Employees, Visitors

Problem Statement: The highway bridge over South Slough is not earthquake or tsunami retrofitted and will likely fail in a CSZ event. While this bridge is not necessary for pedestrian evacuation according to the Beat the Wave analysis, it does serve an important purpose to the community for connectivity post-event.

Project Descriptions:

1. **Bridge retrofit of Cape Arago Highway Bridge over South Slough:** If this bridge needs improvements in the future, it may be beneficial to incorporate earthquake and tsunami retrofits into the bridge at that time. For example, it would be good to include the estimated wave height of tsunami waves at that location in order to ensure the bridge is high enough to survive the tsunami and be functional after a CSZ event. This project would be a major undertaking.

2. **Pedestrian/recreational bridge across South Slough:** Retrofitting a vehicle bridge may be too costly, but constructing a new pedestrian or multi-use pathway bridge may be more feasible and provide additional community benefits. Such a pathway could be developed alongside the existing bridge and be used as a walking/cycling pathway on a day-to-day basis to relieve congestion and provide safety for bikers and pedestrians. It can be incorporated into the County's Transportation System Plan and ongoing traffic planning for the Coos Head area. Construction of this type of bridge should incorporate both earthquake and tsunami design principles to be able to withstand both events. Additionally, the bridge would need to accommodate maritime traffic entering and leaving the slough (e.g. a draw bridge).
3. **Trail improvements along Coos Head Loop:** There is an existing pedestrian trail off Coos Head Loop. This trail could be improved for tsunami evacuation purposes. This could include adding lighting, signage, trail hardening, and vegetation maintenance. This pathway would serve to provide additional evacuation access from the Charleston area to high ground. Additionally, it could provide added community benefits by providing a recreational hiking trail and scenic overlook on a daily basis.

3.4 Outer Coast (South of Coos Bay Estuary)

3.3.1 Community Overview

For this plan, the Outer Coast is defined as the area from the south jetty of the Coos Bay estuary to Shore Acres State Park and includes Bastendorff Beach and Sunset Bay State Park and Campground. Cape Arago State Park was also included in the BTW modeling for this area, but is outside of the tsunami inundation zone so was left out of this analysis for evacuation purposes. This area includes two state parks, one county park, a campground, a golf course, an RV resort, and a few residential areas.

3.3.2 Existing Evacuation Facilities Analysis

Tsunami Wave Arrival Time

The first wave reaches the beaches here around 16 minutes. This whole outer coast area gets completely inundated quickly – in 18 to 20 minutes. The extent of inundation (to areas southwest of Cape Arago Highway) occurs by 22 to 24 minutes.

Existing Evacuations Routes and Speeds

The evacuation routes for this area vary. There are no critical or essential facilities in the inundation zone here. Evacuation speeds for these predominantly beach areas range between a slow walk (0-1.4 mph; near developed areas) to a sprint (6.8-10 mph; out on beaches) and even to “unlikely to survive” categories (>10 mph; in isolated areas). See Appendix C for pedestrian evacuation speeds and evacuation communities.

Challenging areas to evacuate include the beach at the south jetty; Bastendorff beach; the beach between Yoakam Point and Gregory Point; and some areas near Sunset Bay and Sunset Bay campground.

Critical Facilities

There are no critical facilities in this area.

Conclusions

Areas out on the beach and away from existing development or facilities will be hard to evacuate on foot and may prevent evacuation clearance. New or improved pedestrian evacuation trails may help some of these more remote areas evacuate more easily. Additionally, evacuation signs and route markers would help direct pedestrians in the right direction, as evacuation routes may not be intuitive and this area experiences high volumes of visitors. Current signage for tsunami evacuation along the Outer Coast is inadequate. There are no designated assembly areas. Adding assembly areas and signs is suggested.

3.2.3 Evacuation Improvements Project Identification

WAYFINDING & EDUCATION

Project Name	Priority	Potential Project Partners	Potential Funding Sources	Project Beneficiaries

Directional Evacuation Route Signs	High	County Emergency Management, Oregon Department Of Transportation, County Roads Department, Public Works, Oregon State Parks	NTHMP (OEM/DOGAMI), FEMA HMA, Recreational Funds	Tourists/Visitors
Entering/Leaving Signs	High	County Emergency Management, Oregon Department Of Transportation, County Roads Department, Public Works, Oregon State Parks	NTHMP (OEM/DOGAMI), FEMA HMA, Recreational Funds	Tourists/Visitors
Visitor Education	Medium	Chamber of Commerce, Travel Oregon (Oregon Coast Visitor's Association), Oregon Sea Grant, Oregon State Parks, Coos County Parks	Oregon State Parks, Coos County Parks, FEMA HMA	Tourists/Visitors

Problem Statement: Limited existing signage may present difficulty to residents and visitors in evacuating from the inundation zone.

Project Descriptions:

- 1. Directional evacuation highway signs off Cape Arago Highway, towards high ground:** Tsunami evacuation signs with a directional arrow should be placed along Cape Arago Highway at intersections with major evacuation routes that continue to high ground. For areas south of the Coos Bay estuary south jetty, these intersections include: Ocean View Road, Coos Head Loop, Bastendorff Beach Road, Cottell Lane, and an unnamed road to a wastewater treatment facility off Cape Arago Highway. Signage will help to reinforce what roads go to high ground to residents, tourists, and visitors on a daily basis, as well as act as a wayfinding aid during tsunami evacuation. (NOTE: "You are Here" tsunami evacuation signs already exist at the main beach access points at Bastendorff Beach.)
- 2. Entering/leaving tsunami zone signs at high ground intersections along major evacuation routes:** Signs indicating the extent of the XXL tsunami inundation zone should be placed along the major evacuation routes off Cape Arago Highway as noted above. See maps in Appendix C for locations of the intersection of tsunami zones and high ground (green dots). Entering signs should be placed on the side of the road where travel is moving into the tsunami zone. Leaving signs should be placed on the side of the road where travel is moving out of the tsunami zone. These signs help both to educate people of these zones on a daily basis and to let them know when they've reached safety during an evacuation event. Blue lines could be used in addition to or instead of signs, but must be easily visible and include public outreach and education about what they mean. OEM has more information about tsunami blue lines.
- 3. Visitor Education:** Provide educational and evacuation information at every state and county park in this area: Bastendorff Beach, Sunset Bay State Park, Shore Acres State Park, and Cape

Arago State Park. This could include evacuation brochures and route maps, background information on the CSZ earthquake and tsunami hazard, and tips for becoming prepared (as a resident or as a visitor). Some of this information could be developed as an interpretive sign or informational kiosk, as well as to be handed out to visitors as brochures. Interpretive walks along tsunami evacuation routes could be integrated in ongoing park educational activities.

CONSTRUCTION

Project Name	Priority	Potential Project Partners	Potential Funding Sources	Project Beneficiaries
Pedestrian Trail Improvements	Medium	County Public Works, Confederated Tribes Of The Coos, Lower Umpqua, And Siuslaw, Oregon State Parks	ODOT, Recreational Trail Grants	Residents, Employees, Visitors

Problem Statement: Evacuation from the beach is very difficult in this area.

Project Descriptions:

1. **Pedestrian trail improvements:** Evacuation on the beach areas between Bastendorff Beach and Cape Arago Lighthouse is difficult. Adding additional pedestrian evacuation trails off Cape Arago Highway in key places could significantly help decrease pedestrian walking speeds for these areas (Appendix C.8). While locations have been suggested, an investigation into land ownership and easements would have to be conducted, as well as an engineering geologic review of sites to find the best locations to put new pedestrian trails. Additionally, the existing trail located behind Sunset Bay Campground could be more clearly signed and hardened as an official tsunami evacuation route.

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:
 - PUARL (Portland Urban Architecture Research Lab). 2014. "Up and Out" Oregon Tsunami Wayfinding Research Project: Final Project Report and Guidance Document.
 - PUARL (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.
 - OEM & DOGAMI. Version 05-13-2019. Oregon Tsunami Evacuation Wayfinding Guidance.
- Vertical evacuation structures:
 - Applied Technology Council. April 2012. FEMA Guidelines for Design of Structures for Vertical Evacuation from Tsunamis, Second Edition. Federal Emergency Management Agency, National Oceanic and Atmospheric Administration.
 - 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. June 2009. Vertical Evacuation from Tsunamis: A Guide for Community Officials. Federal Emergency Management Agency, National Oceanic and Atmospheric Administration.

4.2 Tsunami Evacuation Wayfinding Signage

Any proposed tsunami evacuation wayfinding signage proposed for the unincorporated coastal areas of Coos County should conform to the publication: OEM & DOGAMI. Version 05-13-2019. *Oregon Tsunami Evacuation Wayfinding Guidance*.

A tsunami evacuation 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:

- 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 summer season, 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. The wayfinding system should include techniques to find safe ground in a limited period of time, potentially at night or in 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 of sign
- Signage technology applied
- Position in space, method of fixing
- Size in relation to reading distance
- Illumination
- Requirements for impaired users
- Level of vandal resistance

4.3 Financing Strategies

Cost estimates have not been developed for the tsunami evacuation improvement projects identified in this plan. Resources to help develop facility improvement cost estimates can be found at the following:

- 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 (AASHTO) – 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>)
- See **Appendix C** for municipal financing mechanisms, state and federal funding programs, and other grant and financing mechanisms to consider.

4.3.1 Questions to Ask

In identifying projects to move forward with, it's 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?

The following tools are mostly likely to succeed for enhancing a community's evacuation route system⁸:

- Using existing right-of-ways,
- Negotiating/purchasing easements, and
- Purchasing new right-of-ways.

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.

⁸ DLCD. 2018. Tsunami Land Use Guide, Chapter 5, Tip. URL: https://www.oregon.gov/LCD/OCMP/docs/Publications/TsunamiLandUseGuide_FINAL_062718.pdf

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 local newspapers and radio stations to announce tsunami awareness events and provide community education information and resources. Local service providers include:
 - All local TV stations (KEZI, KCBY, KDCQ and any other stations available)
 - All Newspapers (The World newspaper, Bandon Western World newspaper, Coquille Valley Sentinel Newspaper, Myrtle Point Herald Newspaper and any other Newspaper that is available in the area)
 - All local radio Stations (KOOZ, K-Light-K-Dock, KYTT-FM, KSHR, BICOASTAL MEDIA and any other stations available in area).

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

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 (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.

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

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 County websites in a prominent location, and use the websites to announce tsunami-related community activities. Consider linking to relevant webpages from DOGAMI, DLCD, NOAA, etc., rather than recreating the information.
- Develop working relationships with local businesses and organizations to include a link back to the County's tsunami information to increase the website's reach.

5.2 Community Activities

Community activities are a vital part of public education and outreach. Below are some examples of community activities held by other coastal communities.

Recommended Action

- 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

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.

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 the County and given brochures to hand out to residents.
- Conduct a community-wide tsunami evacuation drill.

Resources

- The Oregon Office for Emergency Management's Tsunami Evacuation Drill Guidebook: [https://www.oregon.gov/oem/Documents/Tsunami Evacuation Drill Guidebook.pdf](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 provide an opportunity to build awareness of tsunami routes. Participants in the annual 5K and 10K Race the Wave fun run/walk/roll start on the beach, follow a scenic tsunami evacuation route through the County, and reach the finish-line out of the tsunami inundation zone. A preparedness fair is held near the finish-line for all participants and includes 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 6.2.3 for additional information on Preparedness Fairs.

Resources

- An example press release for the Cannon Beach event: <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](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.

Recommended Action

- Set up a booth about tsunami preparedness at local community events such as:

- Coos County Fair
- Local Festivals (Such as: Gay 90's, Harvest Festivals, Gorse Blossom Festival, Cranberry Festival, Blackberry Festival, Seafood Festival and Fun Festival)
- Home & Gardening Shows

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.

Recommended Action

- Invite the Oregon Sea Grants Quest Coordinator to hold a workshop.
- 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/sgps/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.

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>

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 Businesses

5.4.1 Business Workshops

Businesses in the hazard zones may be owned, staffed, or frequented by customers who, like visitors, live elsewhere 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.

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](http://tsunami.org/1about/pdfs/how%20to%20prepare%20your%20business%20for%20the%20next%20tsunami.pdf)

5.4.2 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

- 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>

5.5 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.

5.5.1 Education Materials

The brochures and other hand-outs 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)

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>

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.

5.5.2 Hotels, Motels, and Bed and Breakfasts

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

Recommended Action

- Provide tsunami evacuation literature to local hospitality businesses. Request that they be permanently displayed in the lobby or 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

5.6 Access and Functional Needs

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.

5.6.1 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 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>

5.6.2 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>

5.6.3 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 into community events and websites in their native language.

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>
- <https://www.hhs.gov/civil-rights/for-individuals/special-topics/emergency-preparedness/limited-english-proficiency/index.html>

5.6.4 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 (ground shaking) and the necessity of evacuating immediately after the ground stop 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

5.7 Training and Exercises

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

Recommended Action

- Conduct yearly exercises with County 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.

5.8 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>.

5.9 Current Education & Outreach Efforts

Below is a short summary of current activities related to tsunami evacuation and preparedness happening in Coos County.

Port of Coos Bay – gives informational brochures to all boaters who come into the office. Does training with all their staff about tsunami hazards and evacuation routes. Has an emergency operations plan and updates/practices this regularly.

County Emergency Manager – gives outreach presentations about personal preparedness to any group that requests a presentation. This usually results in approximately 20 public events per year. The Emergency Manager is available to give presentations to schools groups, campgrounds, employees and businesses, and preparation fairs.

SECTION 3.9.500 EROSION

1.1 Critical Streambank Erosion

Streambank erosion (other than by flash flooding) occurs constantly on all rivers and streams in the Coos and Coquille drainage basins. Critical erosion causes a loss of land to streambank cave-ins and can initiate landslides on the adjacent uplands. Critical streambank erosion occurs most commonly along floodplains and at the base of river terraces or landslide deposits in the uplands. Valuable farmland is being lost from the floodplains in the Broadbent area, for example, and along Highway 42 several landslides are kept active by streambank erosion at their bases. The problem is naturally occurring and can be most effectively and most economically controlled by protection of bank vegetation and by careful planning, which can prevent the location of structures in areas threatened by this hazard. Careful engineering of roads is also necessary to prevent frequent need for expensive repairs. Riprap and other structural solutions are less preferred but may be useful or desirable for protection of existing roads or structures and land.

1.2 Coastal Erosion

Coastal erosion is a natural process that continually affects the Oregon coast. Erosion becomes a hazard when human development or public safety is threatened. Beaches, sand spits, dunes, and bluffs are constantly affected by waves, currents, tides, and storms, resulting in chronic erosion, landslides, and flooding. Changes may be gradual over a season or many years. Changes may also be drastic, occurring during the course of a single storm event. Erosion may be caused by large waves, storm surges, rip cell embayments, high winds, rain, runoff, flooding, or increased water levels and ocean conditions caused by periodic El Niños. Coastal dunes and bluffs comprised of uplifted marine terrace deposits are especially vulnerable to chronic and catastrophic erosion. Coastal erosion processes create special challenges for people living near the ocean, requiring thoughtful planning in order to minimize the potential dangers to life and property. Attempts to stabilize the shoreline or beach are often futile, because the forces that shape the coast are persistent and powerful.

1.3 Wind Erosion and Deposits

Wind erosion and deposits are essentially coastal processes locally and, together with wave action, contribute to our changing coastline. Areas subject to the effects of wind erosion and deposition are indicated in the mapping and include the sand dune areas inland from the Coos-Umpqua beach in the Oregon Dunes National Recreation Area, the Bandon spit on the Coquille River, and the New River area.

Blowing sand can be a nuisance to recreational users and a long-term hazard to structures located in the path of migrating dunes, which can move as much as 6 feet per year. This is a hazardous factor in local planning because of an abundant sand supply, persistent winds, and an absence of stabilizing vegetation. Identification and mapping of areas subject to wind erosion and deposition can aid in planning the optional location on development. Concern should also be shown for the impact of development on currently stabilized areas.⁹

Such development could open new deposits of loose sand causing problems on adjacent properties. Protecting existing vegetation and requiring revegetation as soon as possible when the plant cover must

⁹ See "Dunes and Ocean and Lake Shorelands" (Section 3.8, this document) for a discussion of the hazards of development in dune areas. "Stabilized areas" refers both to recently stabilized dunes and older established dunes (DS, DC, and OSC; and ODS respectively on the sand dunes maps in the Background Document, pp. 15-11 through 15-13). Older stabilized dunes generally have well-developed soil profiles. Both types are vegetated, whereas active dune forms are not.

be disturbed are ways of reducing this hazard. Additional hazards of development in dune areas are covered in the section on dunes (Section 3.8).

Section 3.9.600 Other Coastal Erosion

1.1 Winds

Persistent winds are a feature of much of Coos County and are of particular importance as a potential hazard to the siting of mobile homes. Accordingly, the State Department of Commerce enforces siting and tie-down regulations that govern the placement of mobile homes.

1.2 High Groundwater and Ponding

High groundwater and ponding are most common in the coastal lowlands, marine terraces, inland floodplains, and some areas of Coos County's sand dunes. Uneven settling, flooding of basements, floatation of septic tanks, and septic system failure are common consequences of development in these areas. Potential for pollution of domestic water sources is also high. Since public health is at issue, encouraging development of public water and/or sewer systems where dense development already exists in such areas is desirable.

1.3 Shoreline Erosion and Deposition

Beach and headland erosion occur along the entire Coos County coastline. These hazards are addressed in greater detail in Section 3.8, "Dunes and Ocean and Lake Shorelands." Areas of beach erosion and deposition and coastal headland erosion rates are shown on the map accompanying that section.

Wave erosion poses a major hazard to coastal development. Wave energy is highest during winter months, and erosion is consequently greater then. Broad summer beaches become narrow and steep as vast amounts of sand are moved offshore. Development that appears to be a safe distance from the sea becomes threatened when a particularly powerful series of storms pound the coast, as in the winter of 1976-1977.

The pattern of erosion of upland areas by waves depends on the geology. Sheared or crumbly rock leads to earthflow and slumping with rapid rates of erosion. Development in such areas can be dangerous. Wave erosion of hard bedrock forms cliffs and erosion rates are slow (except along faults or joints); when significant erosion does occur, it is be the breaking off of large chunks of rock. Hazard, however, is slight and moderate setbacks are generally considered adequate protection. Removal of driftwood and rock debris from the bases of cliffs and areas where mass movement is occurring probably increases erosion rates significantly.

Sand is constantly being moved by wave and current action. Interruption of this movement can cause formation of new beaches, as at Bastendorff following jetty construction. This generally occurs at the expense of other areas – existing beaches may get smaller or disappear altogether and headland erosion may increase. Placement of large rocks (riprap) and construction of protective structures like seawalls (which are parallel to the coast) and groins (rigid structures which project outward from the shore), then, should be discouraged since they have a negative impact on the properties of others by typing up sand that would have been deposited elsewhere and in some instances by removing a source of beach sand. They may also increase future costs to the public; on the East Coast and in California increased threat to coastal developments have lead to a hue and cry for publicly-funded coastal protection projects, many of which seem to be fraught with unforeseen impacts. One means of dealing with beach erosion holds much promise: beach nourishment (supplying sand, generally from dredging projects or from well offshore) is

being tried by the Army Corps of Engineers in the Miama, Florida, area and elsewhere. The mining and removal of sand from beaches also increases erosion and should be carefully controlled.

SECTION 3.9.700 WILDFIRE

Fire poses a major hazard to development in forested areas of the county and especially to the residential development in brushy coastal areas such as the Bandon area where there are extensive stands of highly inflammable gorse and broom. The problem is often compounded by inadequate roads serving residential developments in forested areas.

Community Wildfire Protection Plans (CWPPs) have helped communities work together to achieve common goals and deal with often controversial issues. CWPPs have offered many valuable opportunities to communities, allowing them to identify local priorities for community protection and resource management. In addition to enhancing safety and reducing risk to human structures and watersheds, communities with CWPPs are also given priority for USFS and BLM funded hazardous fuels reduction projects as authorized under the Healthy Forest Restoration Act of 2003 (HFRA). In the end, CWPPs have helped communities better protect themselves for fire risk and better manage their forested landscape.

The collaborative efforts of foresters from the federal and state agencies, rural fire departments, private landowners, local government agencies, volunteer organizations, and concerned citizens who live in the wildland urban interface, have resulted in signed CWPPs in every county and many communities across Oregon.

Coos County developed a Community Wildfire Protection Plan through a partnership among the University of Oregon's Community Service Center, local wildfire planning experts, and a range of federal, state, and local stakeholders. The project is funded through federal Title III funds. The project utilized a four-phase planning process developed in part based on guidance contained in *Preparing a Community Wildfire Protection Plan: A Handbook for Wildland-Urban Interface Communities (2004)* and the *Community Guide to Preparing and Implementing a Community Wildfire Protection Plan (2008)*. The CWPP is hereby adopted by reference in the Coos County Comprehensive Plan.

Gorse (*Ulex europaeus*) is a perennial, heavily armored evergreen shrub growing from 3 to over 10 feet tall. Gorse plants are shrubby with stout and erect spreading branches covered in terminal thorns frequently forming dense thickets. Clusters of yellow pea-like flowers can be found on the plant throughout the year but peak bloom occurs March through May. Seedpods are hairy ½ to ¾ inch long, and brown when ripe. Mature pods burst, scattering seeds for several feet. Gorse was introduced from Europe in the 1890's at Bandon as an ornamental and living fence. Worldwide, European settlers brought the plant with them to more than 15 countries or islands where it has escaped causing significant economic harm. Currently Oregon has at least 55,000 acres at some level of infestation.

This plant is highly flammable and the morning of Saturday, Sept. 26, 1936, was the reason the City of Bandon burnt to the ground. The first started as a small forest fire but bursts of flame became fueled by the gorse. The fire completely consumed the City of Bandon, population 1,800. At least 10 people were killed, and all but a handful of buildings burned to the ground. Coos County is working to make sure this fire hazard is reduced through vegetation management requirements.