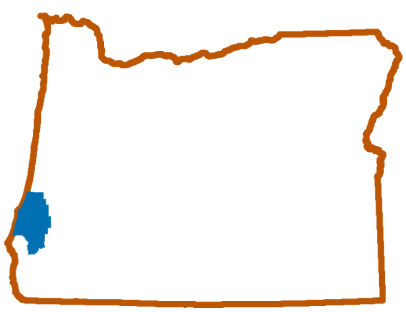
FEMA Approvable Pending Adoption Draft 01-30-2023

Coos County

MULTI-JURISDICTIONAL NATURAL HAZARDS MITIGATION PLAN

- Coos County
- City of Bandon
- City of Coos Bay
- City of Coquille
- City of Lakeside
- City of Myrtle Point
- City of North Bend



- City of Powers
- Port of Coos Bay
- Port of Bandon
- Bay Area Hospital
- Southern Coos Hospital
- Haynes Drainage District

FEMA

Effective Month XX, 2023 through Month XX, 2028

The 2023 Coos County Multi-Jurisdictional Hazards Mitigation Plan is a living document that will be reviewed and updated periodically to address the requirements contained in 44 CFR 201. It will be integrated with existing plans, policies, and programs. The Disaster Mitigation Act of 2000 (DMA2K) and the regulations contained in 44 CFR 201 require that jurisdictions maintain an approved mitigation plan in order to receive federal funds for hazard mitigation grants. This plan meets those requirements as evidenced by FEMA approval which is effective per the cover date range of this plan.

Cover photos: (clockwise): Allegany landslide (CCEM, 4/4/22), Dec. 2015 Hwy 42 landslide (ODOT, 12/26/15), Jan. 2021 King tide wave at Shore Acres State Park (D. Mueller, 1/13/21), 2022 Coquille R. floodwaters off Hwy 42 (D. Mueller, 1/11/22), Jan. 20, 2022 windstorm impacts, Bandon (Joanne Simon, 1/8/22).

Coos County Multi-Jurisdictional Natural Hazard Mitigation Plan Mission:

To create a disaster-resilient Coos County.

Comments, suggestions, corrections, and additions are encouraged to be submitted from all interested parties.

For further information and to provide comments, contact:

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Acknowledgements

The 2023 Coos County Natural Hazard Mitigation Plan (NHMP) update was conducted via a multi-jurisdictional partnership of Coos County and the Cities of Bandon, Coos Bay, Coquille, Lakeside, Myrtle Point, North Bend, and Powers, and the special districts of the Port of Coos Bay, the Port of Bandon, the Bay Area Hospital, the Southern Coos Hospital, and the Haynes Drainage District.

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Pamela Reber, Natural Hazard Planner

DLCD

In 2018, the Department of Land Conservation and Development (DLCD) applied for and received FEMA Pre-Disaster Mitigation grant PDMC-PL-10-OR-2018-005 from FEMA through the Oregon Department of Emergency Management (OEM) to assist Coos County.

OREGON DEPARTMENT OF OEM EMERGENCY MANAGEMENT

FEMA FINAL APPROVAL LETTER

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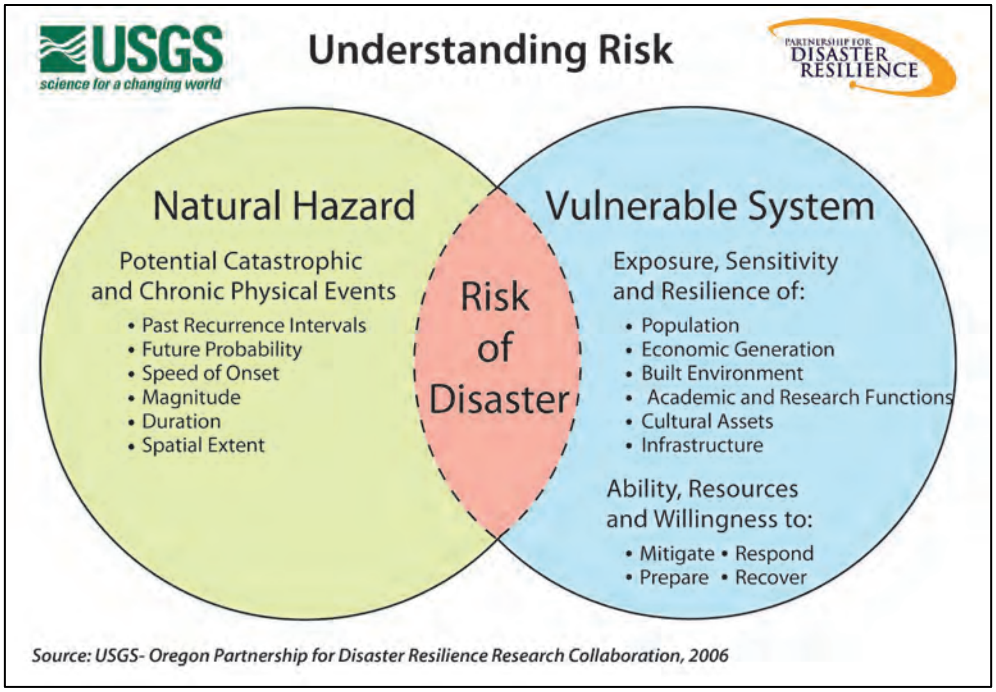
I. RISK ASSESSMENT

A. Introduction

The 2023 Coos County Multi-Jurisdictional Natural Hazard Mitigation Plan (NHMP) applies to Coos County; the cities of Bandon, Coos Bay, Coquille, Lakeside, Myrtle Point, North Bend, and Powers; and the special districts of the International Port of Coos Bay, Port of Bandon, Bay Area Hospital, Haynes Drainage District, and the Southern Coos Hospital. City and District-specific information is called out where relevant. In addition, this chapter can assist with addressing Oregon Statewide Planning Goal 7 – Areas Subject to Natural Hazards.

Risk of natural disaster is defined graphically in the figure below. Ultimately, the goal of hazard mitigation is to reduce the area where hazards and vulnerable systems overlap.

Figure I-1. Understanding Risk



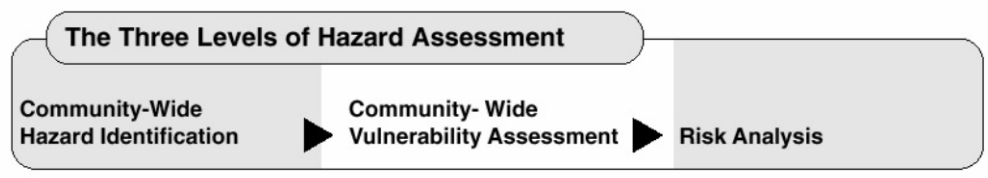
Source: Oregon Partnership for Disaster Resilience.

The information presented in the sections below, along with hazard specific information presented in the Natural Hazard chapters and community characteristics presented in the Community Profile, is used to inform the risk reduction actions identified in the Mitigation Strategy.

What is a Risk Assessment?

A risk assessment consists of three phases: hazard identification, vulnerability assessment, and risk analysis. This three-phase approach to developing a risk assessment should be conducted sequentially because each phase builds upon data from prior phases. However, gathering data for a risk assessment need not occur sequentially. The following figure illustrates the three-phase risk assessment process:

Figure I-2. Three Phases of a Risk Assessment



Source: Planning for Natural Hazards: Oregon Technical Resource Guide, 1998

- Phase 1: Identify hazards that can impact the jurisdiction. This includes an evaluation of potential hazard impacts – type, location, extent, etc.
- Phase 2: Identify important community assets and system vulnerabilities. Example vulnerabilities include people, businesses, homes, roads, historic places and drinking water sources.
- Phase 3: Evaluate the extent to which the identified hazards overlap with, or have an impact on, the important assets identified by the community.

Hazard Identification

Coos County identifies ten natural hazards that could have an impact on Coos County and each of the participating jurisdictions. Summary information for each hazard is presented below; additional information pertaining to the types and characteristics of each hazard is available in the State of Oregon Natural Hazard Mitigation Plan Region 1 Risk Assessment. The table below lists the hazards identified in the county in comparison to the hazards identified in the State of Oregon NHMP for Coastal Oregon (Region 1), which includes Coos County.

Table I-1. Hazards: Coos County NHMP vs. Oregon NHMP

Coos County Hazards 2023	Oregon Coast Region 1 Hazards 2020
Coastal Erosion	Coastal Hazards*
Drought	Droughts
Earthquake	Earthquakes
--	Extreme Heat
Flood	Floods
Dam Failure	Dam Safety
Landslide	Landslides
Tsunami	Tsunamis
--	Volcanoes
Wildfire	Wildfires
Wind Storm	Windstorms
Winter Storm	Winter Storms

*In the Oregon NHMP, Coastal Hazards include Coastal Erosion (short/long term), Landslides, Earthquakes, and Tsunami.
Source: Coos County NHMP Steering Committee (2021) and State of Oregon (Draft) NHMP, Region 1: Coastal Oregon (2020).

DOGAMI Natural Hazard Risk Report for Coos County, Oregon

Open-File Report O-21-04, Natural Hazard Risk Report for Coos County, the cities of Bandon, Coos Bay, Coquille, Lakeside, Myrtle Point, North Bend, and Powers, and the Confederated Tribes of Coos, Lower Umpqua, and Siuslaw Indians and the Coquille Indian Tribe, and the Unincorporated Communities of Bunker Hill, Charleston, Glasgow, Green Acres, Hauser, and Millington. 2021. By Matt C. Williams, Ian P. Madin, Lowell H. Anthony, and Fletcher E. O'Brien of the Oregon Department of Geology and Mineral Industries: Portland, OR.

The DOGAMI Natural Hazard Risk Report for Coos County was developed by the Oregon Department of Geology and Mineral Industries (DOGAMI) in 2018 and was formally published in 2021. It includes the cities of Bandon, Coos Bay, Coquille, Lakeside, Myrtle Point, North Bend, and Powers, and the Confederated Tribes of Coos, Lower Umpqua, and Siuslaw Indians and the Coquille Indian Tribe, and the Unincorporated Communities of Bunker Hill, Charleston, Glasgow, Green Acres, Hauser, and Millington. Matt C. Williams, Lowell H. Anthony, and Fletcher O'Brien. As such, it will be cited with the authors' names and the publication date: Williams et al, 2021.

The purpose of this project is to provide communities in Coos County detailed risk assessments of natural hazards that affect them and to enable communities to compare hazards and act to reduce their risk. The risk assessments contained in this project quantify the impacts of natural hazards to these communities and enhance the decision-making process in planning for disaster. (Williams et al, 2021.)

The Natural Hazard Risk Report for Coos County will be the principal risk assessment reference for the 2023 plan update. The primary findings and conclusions of this project are included by hazard below. The map plates associated with the project are available online with the report download as is a story map of the hazards.

The following table clarifies which hazards and which community areas are evaluated in the Risk Report.

Table I-2. Hazards Analysis Extent of DOGAMI Risk Report for Coos County

Communities	Coastal Erosion	Drought	Earthquake	Flood	Landslide	Tsunami	Wildfire	Windstorm
Unincorporated Coos County			X	X	X	X	X	
Unincorporated Communities: Bunker Hill Charleston Glasgow Green Acres Hauser Millington			X	X	X	X	X	
City of Bandon			X	X	X	X	X	
City of Coquille			X	X	X	X	X	
City of Coos Bay			X	X	X	X	X	
City of Lakeside			X	X	X	X	X	
City of Myrtle Point			X	X	X	X	X	
City of North Bend			X	X	X	X	X	
City of Powers			X	X	X	X	X	
Port of Bandon								
Port of Coos Bay								
Southern Coos Hospital District								
*Confederated Tribes of Coos, Lower Umpqua, and Siuslaw Indians			X	X	X	X	X	
*Coquille Indian Tribe			X	X	X	X	X	

Source: Williams et al, 2021.

Federal Disaster Declarations

Reviewing past events can provide a general sense of the hazards that have caused significant damage in the county. Disaster trends indicated by declarations can help inform hazard mitigation project priorities. President Dwight D. Eisenhower approved the first federal disaster declaration in May 1953 following a tornado in Georgia. Since then, federally declared disasters have been approved within every state as a result of natural hazard related events. As of April 2021, FEMA has approved a total of 38 major disaster declarations, four emergency declarations, and 57 fire management assistance declarations in Oregon (sixteen occurring in 2020). When governors ask for presidential declarations of major disaster or emergency, they stipulate which counties in their state they want included in the declaration based on data and coordination provided by county emergency management staff.

Table I-2 summarizes the major disasters declared in Oregon that affected Coos County since 1955. Coos County has had fourteen major disaster declarations, two since the last plan update (COVID-19 and 2020 wildfires/wind event). Eleven of these were related to severe wind or storm events resulting primarily in flooding, landslides, and wind damage. One declaration was related to a distant tsunami event triggered by the 2011 Tohoku Earthquake in Japan.

Table I-3. Declared Disasters in Coos County

Number	Date Declared	Incident Date	Incident	Individual Assistance	Public Assistance (PA) Categories
DR-4562	9/15/2020	9/7/2020-11/3/2020	Oregon wildfires, straight-line winds	None	B only
DR-4499	3/28/2020	1/20/2020-continuing	COVID-19 pandemic	Yes	B only
DR-4432	5/2/2019	2/23/2019-2/26/2019	Severe winter storms, flooding, landslides, mudslides	None	A, B, C, D, E, F, G
DR-4258	2/17/2016	12/6/2016-12/23/2016	Severe winter storms, straight-line winds, flooding, landslides, mudslides	None	A, B, C, D, E, F, G
DR-4055	3/2/2012	1/17/2012-1/21/2012	Severe storm, flooding, landslides, mudslides	None	A, B, C, D, E, F, G
DR-1964	3/25/2011	3/31/2011	Tsunami wave surge.	None	A, B, C, D, E, F, G
DR-1733	12/8/2007	12/01/2007-12/17/2007	Severe storm, flooding, landslides.	None	A, B, C, D, E, F, G
DR-1632	3/20/2006	12/18/2005-1/21/2006	Severe storm, flooding, landslides.	None	A, B, C, D, E, F, G
EM-3228	9/7/2005	8/29/2005-10/1/2005	Hurricane Katrina evacuation	None	B only
DR-1405	3/12/2002	2/7/2002-2/8/2002	Severe windstorm	None	A, B, C, D, E, F, G
DR-1160	1/23/1997	12/25/1996-1/6/1997	Severe storm, flooding	Yes	A, B, C, D, E, F, G
DR-1099	2/9/1996	2/4/1996-2/21/1996	Severe storm, flooding	Yes	A, B, C, D, E, F, G
DR-413	1/25/1974	1/25/1974	Severe storm, flooding	Yes	A, B, C, D, E, F, G
DR-184	12/24/1964	12/24/1964	Heavy rains, flooding	Yes	A, B, C, D, E, F, G

FEMA. (2021).

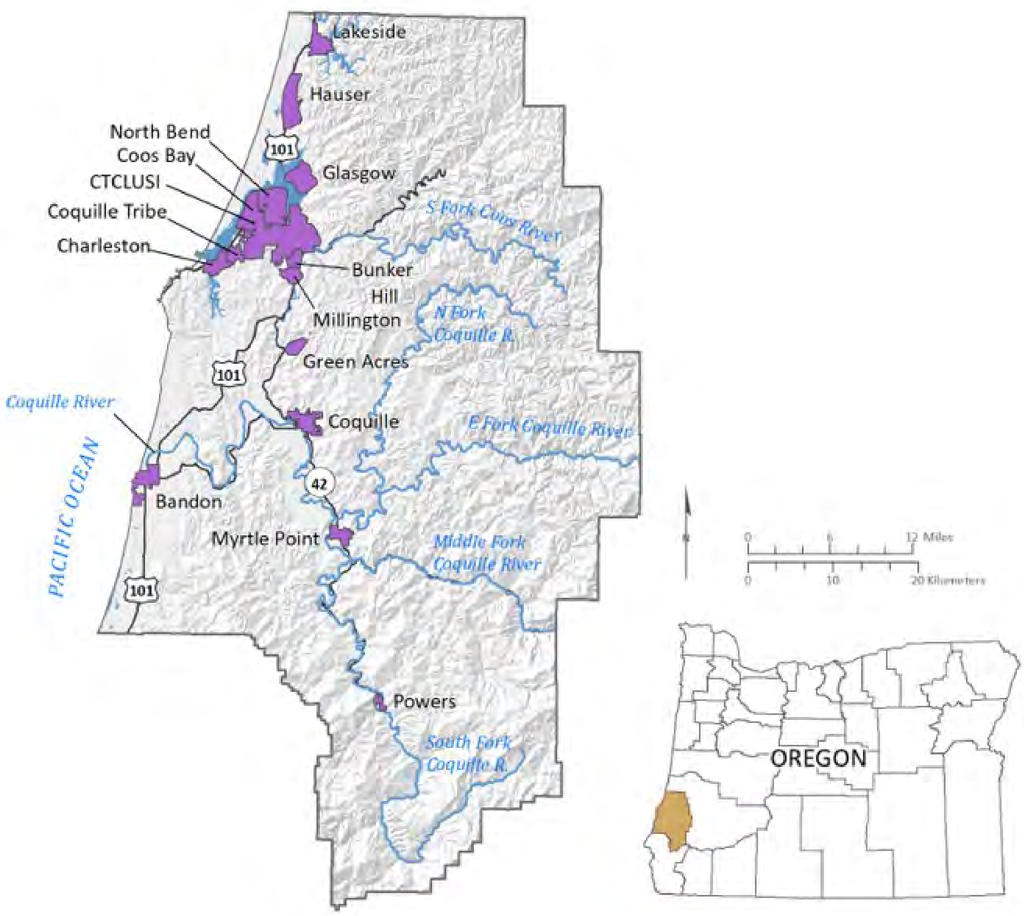
B. Community Profile

Geography

Covering 1,596 square miles, Coos County, Oregon is bordered by Douglas County, Oregon and Curry County, Oregon. Of Oregon's thirty-six counties, Coos County is the 23rd-largest county by area. There are seven cities and five special districts addressed in this Natural Hazard Mitigation Plan update.

Coastal geography of this region consists of rocky and irregular shores and dune-backed beaches, estuarine areas, and coastal lowlands. The heavily timbered interior of the county is very rugged and is comprised of portions of the Oregon Coast Range which transitions to the Klamath Mountains in the southern half of the county.

Figure I-3. Map of Coos County

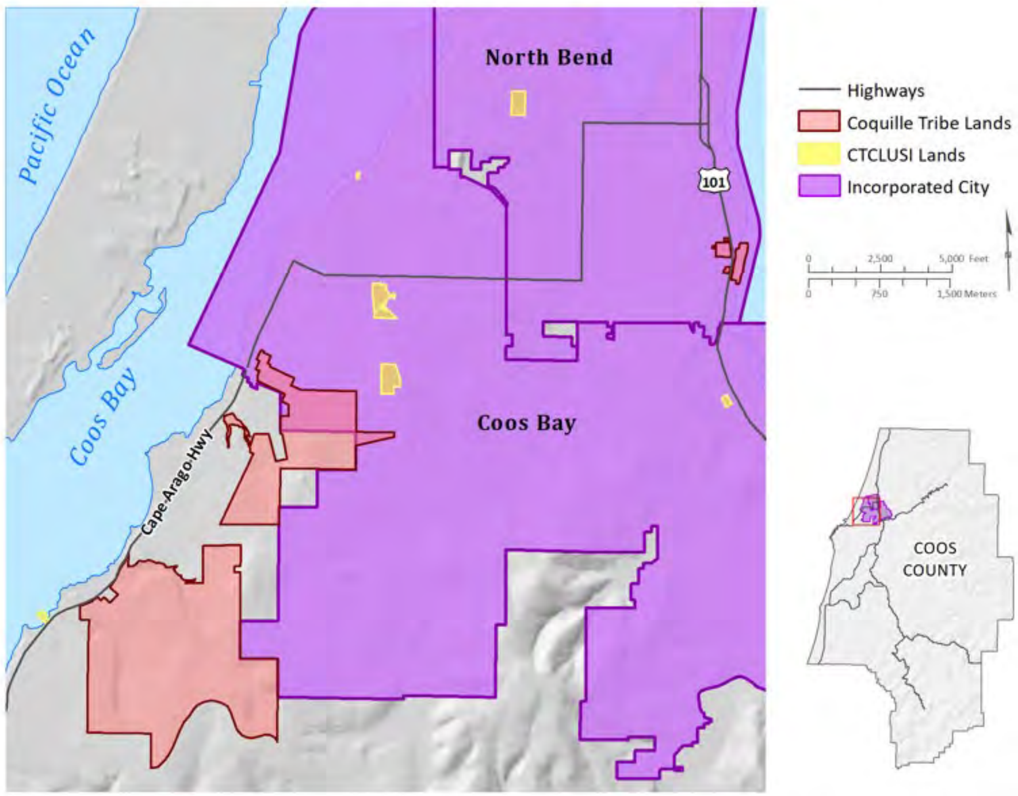


Source: Williams et al, 2021

The Confederated Tribes of Coos, Lower Umpqua, and Siuslaw Indians ("CTCLUSI") and the Coquille Indian Tribe are two federally recognized tribes and communities within the study area. The areas that comprise the tribal lands used in the analyses are made up of several noncontiguous areas within Coos County. The cities of Coos Bay and North Bend have tribal lands adjacent to and within.

Figure I-4. Tribal Lands map

Figure 1-2. Cities of Coos Bay and North Bend with overlapping tribal lands.



Source: Williams et al, 2021

Environment

Coos County has a unique geography and climate that features many rivers and streams, the largest estuary on the Oregon Coast, many inland coastal lakes, and low-elevation Coast Range forests that are some of the most productive in the world. The capacity of the natural environment is essential in sustaining all forms of life including human life, yet it often plays an underrepresented role in community resiliency to natural hazards. The natural environment includes land, air, water and other natural resources that support and provide space to live, work and recreate. Natural capital such as wetlands and forested hill slopes play significant roles in protecting communities and the environment from weather-related hazards, such as flooding and landslides. When natural systems are impacted or depleted by human activities, those activities can adversely affect community resilience to natural hazard events.

Environmental Vulnerabilities

- Environmental assets, particularly those along the coastal margin, are vulnerable to sea level rise, salt water intrusion and ocean acidification. Changes in these categories are largely being driven by changes in global temperature and climate regimes.
- Higher sea levels and more powerful storms will alter coastal shorelines, shorelands and estuaries. Increased wave heights and storm surges can also lead to loss of natural buffeting functions of beaches, tidal wetlands and dunes.
- Forest ecosystems are also vulnerable to drought, wildfire and severe storm impacts.

Population

The socio-demographic qualities of a community can influence the community's ability to cope, adapt to and recover from natural disasters. Population demographics such as age, disability, income, veteran status, language, race and ethnicity, and educational attainment can indicate the type of help that is needed or the resources a community has to build resilience. Historically, a lack of support for people in need in a disaster has put the burden of meetings these needs on those at risk. Population vulnerabilities can be reduced or eliminated with proper outreach and community mitigation planning.

In 2022, the population of Coos County was 65,215. The 2022 proposed population forecast for the incorporated communities in Coos County were Bandon (3,678), Coos Bay (16,044), Coquille (4,376), Lakeside (1,918), Myrtle Point (3,548), North Bend (10,439), and Powers (718). The proposed population forecast for areas outside of urban growth boundary of the cities was 24,494 (PSU PRC, 2022). In Oregon, the Portland State University's Population Research Center analyzes US Census Data and makes statistical analyses to inform community planning. The most recent report is titled the Coordinated Population Forecast 2022 through 2027: Coos County Urban Growth Boundaries (UGBs) & Area Outside UGBs. The statistical analysis used creates estimates that are the most accurate representation of the US Census survey data. For detail of county population; births and deaths; migration; age structure; and race/ ethnicity, see the full report.

Table I-4. Total Projected Population Coos County 2022-2072

Total Population							
Area / Year	**2022**	**2030**	**2040**	**2050**	**2060**	**2070**	**2072**
Coos County	65,215	65,267	65,046	65,528	66,234	66,949	67,093
Bandon	3,678	3,867	4,195	4,787	5,468	6,235	6,400
Coos Bay	16,044	16,256	16,397	16,625	16,887	17,124	17,169
Coquille	4,376	4,305	4,209	4,174	4,147	4,113	4,106
Lakeside	1,918	2,005	2,079	2,135	2,197	2,257	2,269
Myrtle Point	3,548	3,449	3,326	3,256	3,193	3,127	3,113
North Bend	10,439	10,720	10,956	11,190	11,449	11,695	11,742
Powers	718	697	684	701	720	738	742
Outside UGB Area	24,494	23,967	23,201	22,659	22,172	21,659	21,553

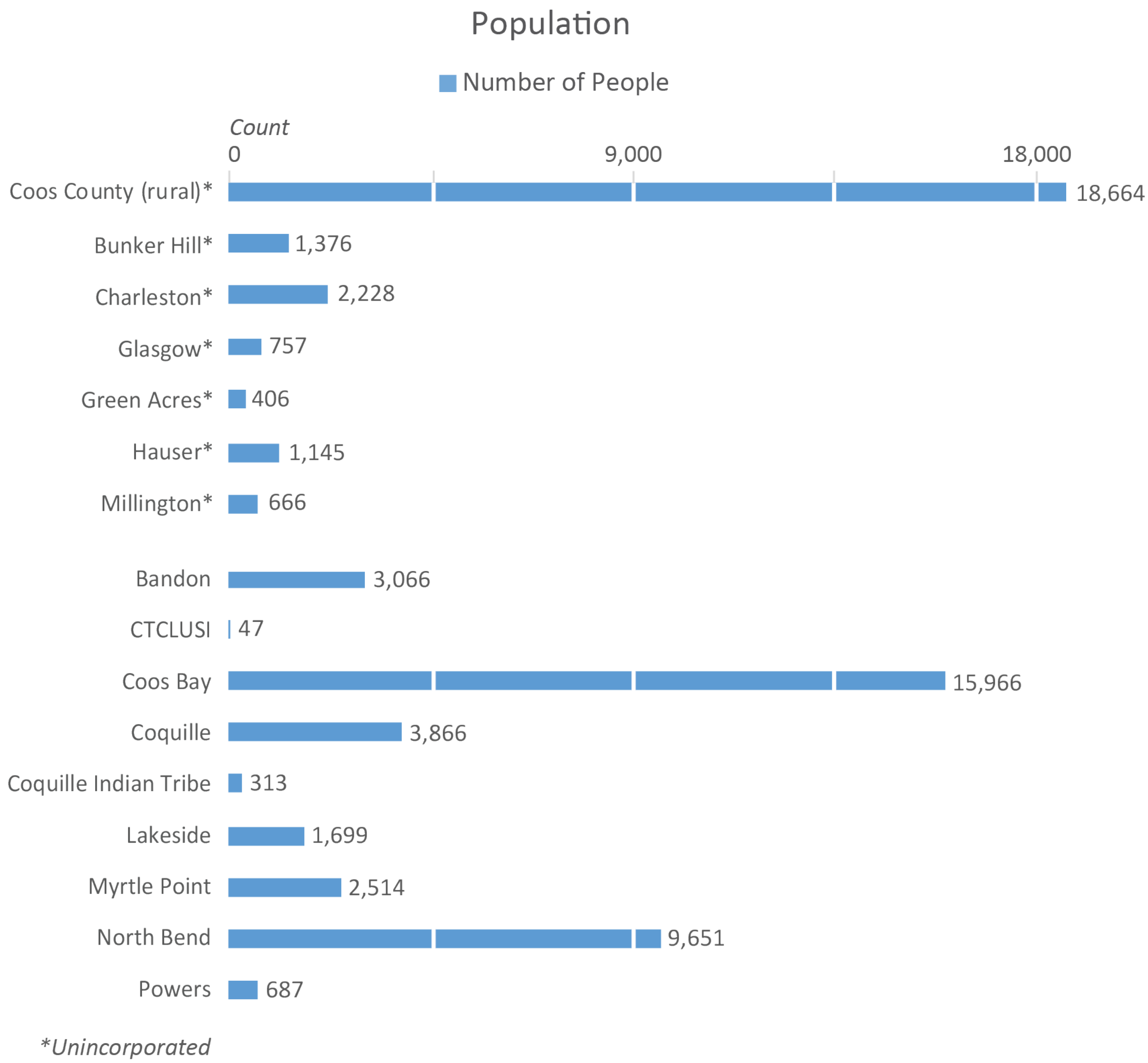
Source: PSU PRC, 2022. Proposed Population Forecast Note: All UGBs are referred using their city names.

Table I-5. Broad Age Group Population Estimate, 2021

	Total Population	**Ages 0-17**	**Ages 0-17 % of Total Population**	**Ages 18-64**	**Ages 18-64 % of Total Population**	**Ages 65 and over**	**Ages 65 and over as % of Total Population**
OREGON	4,266,560	861,013	20.2	2,596,204	60.9	809,343	18.9
COOS	65,154	11,792	18.1	35,139	53.9	18,223	28.0

Source: PSU PRC, 2021.

Figure I-5. Total Population by Coos County Community, 2010



Source: Williams et al, 2021; US Census 2010.

Population Vulnerabilities

Some individuals and groups within the population in Coos County may face more challenges than others when exposed to the hazards addressed in this mitigation plan. It is recommended that local jurisdictions work to refine their understanding and approach to these potential needs by working with community-based organizations to provide services. A list of community organizations follows this section.

- In 2022, the 50-64 age group is projected to continue aging forward while the youngest age groups are expected to decline in shares. Moving forward, the age structure in the county is projected to have larger middle-age and old-age population than younger population (PSU PRC, 2022).

- 18.4% of the population was under the age of 18 years old for the period 2016-2020. Consideration should be given to the needs of parents, teachers, and others who work with children daily as well as how equipped schools and day cares may be in the event of a disaster.
- Nearly 50% (48.8%) of renter households during the period 2016-2020 spent more than 30% of their income on rent and utilities.
- 5.3% of the population speaks a language other than English in the home (for the period 2016-2020).
- 16.1% of the population lived below the poverty line during the period 2016-2020 in Coos County.

Table I-6. Population, Housing, Social and Economic Profile Coos County, Oregon

Population, Housing, Social and Economic Profile
Coos County, Oregon

	2011-2015			2016-2020			Compare
	Estimate	CV *	Margin of Error (+/-)	Estimate	CV *	Margin of Error (+/-)	Statistically Different?
POPULATION							
Total population	62,775	●	*****	64,175	●	*****	**
Percent under 18 years	*18.6%*	●	*0.1%*	*18.4%*	●	*****	**
Percent 65 years and over	*23.3%*	●	*0.2%*	*25.9%*	●	*0.2%*	**
Median age (years)	48.1	●	0.3	48.7	●	0.3	**
Percent white alone, non-Latino	*85.8%*	●	*0.3%*	*84.7%*	●	*0.3%*	**
HOUSING							
Total housing units	30,482	●	94	31,246	●	83	**
Occupied housing units	25,888	●	565	27,819	●	496	**
Owner occupied	16,831	●	573	19,009	●	634	**
Percent owner-occupied	*65.0%*	●	*2.0%*	*68.3%*	●	*2.1%*	**
Renter occupied	9,057	●	586	8,810	●	629	
Vacant housing units***	4,594	●	576	3,427	●	495	**
Vacancy rate	*15.1%*	●	*1.9%*	*11.0%*	●	*1.6%*	**
Average household size	2.38	●	0.05	2.27	●	0.04	**
Renter households paying more than 30 percent of household income on rent plus utilities	*54.5%*	●	*4.5%*	*48.8%*	●	*5.1%*	
SOCIAL							
Age 25+ with a bachelor's degree or higher	*18.3%*	●	*1.5%*	*19.9%*	●	*1.8%*	
Foreign-born population	2,234	●	390	2,372	●	368	
Percent foreign-born	*3.6%*	●	*0.6%*	*3.7%*	●	*0.6%*	
Age 5+ language other than English at home	3,074	●	423	3,244	●	444	
Percent language other than English	*5.2%*	●	*0.7%*	*5.3%*	●	*0.7%*	
ECONOMIC							
Median household income (2020 dollars)	$42,179	●	$1,579	$49,445	●	$3,052	**
Per capita income (2020 dollars)	$24,765	●	$1,261	$30,720	●	$1,855	**
Percent of persons below poverty level	*18.3%*	●	*1.8%*	*16.1%*	●	*1.8%*	

** Green, yellow, and red icons indicate the reliabilty of each estimate using the coefficient of variation (CV). The lower the CV, the more reliable the data. High reliability (CV <15%) is shown in green, medium reliability (CV between 15-30% - be careful) is shown in yellow, and low reliability (CV >30% - use with extreme caution) is shown in red. However, there are no absolute rules for acceptable thresholds of reliability. Users should consider the margin of error and the need for precision.*

*** Indicates that the two estimates are statistically different based on results of z-test taking into account the difference between the two estimates as well as an approximation of the standard errors of both estimates.*

**** Vacant units include those for sale or rent, those sold or rented but not yet occupied, those held for seasonal, recreational, or occasional use, as well as other vacant such as homes under renovation, settlement of an estate, or foreclosures.*

****** Indicates that the estimate is controlled. A statistical test for sampling variability is not appropriate.*

Source: U.S. Census Bureau, American Community Survey 5 year estimates. Surveys are collected over a 60 month period. Estimates represent average characteristics over the entire period. Tabulated by Population Research Center, Portland State University, with additional calculations from source data as needed.

Source: Chen et al, 2022

Community Organizations

Table I-7. Community Organizations

Name and Contact Information	Description	Service Area	Populations Served							Involvement with Natural Hazard Mitigation
			Businesses	Children	Disabled	Seniors	English Second Language	Families	Low Income	
4-H Club/ OSU Extension Coos County 631 Alder St Myrtle Point, OR 97458 541-572-5263	Strengthening our community through trusted relationships, fostering youth skills, sustaining natural resources, building a community of health, enhancing farming and forestry practices, developing marine fisheries initiatives, and creating practical solutions for a thriving community.	Coos County	X	X				X		
Aging & People with Disabilities (APD) 2675 Colorado Ave North Bend, OR 97459 541-756-2017					X	X			X	
Alternative Youth Activities 575 S Main St Coos Bay, OR 97420 541-888-2432				X				X		
American Red Cross 2520 Broadway Ave, North Bend, OR 97459 541-344-5244				X			X	X	X	
Bandon Youth Center 101 11th St Bandon, OR 97411 541-347-8336				X			X	X	X	

Name and Contact Information	Description	Service Area	Populations Served							Involvement with Natural Hazard Mitigation
			Businesses	Children	Disabled	Seniors	English Second Language	Families	Low Income	
Bay Area Senior Center 886 S 4th St Coos Bay, OR 97420 541-269-2626					X	X	X	X	X	
Boys & Girls Club (SWOYA) 3333 Walnut Ave or PO Box 1082 Coos Bay, OR 97420 541-267-3635 541-266-0844				X			X	X	X	
Coos County Veterans Services Office 217 N Adams St Coquille, OR 97423 541-294-8471			X		X	X	X	X	X	
Coos Curry County Agency on Aging 93781 Newport Coos Bay, OR 97420 541-269-2013					X	X			X	
The Coos Drop 1960 Sherman Ave North Bend, OR 97459 541-521-0043 971-334-9295 activatethe@youthera.org	The Coos Drop is staffed by Youth Peer Support Specialists who are committed to helping young adults empower themselves and successfully transition into adulthood.			X			X	X	X	

Name and Contact Information	Description	Service Area	Populations Served							Involvement with Natural Hazard Mitigation
			Businesses	Children	Disabled	Seniors	English Second Language	Families	Low Income	
Coos Forest Protective Association (CFPA) CFPA Headquarters 63612 Fifth Road Coos Bay, OR 97420 541-267-3161	Private, nonprofit corporation that provides protection from fires on 1.5 million acres of private, county, state, and Bureau of Land Management timber and grazing lands in Coos, Curry, and western Douglas counties.	Coos and Curry Counties	X	X	X	X	X	X	X	Participate in mitigation efforts
Coos Health & Wellness 281 LaClair Street Coos Bay, OR 97420 541-266-6700 https://cooshealthandwellness.org/community-resources/senior-services/				X	X	X	X	X	X	
Devereux Center 1200 Newmark Ave Coos Bay, OR 97420 541-888-3202 info@thedevereuxcenter.org	The Devereux Center offers support systems and advocacy for the homeless, those suffering from mental illness, and veterans.				X	X			X	
Kairos Coastline Services 1913 Meade Avenue North Bend, OR 97459 541-756-4508	Kairos collaborates with young people, families, and communities across Oregon to provide intensive mental health services and instill hope.			X				X		
Kids' HOPE Center 1925 Thompson Rd Coos Bay, OR 97420 541-266-8806	Services for foster youth.			X			X	X		

Name and Contact Information	Description	Service Area	Populations Served							Involvement with Natural Hazard Mitigation
			Businesses	Children	Disabled	Seniors	English Second Language	Families	Low Income	
Maslow Project 755 S 7th St Coos Bay, OR 97420 541-297-4448 (drop-in M-W 1:30-4pm)	Outreach for homeless youth.			X			X		X	
Newmark Family Center/ Care Connections 1988 Newmark Ave. Coos Bay, OR 97420 541-888-7957 800-611-7555	Our Family Center provides young children and their families with a nurturing, supportive environment that fosters their love of learning and their development as happy, healthy, responsible human beings who can achieve their fullest potential in society.			X			X	X	X	
North Bend Senior Center 1470 Airport Rd North Bend, OR 97459 541-756-7622					X	X		X	X	
Oregon Coast Community Action 1855 Thomas Ave Coos Bay, OR 97420 541-435-7080	Oregon Coast Community Action (OR-CCA), is a private non-profit organization that provides Meals on Wheels, children's programs, and emergency services on the Southern Oregon Coast.	Curry and Coos Counties		X	X	X	X	X	X	Education and outreach Information dissemination Participate in mitigation efforts
OSU Marine Biology Extension Office			X							

Name and Contact Information	Description	Service Area	Populations Served							Involvement with Natural Hazard Mitigation
			Businesses	Children	Disabled	Seniors	English Second Language	Families	Low Income	
South Coast Family Harbor Relief Nursery & Baby Closet 250 Hull St or PO Box 413 Coos Bay, OR 97420 541-982-3090	SCFH is dedicated to preventing child abuse and neglect by nurturing successful resilient children, strengthening parents and preserving families.			X			X	X	X	
South Coast Gospel Mission 1999 N. 7th St Coos Bay OR 97420 541-269-5017 gospelmission@frontier.com				X	X	X	X	X	X	
Southwestern Oregon Community College, Coos County Campuses	Southwestern Oregon Community College fulfills the educational and cultural needs of our diverse communities by providing equitable access to exceptional teaching and learning in a collaborative, engaging, sustainable environment, which supports innovation, lifelong enrichment, and contribution to global society.	Coos, Curry, and Western Douglas Counties	X		X	X	X	X	X	Education and outreach Information dissemination Participate in mitigation efforts
United Way of Southwestern Oregon			X	X	X	X	X	X	X	

Economy

Economic diversification, employment and industry are measures of economic capacity. However, economic resilience to natural disasters is far more complex than merely restoring employment or income in the local community. Building a resilient economy requires an understanding of how the component parts of employment sectors, workforce, resources and infrastructure are interconnected in the existing economic picture. The current and anticipated financial conditions of a community are strong determinants of community resilience, as a strong and diverse economic base increases the ability of individuals, families and the community to absorb disaster impacts for a quick recovery.

The largest employment sectors in Coos County are Local Government (20%) and Trade, Transportation, and Utilities (19%) followed by Education and Health Services (12%), Leisure and Hospitality (11%), and Professional and Business Services (11%). The largest revenue sectors in Coos County are Retail Trade ($716 million), Health Care and Social Assistance ($329.8 million), Manufacturing ($279.1 million) and Wholesale Trade ($260.8 million). The Education and Health Services sector is expected to have the most employment growth from 2012 to 2022 at 17%. Natural Resources and Mining and Leisure and Hospitality are the next closest growth sectors, with both projecting 9% growth from 2012 to 2022.

Employment

In 2021, the State of Oregon Employment Department reported an annual average of 22,380 persons in the civilian labor force in Coos County. The major sectors of employment included:

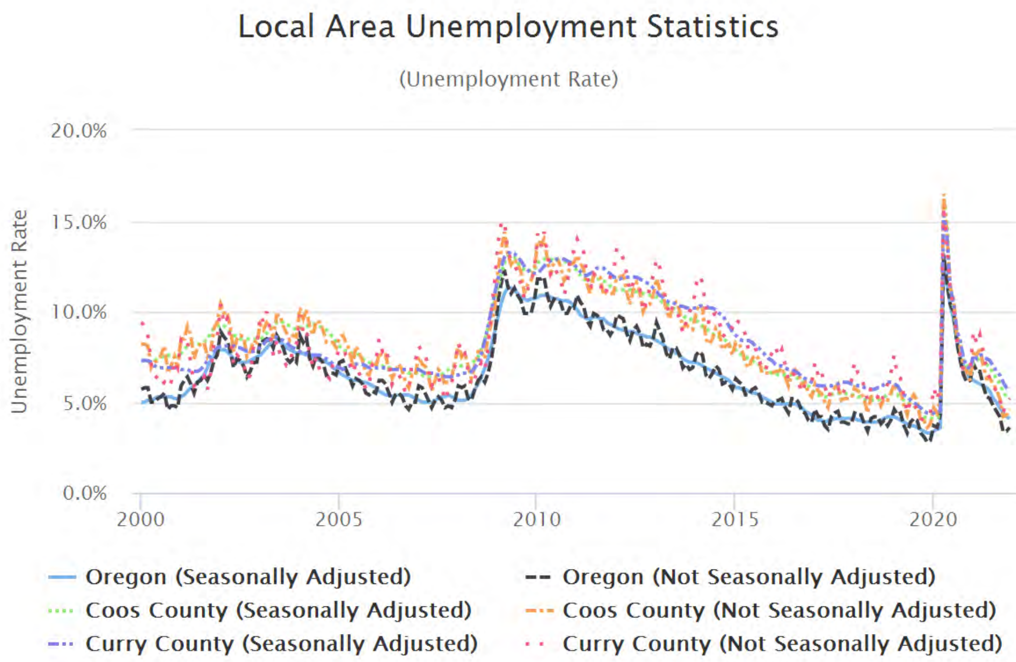
Total nonfarm employment: 22,380 (same when seasonally adjusted)

- Total private: 17,300
- Mining, logging, and construction: 1,430
- Manufacturing (wood and food products): 1,550
- Trade, transportation, and utilities: 4,330, of which 3,050 is retail trade
- Leisure and hospitality: 2,930
- Government: 5,090

Coos County unemployment has decreased from 9.9% in 2013 to 5.1% in September 2022. While Oregon lost 285,000 nonfarm payroll jobs from February to April 2020 due to the COVID-19 pandemic, by December 2021, Oregon's unemployment rate was 4.1% and Coos County's was just over 5%, after 20 consecutive months of declines in Oregon's unemployment rate (OED, 2022).

Coos Bay, North Bend, and Coquille City are areas with the highest job counts according to the Census Bureau (PSU PRC, 2022). Coos County median household income was 68% ($44,698) of the state median ($65,667) in 2021. Powers had the lowest median income of the incorporated cities at $34,286. Lakeside, Bandon, Coos Bay, Myrtle Point and Coquille were all below the County median income. North Bend was the only city with a higher median income than the county at $59,577. In 2013, the housing vacancy rate in Coos County was estimated at just over 10% with one-quarter of the housing units in Powers, one-fifth of the housing units in Myrtle Point and 17% of the units in Coquille were estimated to be vacant; Bandon, Coos Bay, Lakeside and North Bend were all under 10% vacancy. In 2018, of 30,971 total housing units, 4,331 were vacant. The resulting housing unit occupancy rate was 2.3% (owner) and 4.0% (rental) by vacancy rate type—and this 6%+ change reflecting the strong housing market.

Table I-8. Local Area Unemployment Statistics



- Source: Oregon Employment Department Qualityinfo.org

Economic Vulnerabilities

Coos County has the third lowest property tax rate in the state at 1.0799 per $1,000 of assessed value.

Median household income was $67,521 in 2020, a decrease of 2.9% from the 2019 median of $69,560. This is the first statistically significant decline in median household income since 2011.

Between 2019 and 2020, the real median earnings of all workers decreased by 1.2%, while the real median earnings of full-time, year-round workers increased 6.9%. The total number of people with earnings decreased by about 3.0 million, while the number of full-time, year-round workers decreased by approximately 13.7 million.

The official poverty rate in 2020 was 11.4%, up 1.0 percentage point from 2019. This is the first increase in poverty after five consecutive annual declines. In 2020, there were 37.2 million people in poverty, approximately 3.3 million more than in 2019.

Private health insurance coverage continued to be more prevalent than public coverage, at 66.5% and 34.8%, respectively. Some people may have more than one coverage type during the calendar year. Of the subtypes of health insurance, employment-based insurance was the most common subtype of health insurance, covering 54.4% of the population for some or all of the calendar year.

Built Environment

For the purposes of the Coos County Natural Hazard Risk Report, DOGAMI created a building inventory consisting of assessor data and building footprints for which a significant portion of Coos County was already available from a previous DOGAMI project (Priest and others, 2013). Building footprints in the database were digitized from high-resolution lidar collected in 2009 (South Coast project, Oregon Lidar

Consortium). This inventory consists of all buildings larger than 500 square feet, as determined from existing building footprints or tax assessor data.

Table I-9. Coos County Building Inventory

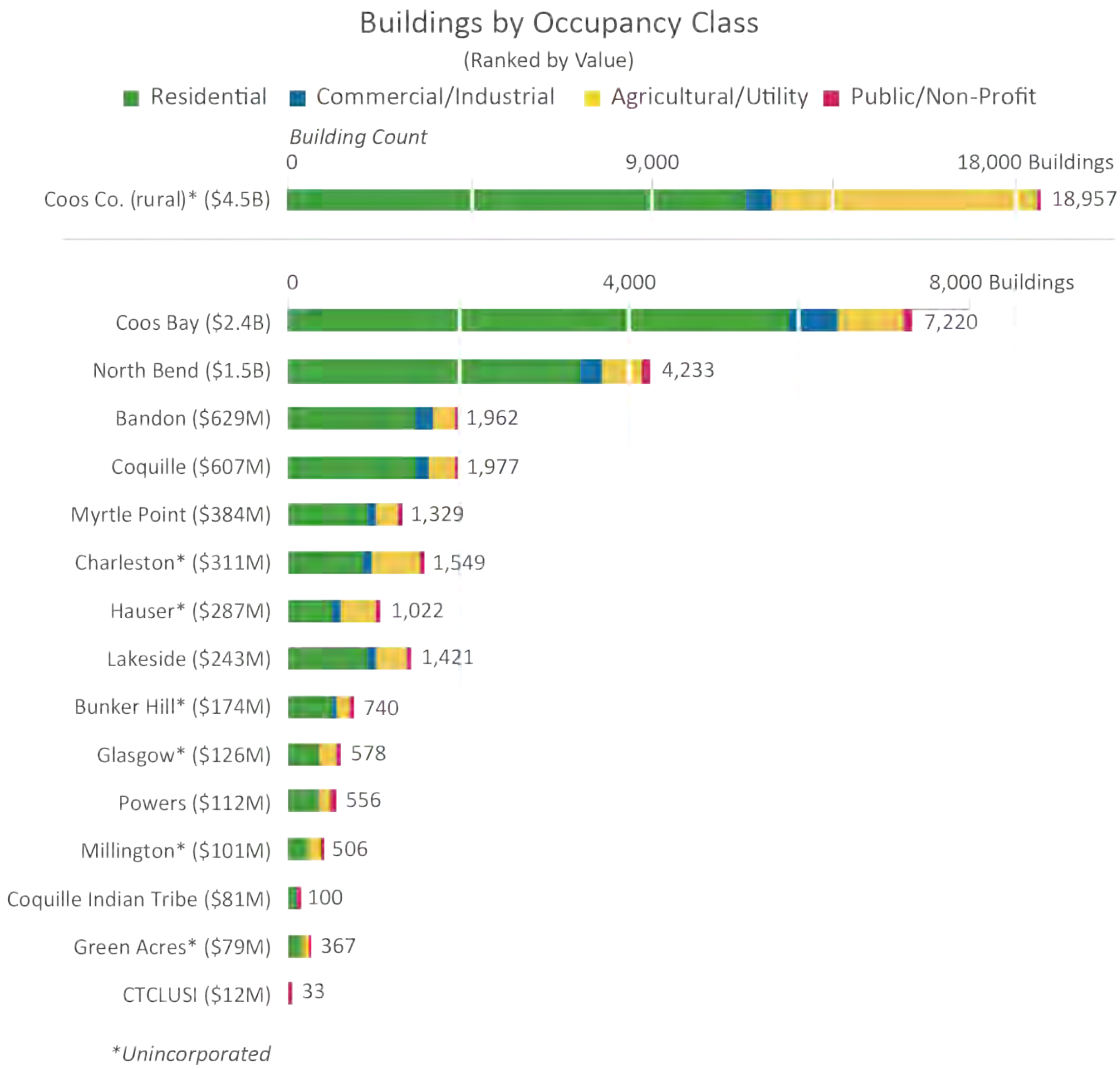
Community	Total Number of Buildings	Percentage of Buildings of Coos County	Total Estimated Building Value ($)	Percentage of Building Value of Coos County
Unincorp. County (rural)	18,957	45%	4,476,885,000	39%
Bunker Hill	740	1.7%	173,872,000	1.5%
Charleston	1,549	3.6%	310,927,000	2.7%
Glasgow	578	1.4%	125,629,000	1.1%
Green Acres	367	0.9%	79,090,000	0.7%
Hauser	1,022	2.4%	286,877,000	2.5%
Millington	506	1.2%	100,571,000	0.9%
Total Unincorp. County	23,719	56%	5,553,851,000	48%
Bandon	1,962	4.6%	629,445,000	5.5%
CTCLUCI	33	0.1%	12,470,000	0.1%
Coos Bay	7,220	17%	2,420,579,000	21%
Coquille	1,977	4.6%	606,670,000	5.3%
Coquille Indian Tribe	100	0.2%	80,721,000	0.7%
Lakeside	1,421	3.3%	242,768,000	2.1%
Myrtle Point	1,329	3.1%	383,743,000	3.3%
North Bend	4,233	9.9%	1,494,790,000	13%
Powers	556	1.3%	111,516,000	1.0%
Total Coos County	42,550	100%	11,536,552,000	100%

Building occupancy types were then assigned to each of the buildings in the inventory. The four classes of occupancy are:

- Residential
- Commercial/ industrial
- Agricultural/ Utility
- Public/Non-Profit

The table below shows the buildings by occupancy by community.

Table I-10. Community Building Value in Coos County



Source: Williams et al, 2021

Changes in Development

Coos County

Coos County recorded over 637 new private residential building permits between 2002 and 2013.

According to the PSU Population Research Center, a general survey received in 2021 showed “there has been an increase in permits for dwellings, additions, and remodels in addition to a substantial request for RV parks in Coos County compared to previous years. There has also been an increase in permits for dwellings, and an increase in second home ownership, short-term rentals, and primary homeownership. The primary migrating origins for people moving to Coos County are California and other parts of Oregon, and recent wildfires may play a role in people’s decision in moving to the County…” (PSU PRC, 2022) In addition, the following information was collected regarding changes in development from four jurisdictions.

Coos Bay

- Completed Housing Units: 23 units in 2019; 17 units in 2020; 25 units in 2021.
- Lack of housing and lack of affordable housing continue to be a challenge for Coos Bay.
- 400 single unit phased stick-built subdivision/PUD/Lindy Lane & Ocean Blvd. estimated year of completion 2025. 41 multi-unit affordable housing units / Pennsylvania street (not a subdivision) 15-unit Morrison PUD/subdivision 11 new units as a part of a mixed-use project downtown.
- Coos Bay Village, commercial development at 999 Front Street with an estimated 45 jobs 45,000 s.f. commercial development/Hwy 101 & Teakwood, estimated 25 jobs. Newmark new food businesses, (Arby's, Starbuck, Mod Pizza, & Taco Bell) estimated 60 jobs.
- Wastewater Treatment Plant 1 – Phase 1 Upgrade, Pump Station 6 & 9 Upgrade, 5th & Bennet intersection & storm drain improvements, 9th Avenue/Lagoon Road Rehabilitation, Englewood School Brownfield Remediation, Front Street Brownfield Remediation & Green Parking Lot, Wastewater Treatment Plant 1 Headworks Upgrade, Wastewater Treatment Plant 2 Permanent Chemical Feed System, Pump Station 27 & Force main project, 3rd & Central Green Parking Lot.
- Addition of generous ADU standards Land Use development streamlining processes has been completed in the last two years and minimizes permitting processing time. Expedited development standards to loosen restrictions on new housing & commercial projects. Job creation with these revisions is anticipated.

Port of Coos Bay

- Ongoing discussions regarding wave energy projects off the coast.
- Port of Coos Bay work ongoing to secure a container ship project which could bring 500 construction jobs in two years & result in 200 family wage jobs.

According to PSU Population Research Center, changes to the population of Coos County include two trends. One trend is of people retiring in the area and the other is a new trend of people relocating families to more rural areas. As a result, several cities such as Bandon and Coos Bay are increasing in size, yet growth is constrained in Coos County by high housing costs and a lack of professionals (PSU PRC, 2022).

Housing Characteristics

The metric of 'year structure built' is intended to indicate which buildings in the jurisdiction were built to withstand seismic impacts. Seismic building code standards went into effect in Oregon in 1994. The 2018 Census has countywide data available for year structure built, as seen below.

Table I-11. Year Structure Built, Coos County Housing Units

	Year Structure Built						Total Units
	2014 or later	2010 to 2013	2000 to 2009	1990 to 1999	1980 to 1989	Before 1970	
Coos County	161	511	3,419	3,323	3,274	20,283	30,971

Source: ACS, 2018

Vulnerabilities

Mobile home and other non-permanent residential structures account for 14.4% of the housing in Coos County. In Lakeside, mobile homes account for over 30% of the housing total. These structures are particularly vulnerable to certain natural hazards, such as earthquake, tsunami, windstorms and heavy flooding events.

Based on U.S. Census data, only 21% of the residential housing in Coos County was built after the current seismic building standards of 1990. Lakeside and Bandon are notable exceptions at 42% and 39% post 1990 respectively.

Critical Facilities

For the purposes of the Coos County Natural Hazard Risk Report, DOGAMI used the DOGAMI Statewide Seismic Needs Assessment (SSNA; Lewis, 2007) for critical facilities. The critical facilities attributed include hospitals, schools, fire stations, police stations, emergency operations, and military facilities. Critical facilities are important to note because these facilities play a crucial role in emergency response efforts. Communities that have critical facilities that can function during and immediately after a natural disaster are more resilient than those with critical facilities that are inoperable after a disaster. The table below shows the critical facilities on a community basis.

Table I-12. Coos County Critical Facilities Inventory

	Hospital & Clinic		School		Police/Fire		Emergency Services		Military		Other*		Total	
Community	Count	Value ($)	Count	Value ($)	Count	Value ($)	Count	Value ($)	Count	Value ($)	Count	Value ($)	Count	Value ($)
(all dollar amounts in thousands)														
Unincorp. County (rural)	0	0	0	0	14	17,574	0	0	0	0	7	49,986	21	67,560
Bunker Hill	0	0	1	9,335	0	0	0	0	0	0	0	0	1	9,335
Charleston	0	0	0	0	1	783	0	0	1	3,551	0	0	2	4,333
Glasgow	0	0	0	0	1	1,754	0	0	0	0	0	0	1	1,754
Green Acres	0	0	0	0	1	815	0	0	0	0	0	0	1	815
Hauser	0	0	1	17,261	1	1,886	0	0	0	0	0	0	2	19,147
Millington	0	0	0	0	1	1,099	0	0	0	0	0	0	1	1,099
Total Unincorp. County	0	0	2	26,596	19	23,911	0	0	1	3,551	7	49,986	29	104,044
Bandon	1	7,414	3	38,553	2	3,813	0	0	0	0	2	1,024	8	50,804
CTCLUCI	0	0	0	0	0	0	0	0	0	0	1	3,164	1	3,164
Coos Bay	1	32,309	8	104,239	5	16,535	0	0	2	4,846	6	23,977	22	181,906
Coquille	1	7,858	3	44,644	2	3,300	1	2,647	0	0	1	6,424	8	64,872
Coquille Indian Tribe	0	0	0	0	0	0	0	0	0	0	1	3,315	1	3,315
Lakeside	0	0	0	0	1	1,628	0	0	0	0	2	2,476	3	4,103
Myrtle Point	0	0	2	29,743	1	1,882	0	0	0	0	3	3,650	6	35,275
North Bend	0	0	4	75,399	5	9,657	0	0	1	8,782	2	28,906	12	122,745
Powers	0	0	2	9,355	2	1,782	0	0	0	0	0	0	4	11,136
Total Coos County	3	47,581	24	328,529	37	62,508	1	2,647	4	17,179	25	122,921	94	581,365

Note: Facilities with multiple buildings were consolidated into one building.

*Category includes buildings that are not traditional (emergency response) critical facilities but considered critical during an emergency based on input from local stakeholders (e.g., water treatment facilities or airports).

Source: Williams et al, 2021

There are three general hospitals in the county with 216 beds total.

Southern Coos Hospital located in Bandon

Bay Area Hospital located in Coos Bay

Coquille Valley Hospital in Coquille

Coos County Critical Facility Inventory

2023 Coos County Natural Hazard Mitigation Plan Jurisdictions

Table I-13. Critical Facility Inventory, 2023 Plan Jurisdictions

Type	Critical Facility Name	Infrastructure Owner	Point of Contact for NHMP	Location/Address	Website/Notes
Admin	Bandon City Hall	City of Bandon	541-347-2437	555 Highway 101 Bandon, OR 97411	https://www.cityofbandon.org/
Police Station	Bandon Police Department	City of Bandon	541-347-7922	555 Highway 101 Bandon, OR 97411	https://www.cityofbandon.org/
Utility	Bandon Water/ Waste Water Plants	City of Bandon	541-347-7922	80 Filmore Ave Bandon, OR 97411	https://www.cityofbandon.org/
Public Works	Bandon City Shops	City of Bandon	541-347-7922	455 13th Street SE Bandon, OR 97411	https://www.cityofbandon.org/
Hospital or Clinic	Bay Area Hospital	Bay Area Hospital &/or Bay Area Health District	541-266-7983	1775 Thompson Rd Coos Bay, Oregon 97420	https://bayareahospital.org/
Hospital or Clinic	Bay Area Hospital - Community Health & Education Center	Bay Area Hospital &/or Bay Area Health District	541-266-7983	3950 Sherman Ave Coos Bay, Oregon 97420	https://bayareahospital.org/
Hospital or Clinic	Bay Area Hospital – Women's Imaging Center	Bay Area Hospital &/or Bay Area Health District	541-266-7983	2650 N 17th St Coos Bay, OR 97420	https://bayareahospital.org/

Type	Critical Facility Name	Infrastructure Owner	Point of Contact for NHMP	Location/Address	Website/Notes
Admin	Coos Bay City Hall	City of Coos Bay	541-269-1191	500 Central Ave Coos Bay, OR 97420	http://coosbay.org/
Police Station	Coos Bay Police Department	City of Coos Bay	541-269-8911	500 Central Ave Coos Bay, OR 97420	http://coosbay.org/departments/police
Fire Station	Coos Bay Fire Department - Station 1	City of Coos Bay	541-269-1191	450 Elrod Ave Coos Bay, OR 97420	http://coosbay.org/departments/fire-department
Fire Station	Coos Bay Fire Department - Station 2 Empire	City of Coos Bay	541-269-1191	189 S Wall St Coos Bay, OR 97420	http://coosbay.org/departments/fire-department
Fire Station	Coos Bay Fire Department - Station 3 Eastside	City of Coos Bay	541-269-1191	365 D St Coos Bay, OR 97420	http://coosbay.org/departments/fire-department
Utility	Coos Bay Wastewater Department	City of Coos Bay	541-267-3966	680 Ivy St, Coos Bay, OR 97420	
Utility	Coos Bay Wastewater Plant II - Empire	City of Coos Bay	541-267-3966	Fulton Ave, Coos Bay, OR 97420	
Sheriff's Office	Coos County Circuit Court	Coos County	541- 396-8372	250 N Baxter St Coquille, OR 97423	https://www.courts.oregon.gov/courts/coos/Pages/default.aspx
Sheriff's Office	Coos County Community Corrections	Coos County	541-396-7700 commcorr@co.coos.or.us	155 N Adams St Ste B, Coquille, OR 97423	https://www.co.coos.or.us/Community-corrections

Type	Critical Facility Name	Infrastructure Owner	Point of Contact for NHMP	Location/Address	Website/Notes
Sheriff's Office	Coos County Juvenile Detention	Coos County	541-396-7880	240 N. Collier Street Coquille, OR 97423	https://www.co.coos.or.us/juv
Sheriff's Office	Coos County Sheriff's Office	Coos County	emergencymanagement@co.coos.or.us	250 N Baxter St Coquille, OR 97423	https://www.co.coos.or.us/sheriff
EOC	Coos County Emergency Operations Center	Coos County	emergencymanagement@co.coos.or.us	250 N Baxter St Coquille, OR 97423	https://www.co.coos.or.us/sheriff/page/emergency-management
Hospital or Clinic	Coos Health & Wellness	Coos County	541-266-6774	281 LaClair Street Coos Bay, OR 97420	https://cooshealthandwellness.org/
Admin	Coquille City Hall	City of Coquille	541-396-2114	851 N. Central Blvd. Coquille, Oregon	http://www.cityofcoquille.org/
Public Works	Coquille City Shop	City of Coquille	541-396-2114	300 W Main St Coquille, OR 97423	http://www.cityofcoquille.org/
Police Station	Coquille Police Department	City of Coquille	541-396-2114	851 N Central Blvd Coquille, OR 97423	http://www.cityofcoquille.org/public_safety/police.php
Fire Station	Coquille Fire and Rescue – Station 1	City of Coquille	541-396-2232	89 W Third St Coquille, OR 97423	http://www.cityofcoquille.org/public_safety/fire.php
Fire Station	Coquille Fire and Rescue – Station 2	City of Coquille	541-396-2232	Arago-Fishtrap Rd Myrtle Point, OR 97458	http://www.cityofcoquille.org/public_safety/fire.php

Type	Critical Facility Name	Infrastructure Owner	Point of Contact for NHMP	Location/Address	Website/Notes
Fire Station	Coquille Fire and Rescue – Station 3	City of Coquille	541-396-2232	Riverton Rd Coquille, OR 97423	http://www.cityofcoquille.org/public_safety/fire.php
Fire Station	Coquille Fire and Rescue – Station 4	City of Coquille	541-396-2232	Hwy 42 Coquille, OR 97423	http://www.cityofcoquille.org/public_safety/fire.php
Utility	Coquille Sewage Treatment Plant	City of Coquille	541-396-4336	300 OR-42 Coquille, OR 97423	http://www.cityofcoquille.org/
Utility	Coquille Water Plant	City of Coquille	541-396-4336	94186 Crystol Creek Ln Coquille, OR 97423	http://www.cityofcoquille.org/
Port	Oregon International Port of Coos Bay	Port of Coos Bay	541-267-7678	125 W. Central Ave Ste 300 Coos Bay, OR 97420	https://www.portofcoosbay.com/
Admin	Port and Coos Bay Rail Line Admin Office	Port of Coos Bay	541-267-7678	125 W. Central Ave Ste 300 Coos Bay, OR 97420	https://www.portofcoosbay.com/
Port	Charleston Marina	Port of Coos Bay	541-267-7678	63534 Kingfisher Road - P.O. Box 5409 Charleston, OR 97420	https://www.portofcoosbay.com/
Admin	Lakeside City Hall	City of Lakeside	541-759-3011	915 N. Lake Rd Lakeside, OR 97449	https://www.cityoflakeside.org/ City Hall includes the library, senior center, and food bank.

Type	Critical Facility Name	Infrastructure Owner	Point of Contact for NHMP	Location/Address	Website/Notes
Airport	Lakeside City Airport	City of Lakeside	541-759-3011	915 N Lake Rd Lakeside, OR 97449	https://www.cityoflakeside.org/airport
Utility	Lakeside Waste Water Treatment Plant	City of Lakeside	541-759-3011	105 Park Ave Lakeside, OR 97449	New location on Airport Drive, scheduled for 5 years.
Fire Station	Lakeside Fire Department	Lakeside Fire Department	541-759-3931	115 N. 9th St Lakeside, OR 97449	https://www.facebook.com/groups/1606978255986342/
Utility	Lakeside Water Plant	Lakeside Water District	541-759-3602	1000 N. Lake Road Lakeside, OR 97449	
School	Myrtle Crest School	Myrtle Point School District	541-572-1230	903 Myrtle Crest Ln. Myrtle Point, OR 97458	
Utility	Myrtle Point Sewer Treatment Plant	City of Myrtle Point	541-572-2860	220 River Rd Myrtle Point, OR 97458	
Fire Station	Myrtle Point Fire Department – Station 1	City of Myrtle Point	541- 572-5422	424 5th St Myrtle Point, OR 97458	https://www.ci.myrtlepoint.or.us/general/page/myrtle-point-fire-department
Admin	Myrtle Point City Hall	City of Myrtle Point	541-572-2626	424 5th St Myrtle Point, OR 97458	https://www.ci.myrtlepoint.or.us/
Police Station	Myrtle Point Police Department	City of Myrtle Point	541-572-2124	424 5th St Myrtle Point, OR 97458	https://www.ci.myrtlepoint.or.us/general/page/myrtle-point-police-department

Type	Critical Facility Name	Infrastructure Owner	Point of Contact for NHMP	Location/Address	Website/Notes
Other	Myrtle Point Ambulance Department	City of Myrtle Point	541-572-2993	320 5th St Myrtle Point, OR 97458	https://www.ci.myrtlepoint.or.us/general/page/myrtle-point-ambulance-department
Utility	Myrtle Point Water Treatment Plant	City of Myrtle Point	541-572-2589	2585 Maple Street Myrtle Point, OR 97458	
Admin	North Bend City Hall	City of North Bend	541-756-8586	1255 E Airport Way, North Bend, OR 97459	https://www.northbendoregon.us/
Fire Station	North Bend Fire & Rescue – Station 1	City of North Bend	541-756-8500	1880 McPherson North Bend, OR 97459	https://www.northbendoregon.us/fire Seismic retrofits.
Fire Station	North Bend Fire Department – Station 2	City of North Bend	541-756-8500	2222 Newmark North Bend, OR 97459	https://www.northbendoregon.us/fire
Police Station	North Bend Police Department	City of North Bend	541-756-3161	835 California Ave #2, North Bend, OR 97459	https://www.northbendoregon.us/police
Utility	North Bend Wastewater Treatment Plant	City of North Bend	541-756-8586	1255 Airport Ln. North Bend, OR 97459	
Port	Port of Bandon	Port of Bandon	541-366-0115	390 1st St SW Bandon, OR 97411	https://www.portofbandon.com/ Historic Coast Guard building, boardwalk, marina.
Admin	Powers City Hall	City of Powers	541-439-3331	275 Fir St Powers, OR 97466	

Type	Critical Facility Name	Infrastructure Owner	Point of Contact for NHMP	Location/Address	Website/Notes
Fire Station	Powers Fire & Ambulance Department	City of Powers	541-439-3331	275 Fir St Powers, OR 97466	
Police Station	Powers Police Department	City of Powers	541-439-2411	273 Fir St Powers, OR 97466	
Utility	Powers Sewer Plant	City of Powers	541-439-3331	241 E Cedar St Powers, OR 97466	
Utility	Powers Water Plant	City of Powers	541-439-3331	41903 S Powers Rd Powers, OR 97466	
Utility	Powers Water Intake	City of Powers	541-439-3331	31S-12W-13D-01500 Across from Water Plant Powers, OR 97466	
Utility	Powers Water Reservoir	City of Powers	541-439-3331	31S-12W-13D-00300 Adjacent to PHS Powers, OR 97466	
Hospital or Clinic	Southern Coos Hospital and Health Center	Southern Coos Hospital and Health Center	541-347-2426	900 11th Street, SE Bandon, OR 97411	https://southerncoos.org/

Table I-14. Critical Facility Inventory, Other Coos County Jurisdiction

Type	Critical Facility Name	Infrastructure Owner	Point of Contact for NHMP	Location/Address	Website/Notes
School	Alternative Youth Activities, Inc.	Alternative Youth Activities, Inc.	541- 888-2432	575 S Main St, Coos Bay, OR 97420	http://www.aya-or.org/
School	Bandon Pacific Christian School	Bandon Pacific Christian School	541-347-2256	48967 Hwy 101 Bandon, OR 97411	https://pacificcommunitychurch.org/sample/index.html
Fire Station	Bandon Rural Fire Protection District – Union St.	Bandon RFPD	541- 347-3430	555 Oregon Ave Bandon, OR 97411	https://www.firedepartment.net/directory/oregon/coos-county/bandon/bandon-rural-fire-protection-district
Fire Station	Bandon RFPD 8 – Kehl Station	Bandon RFPD	541- 347-3430	In Bandon State Airport Batson Ln Bandon, OR 97411	https://www.firedepartment.net/directory/oregon/coos-county/bandon/bandon-rural-fire-protection-district
Fire Station	Bandon Rural Fire Protection District 8 - Randolph Station	Bandon RFPD	541- 347-3430	Randolph Rd Bandon, OR 97411	https://www.firedepartment.net/directory/oregon/coos-county/bandon/bandon-rural-fire-protection-district
Admin	Bandon Schools District Office	Bandon School District #54	541- 347-4411	401, 599 9th St SW, Bandon, OR 97411	https://www.bandon.k12.or.us/
School	Bandon High School	Bandon School District #54	541- 347-4411	550 9th St. SW Bandon, OR 97411	https://www.bandon.k12.or.us/bandon-high-school/
School	Harbor Lights Middle School	Bandon School District #54	541- 347-4415	390 9th St. SW Bandon, OR 97411	http://www.bandon.k12.or.us/harbor-lights-middle-school/
Hospital or Clinic	Bay Clinic	Bay Clinic, LLC	541-269-0333	1750 Thompson Rd, Coos Bay, OR 97420	https://bayclinic.net/
Fire Station	Bridge Rural Fire Protection District	Bridge RFPD		98183 Bridge Ln Myrtle Point, OR	
Utility	Bunkerhill Sanitary District	Bunkerhill Sanitary District	541-396-2888	590 Commercial St Coos Bay, OR 97420	

Type	Critical Facility Name	Infrastructure Owner	Point of Contact for NHMP	Location/Address	Website/Notes
Fire Station	Charleston RFPD - Station 1 Barview	Charleston RFPD	541- 888-3268	92342 Cape Arago Hwy Coos Bay, OR 97420	https://charlestonorfd.samariteam.com/default.aspx
Fire Station	Charleston RFPD - Station 2	Charleston RFPD	541- 888-3268	63081 Crown Point Road Coos Bay, OR 97420	https://charlestonorfd.samariteam.com/default.aspx
Fire Station	Charleston RFPD - Station 3	Charleston RFPD	541- 888-3268	90414 Metcalf Lane Coos Bay, OR 97420	https://charlestonorfd.samariteam.com/default.aspx
School	Christ Lutheran School	Christ Lutheran Church & School	541-267-3851	1835 N 15th St, Coos Bay, OR 97420	http://lcmschurch.org/
Admin	Confederated Tribes of the Coos, Lower Umpqua and Siuslaw Indians	Confederated Tribes of the Coos, Lower Umpqua and Siuslaw Indians	541-888-9577	1245 Fulton Ave, Coos Bay, OR 97420	https://ctclusi.org/
Other	CTCLUSI Tribal Hall	Confederated Tribes of the Coos, Lower Umpqua and Siuslaw Indians	541-888-9577	338 Wallace St, Coos Bay, OR 97420	https://ctclusi.org/
Admin	CTCLUSI Housing Authority	Confederated Tribes of the Coos, Lower Umpqua and Siuslaw Indians	541-888-9577	336 Wallace St, Coos Bay, OR 97420	https://ctclusi.org/
Utility	Pony Creek Treatment Plant	Coos Bay – North Bend Water Board	541 267-3128	2315 Ocean Blvd SE, Coos Bay, OR 97420-0108	http://cbnbh2o.com/
Utility	Coos Curry Electric Cooperative	Coos Curry Electric Cooperative	541-332-8184	220 Mill St Coquille, OR 97423	https://www.ccec.coop/
Fire Station	Coos Forest Protective Association – Headquarters Coos Bay Station	Coos Forest Protective Association	541-267-3161	63612 Fifth Road Coos Bay, OR 97420	https://www.coosfpa.net/contact
Fire Station	Coos Forest Protective Association – CFPA Bridge Unit	Coos Forest Protective Association	541-572-2796	98247 Bridge Lane Myrtle Point, OR 97458	https://www.coosfpa.net/contact
Fire Station	Coos Forest Protective Association – CFPA Fourmile Station	Coos Forest Protective Association	541-347-3400	46946 Hwy 101 Bandon, OR 97411	https://www.coosfpa.net/contact

Type	Critical Facility Name	Infrastructure Owner	Point of Contact for NHMP	Location/Address	Website/Notes
Admin	Coquille Indian Tribe – Administration	Coquille Indian Tribe	541- 756-0904	3050 Tremont St. North Bend, OR 97459	https://www.coquilletribe.org/
Other	Coquille Indian Tribe - Community Plank House	Coquille Indian Tribe	541- 756-0904	1050 Plankhouse Road, Coos Bay, OR 97420	
School	Coquille Indian Tribal Learning Center	Coquille Indian Tribe		600 Miluk Dr, Coos Bay, OR 97420	
School	Coquille Jr/Sr. High School	Coquille School District #8	541-396-2181	499 W Central Blvd, Coquille, OR 97423	https://www.coquille.k12.or.us/coquille-jr-sr-high-school/
Admin	Coquille School District Office	Coquille School District #8	541-396-2181	180 N. Baxter Coquille, OR 97423	https://www.coquille.k12.or.us/
School	Coquille Valley Elementary School	Coquille School District #8	541-396-2181	180 N. Baxter Coquille, OR 97423	https://www.coquille.k12.or.us/coquille-valley-elementary/
School	Winter Lakes Elementary School	Coquille School District #8	541-396-2181	1742 N. Fir St., Coquille, OR 97423	https://www.coquille.k12.or.us/winter-lakes-elementary-school/
School	Winter Lakes High School	Coquille School District #8	541-396-2181	1501 W. Central Blvd, Coquille, OR 97423	https://www.coquille.k12.or.us/winter-lakes-high-school/
Hospital or Clinic	Coquille Valley Hospital	Coquille Valley Hospital	541-396-3101	940 E 5th St Coquille, OR 97423	https://www.cvhospital.org/
Fire Station	Dora-Sitkum Rural Fire Protection District	Dora-Sitkum RFPD	541- 572-5944	56129 Gold Brick Rd, Myrtle Point, OR 97458	http://dorasitkumfire.com/
School	Eastside School	Coos Bay School District #9	541-267-1340	370 2nd Ave Coos Bay, OR 97420	https://eastside.cbd9.net/
School	Emmanuel Episcopal Preschool	Emmanuel Episcopal Church	541-269-5829	400 Highland Ave Coos Bay, OR 97420	https://www.episcopalcoosbay.org/
Fire Station	Fairview Rural Fire Protection District	Fairview RFPD	541-396-3473	96775 Sumner-Fairview Rd, Coquille, OR 97423	
School	Gold Coast Christian School	Gold Coast Christian School	541-756-7413	2175 Newmark Ave Coos Bay, OR 97420	
Fire Station	Greenacres Rural Fire Protection District	Greenacres RFPD	541-269-2441	93449 Upper Loop Ln, Coos Bay, OR 97420	
Fire Station	Hauser Rural Fire Protection District	Hauser RFPD	541-756-7222	93622 Viking Ln, North Bend, OR 97459	

Type	Critical Facility Name	Infrastructure Owner	Point of Contact for NHMP	Location/Address	Website/Notes
School	Hillcrest Elementary School	North Bend School District	541-756-8348	1100 Maine St. North Bend, OR 97459	https://hillcrest.nbend.k12.or.us/o/hillcrest
School	Kingsview Christian School	Bay Area Church of the Nazarene	541-756-1411	1850 Clark St North Bend, OR 97459	https://www.kingsviewchristian.com/contact-us
Fire Station	Lakeside Fire Department	Lakeside Fire Department	541-759-3931	115 N. 9th St Lakeside, OR 97449	https://www.facebook.com/groups/1606978255986342/
Utility	Lakeside Water Plant	Lakeside Water District	541-759-3602	1000 N. Lake Road Lakeside, OR 97449	
School	Lincoln School of Early Learning	Coquille School District #8	541-396-2181	1366 N. Gould Coquille, OR 97423	https://www.coquille.k12.or.us/lincoln-school-of-early-learning/
Admin	Coos Bay School District Office	Coos Bay School District #9	541-267-3104	1255 Hemlock Coos Bay, OR 97420	https://www.cbd9.net/
School	Destinations Academy	Coos Bay School District #9	541- 267-1485	1255 Hemlock Coos Bay, OR 97420	https://destinations.cbd9.net/
School	Madison (Elementary) School	Coos Bay School District #9	541-888-1218	400 Madison Street Coos Bay, OR 97420	https://madison.cbd9.net/
School	Marshfield High School	Coos Bay School District #9	541- 267-1405	S 10th & Ingersoll St., Coos Bay, OR 97420	https://marshfield.cbd9.net/
School	Marshfield Junior High School	Coos Bay School District #9	541-267-1487	755 S. 7th Coos Bay, OR 97420	https://marshfieldjhs.cbd9.net/
School	Millicoma School	Coos Bay School District #9	541- 267-1468	260 2nd Avenue Coos Bay, OR 97420	https://millicoma.cbd9.net/
Fire Station	Millington Rural Fire Protection District 5 – Station 1	Millington RFPD	541- 267-3151	62866 Millington Frontage Rd, Coos Bay, OR 97420	
Fire Station	Millington Rural Fire Protection District 5 – Station 2	Millington RFPD	541- 267-3151	62274 Olive Barber Rd, Coos Bay, OR 97420	
School	Myrtle Crest School	Myrtle Point School District	541-572-1230	903 Myrtle Crest Ln. Myrtle Point, OR 97458	

Type	Critical Facility Name	Infrastructure Owner	Point of Contact for NHMP	Location/Address	Website/Notes
School	Myrtle Point High School	Myrtle Point School District	541-572-1270	717 4th St Myrtle Point, OR 97458	https://www.mpsd.k12.or.us/domain/51
Admin	Myrtle Point School District Office	Myrtle Point School District	541-572-2811	413 C Street Myrtle Point, OR 97458	https://www.mpsd.k12.or.us/
School	North Bay Elementary School	North Bend School District	541-756-8351	93670 Viking Lane North Bend, OR 97459	https://northbay.nbend.k12.or.us/o/north-bay
Fire Station	North Bay Rural Fire Protection District	North Bay RFPD	541- 756-3501	67577 E Bay Rd, North Bend, OR 97459	https://www.firedepartment.net/directory/oregon/coos-county/north-bend/north-bay-fire-district
Hospital or Clinic	North Bend Medical Center – Coos Bay	North Bend Medical Center	541-267-5151	1900 Woodland Dr Coos Bay, OR 97420	https://www.nbmchealth.com/
Hospital or Clinic	North Bend Medical Center – Bandon	North Bend Medical Center	541-347-5191	110 10th Street SE Bandon, OR 97411	https://www.nbmchealth.com/locations/bandon/
Hospital or Clinic	North Bend Medical Center – Coquille	North Bend Medical Center	541-396-7295	790 E 5th Street Coquille, OR 97423	https://www.nbmchealth.com/locations/coquille/
Hospital or Clinic	North Bend Medical Center – Myrtle Point	North Bend Medical Center	541-572-2111	324 4th Street Myrtle Point, OR 97458	https://www.nbmchealth.com/locations/myrtle-point/
School	North Bend Middle School	North Bend School District	541-756-8341	1500 N 16th Street North Bend, OR 97459	http://www.nbms.nbend.k12.or.us/
School	North Bend Senior High School	North Bend School District	541-756-8328	2323 Pacific Ave North Bend, OR 97459	https://nbhs.nbend.k12.or.us/o/nbhs
School	Oregon Coast Technology School	North Bend School District	CLOSED IN 2018	North Bend, OR	https://www.publicschoolreview.com/oregon-coast-technology-school-profile
School	Oregon Virtual Academy	North Bend School District	866-529-0160	400 Virginia Ave., Ste 210 North Bend, OR 97459	https://orva.k12.com/
Airport	Bandon State Airport	OR Dept of Aviation	State Airports Manager 503-378-4880	2 miles SE of Bandon, OR	https://www.airnav.com/airport/S05

Type	Critical Facility Name	Infrastructure Owner	Point of Contact for NHMP	Location/Address	Website/Notes
Airport	Powers Airport	Port of Coquille River	541- 572-2737	1 mile SE of POWERS, OR	https://www.airnav.com/airport/6S6
School	Powers Elementary School	Powers School District 31	541-439-2291	Corner of 4th and Poplar Powers, OR 97466	https://www.powersschools.com/
School	Powers High School	Powers School District 31	541-439-2291	1 High School Hill Rd Powers, OR 97466	https://www.powersschools.com/
School	Powers Elementary School	Powers School District 31	541-439-2291	430 4th Avenue Powers, OR 97466	School
School	Powers Pre-K School	Powers School District 31	541-439-2291	400 Fir Street (on same lot as elementary) Powers, OR 97466	School
Utility	Ziply Phone & Fiber Building	Ziply c/o Gen. Telephone Co of the NW		101 Poplar Street Powers, OR 97466	Utility
Other	US Forest Service Ranger Station	USDA Forest Service	541-439-6200	42861 Hwy 242 Powers, OR 97466	Other
School	Resource Link Charter School	Resource Link Charter School and/or Coos Bay School District	541- 267-1485	1255 Hemlock Ave Coos Bay, OR, 97420	https://www.resourcelinkcharter.org/
School	Oregon Coast Community Action – Child and Family Resource Center	Oregon Coast Community Action	541- 435-7080	1855 Thomas Ave Coos Bay, OR 97420	https://www.orcca.us/ Includes South Coast Head Start
Fire Station	Sumner Rural Fire Protection District	Sumner RFPD	541-404-1826	60817 Selander Rd Coos Bay, OR 97420	https://www.facebook.com/sumnerrfpd/
Airport	Sunnyhill Airport	Private: Gary Femling and John Carr	541-756-3777	4 miles NE of NORTH BEND, OR	https://www.airnav.com/airport/1OR0
School	Sunset Middle School	Coos Bay School District #9	541- 888-1242	245 S Cammann St Coos Bay, OR 97420	https://sunset.cbd9.net/

Type	Critical Facility Name	Infrastructure Owner	Point of Contact for NHMP	Location/Address	Website/Notes
School	The Lighthouse School	The Lighthouse School	541-751-1649	62858 Highway 101 Coos Bay, Oregon 97420	https://www.thelighthouseschool.org/ https://www.thelighthouseschool.org/notices.php#rsp
Military	US Coast Guard – Sector North Bend	US Coast Guard	541- 756-9220	2000 Connecticut Ave North Bend, OR 97459	https://www.pacificarea.uscg.mil/Our-Organization/District-13/Units/Sector-North-Bend/
Military	US Coast Guard – USCGC Orcas (WPB 1327)	US Coast Guard	541- 267-6981	P.O. Box 1497 Coos Bay, OR 97420	https://www.pacificarea.uscg.mil/Portals/8/District_13/lib/doc/factsheet/uscgc_orcas.pdf?ver=2017-06-15-151557-953
Military	US Coast Guard – Station Coos Bay	US Coast Guard	541-888-3267	P.O. Box 5659 Charleston, OR 97420	https://www.pacificarea.uscg.mil/Our-Organization/District-13/Units/Sector-North-Bend/
Hospital or Clinic	Coos Bay Clinic – School Based Health Center	Waterfall Community Health Center	541-756-6232	826 S. 11th St. Coos Bay, OR 97420	https://www.wfall.org/
Hospital or Clinic	North Bend Clinic - Mental Health Center	Waterfall Community Health Center	541-756-6232	1950 Waite St. North Bend, OR 97459	https://www.wfall.org/
Hospital or Clinic	North Bay Clinic – School Based Health Center	Waterfall Community Health Center	541-756-6232	93670 Viking Ln. North Bend, OR 97459	https://www.wfall.org/
Hospital or Clinic	North Bend Clinic - Primary Care Center	Waterfall Community Health Center	541-756-6232	1890 Waite St. North Bend, OR 97459	https://www.wfall.org/
Hospital or Clinic	Starfish Youth Therapy Center – Pediatric Occupational Therapy and Autism Support	Waterfall Community Health Center	541-756-6232	465 Elrod Ave., Suite 101 Coos Bay, OR 97420	https://www.wfall.org/

C. Natural Hazards

1. Coastal Erosion

Causes and Characteristics

Coastal erosion occurs through a complex interaction of many geologic, atmospheric, and oceanic factors. Two important natural variables for coastal change are the beach sand budget (balance of sand entering and leaving the system) and processes (waves, currents, tides, and wind) that drive the changes. Erosion becomes a hazard when development, human life, or community safety are threatened.

Coastal erosion occurs throughout the year in Coos County, but is accelerated during the winter months, November through February, resulting in episodic and recurrent erosion of beaches, sand spits, dunes, and bluffs. Shoreline retreat may be gradual over a season or many years, or it can be drastic, with the loss of substantial upland area during the course of a single storm event. Twice a year, high tides in Oregon are higher than usual. These extreme high tides, commonly called "King Tides," occur when the moon is closest to the Earth, and the Earth is closest to the sun. These events are associated with localized flooding and erosion, and they are used to measure and understand the potential impacts of sea level rise and changing wave dynamics.

Human activities also influence, and in some cases, intensify the effects of erosion and other coastal hazards. Major actions such as jetty construction and maintenance dredging can have long-term effects. Residential and commercial development can affect shoreline stability over shorter periods of time and in smaller geographic areas. Activities such as grading and excavation, surface and subsurface drainage alterations, vegetation removal, and vegetative as well as structural shoreline stabilization can all reduce shoreline stability (DLCD, 2020).

Although the Pacific Coast in Coos County is vulnerable to the coastal erosion hazard, some areas experience more erosion than others.

- *Beaches and dune-backed shorelines* extend across the majority of the Pacific coast in Coos County. Sand and other sediments circulate within littoral cells defined by ocean currents and nearshore features causing some areas to aggrade or add sand while others accrete or lose sand. Wave attack, such as that occurring during storms and king tides, is the primary risk to dune-backed shorelines, resulting in undercutting and wave overtopping.

- *Cliffs and bluff-backed beaches* dominate the southern coast of Coos County at Cape Arago near Charleston and near Seven Devils State Park at Bandon. Bluff-backed shorelines, while less susceptible to rapid shoreline retreat from wave attack, can be associated with deep currents of fast moving water. A rip current embayment is an erosion "hot spot" seen in the shoreline and formed by a rip current system. Rip embayments are crescent shaped features and have steeper slopes at the maximum point of erosion. The size, spacing, and location are dependent upon the magnitude of the rip current system. Relative to the adjacent section of beach, wave energy can propagate further towards the shoreline through the center of the embayment due to an increased nearshore water depth and reduced beach width. This wave energy can induce erosion and attack the coastal dunes, cliffs, bluffs, and coastal infrastructure (OSU, 2021).

- *The Coos Bay and Coquille River estuaries* begin where the rivers meet the ocean. Tidal influences continue for miles upstream, but storm surges and waves are largely attenuated by the narrow and long river channel. Nonetheless, tidal and stormwater flooding is an increasing nuisance and contributor to local erosion in low-lying areas.

Hazard History

The following table provides information on the previous occurrences of coastal erosion. No new coastal erosion events have been identified and two historic events have been added for the 2021 update.

Table I-15. Historic Coastal Erosion Events

Date	Location	Description	Notes
2003	Sunset Bay State Park	High Waves, Coastal Erosion	Sunset Bay State Park lost a parking lot due to coastal erosion.
1997-1998*	S. Oregon Coast	High Wind, High Surf	El Niño events. Severe beach erosion; trees toppled (Nov. 1997).
Jan.-Feb. 1960, Apr. 1958*	Sunset Bay State Park	Flooding	Large waves and storm surge caused localized flooding in the low-lying beach and nearshore area with recreation infrastructure.
1939	Sunset Bay	Wind, Waves, Coastal Erosion	The Sunset Beach Resort was destroyed.

Note: * indicates newly listed event for the 2021 NHMP update. Source: 2016 Coos NHMP; NOAA Storm Events Database, https://www.ncdc.noaa.gov/stormevents/; 2020 OR NHMP.

Future Climate Conditions: Coastal Erosion

Sea level rise and changing wave dynamics are key climate change impacts expected to increase the risk of coastal erosion and flooding hazards on the Oregon Coast. "The projected increase in local sea levels along the Oregon coast raises the starting point for storm surges and high tides making coastal hazards more severe and more frequent in the future (Climate Central, 2019)."

Local sea level rise in Coos County is projected to rise by 1.2 to 5.3 feet by 2100. This projection is based on the intermediate-low to intermediate-high global sea level scenarios used in the 2018 U.S. National Climate Assessment. Because these local sea level projections account for estimated trends in vertical land movement, they are relative to the future land position.

Given these levels of sea level rise, the multiple-year likelihood of a flood reaching four feet above mean high tide is 4–34% by the 2030s, 25–100% by the 2050s, and 100% by 2100. At risk within the four-foot inundation zone in Coos County as of the 2010 census are 1062 people, $72 million in property value, 10.9 miles of highways and roads, 9.4 miles of railways, 3 critical facilities, 2 municipal drinking water facilities, 3 potential contaminant sources, and 715 buildings.

The structure, composition, and function of coastal wetland ecosystems will also be affected by rising sea levels and saltwater intrusion, coastal erosion and flooding, changes in temperature and precipitation, and ocean acidification. Wetland area in the Coos Bay and Coquille River estuaries is projected to decrease with increasing sea levels. Under 4.7 feet of sea level rise, tidal wetland area in these estuaries is projected to decrease by about 50%. Tidal wetland area in the New River Area is projected to increase by more than 2000%, but whether future tides will push into this area is uncertain.

In October 2022, the **Sea Level Rise Adaptation Planning Toolkit** was released by the Oregon Department of Land Conservation and Development's Coastal Management Program.

Oregon's coastlines are vulnerable to the impacts of sea level rise. DLCD developed tools to assist local communities in planning for the impacts of sea level rise, which are listed below.

The sea level rise adaptation planning toolkit is a set of three resources for local governments and communities to assess and address the impacts of sea level rise:

1. Sea Level Rise Impact Explorer is a combination of multiple data sources and is meant to serve as a planning tool. There are three main geographies covered by the sea level rise planning area: outer coast, estuaries, and Columbia River. A mix of datasets are displayed for these three geographies and are meant to approximate the areas that will be impacted by sea level rise, using the current best available data. Inclusion of an area in the SLR planning area could mean permanent inundation or that the area will be impacted periodically by high tide flooding, storm surge, or erosion events.
2. Sea Level Rise Impact Assessment Tool is a set of spreadsheets designed to help users inventory what activities take place within affected areas, assess vulnerability to harm, and prioritize further investigation into remedial and adaptative actions. This process can serve as the jurisdiction's vulnerability assessment. Specific instructions for how to use the worksheets is included in the file.
3. Sea Level Rise Planning Guide for Coastal Oregon is a document that provides a suggested approach to evaluate the assets at risk from the impacts of sea level rise and offer potential adaptation strategies to adapt to those impacts within Oregon's regulatory framework. The guide also provides authoritative information about sea level rise projections and impacts. This document is intended to guide local planning, capital improvement, and development decisions on the Oregon Coast to support community resilience and ensure effective coastal management actions.

All three resources can be found on the Oregon Coastal Atlas website: www.coastalatlas.net/sealevelrise. This is an active area of continued research, and DLCD will continue to update these resources as more data and information become available.

Vulnerability Assessment

No local or state-owned critical facilities are exposed to the coastal erosion hazard in Coos County according to the 2020 Oregon NHMP. Available data also indicates that Coos County-area historic and archaeologic resources are not at risk of coastal erosion. Overall, Coos County is ranked fifth of seven coastal counties for its vulnerability to coastal erosion in the State Plan (DLCD, 2020).

The following assets and locations are generally the most vulnerable to coastal erosion:

- Coquille River Lighthouse, Bullard's Beach State Park
- Coquille River, south jetty in Bandon (erosion, flooding)
- East Bay Road (erosion, flooding?)
- Pony Creek Slough, North Bend (erosion, flooding)
- Sunset Bay, Sunset Bay State Park (beach erosion)
- Lighthouse Beach, Charleston (bluff erosion)
- North Coos Spit (erosion)

Table I-16. Coastal Erosion Hazard Vulnerability Analysis Summary

Jurisdiction	Total	Risk Level	Jurisdiction	Total	Risk Level
Unincorporated Coos County	135	M	City of Powers	-	-
City of Bandon	117	M	Bay Area Hospital District	-	-
City of Coquille	-	-	Haynes Drainage District	192	H
City of Coos Bay	70	L	International Port of Coos Bay	137	M
City of Lakeside	-	-	Port of Bandon	117	M
City of Myrtle Point	-	-	Southern Coos Hospital District	-	-
City of North Bend	70	L			

Source: Coos MJ-NHMP Risk Assessment, March-May 2021.

Risk Reduction Recommendations

The science of risk reduction is an emerging field. These potential coastal erosion mitigation actions are listed along with the hazard description so that readers understand the type of mitigation actions being considered or that might be considered current best practices. Source: various.

- Maintain existing erosion control structures.
- Consider limiting development in coastal erosion zones.
- Identify and relocate infrastructure near coastal erosion areas.
- Monitor the effects and drivers of coastal change such as high tide, large wave, and storm events in erosion-prone and low-lying areas.
- Consider land value losses due to coastal erosion in future risk assessments.
- Support citizen science: Local citizens can observe and help document the impacts of climate change. A citizen science photo documentation project can be viewed or participated in online at https://www.oregonkingtides.net/ .

Figure I-6. Dune-Backed Beach Erosion near Devil's Kitchen, Bandon (Beach Loop)

Source: D. Mueller, 2021.

2. Drought

Causes and Characteristics

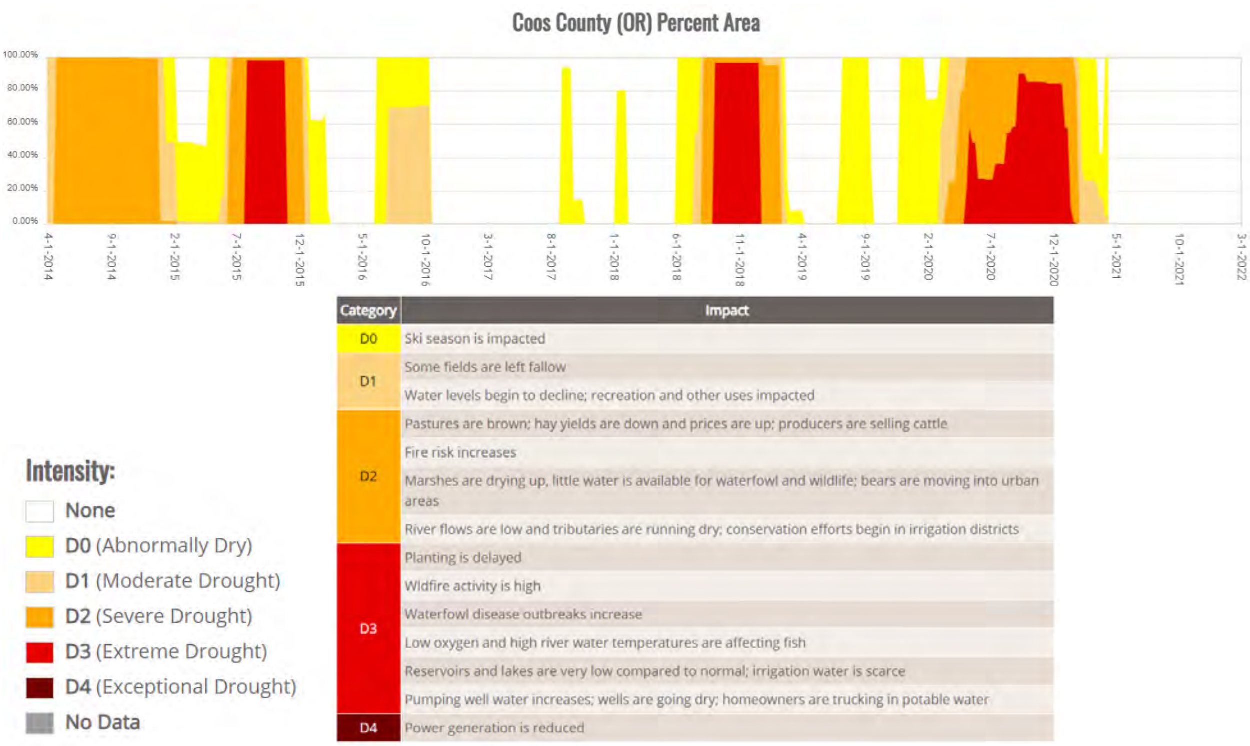
Drought is commonly defined as a deficiency of precipitation over an extended period of time (usually a season or more), resulting in a water shortage (NDMC, 2020). The extent of drought events depends upon the degree of moisture deficiency, and the duration and size of the affected area. Typically, droughts occur as regional events and often affect more than one city and county. Drought is frequently an "incremental" hazard; the onset and end are often difficult to determine. Also, its effects may accumulate slowly over a considerable period of time and may linger for years after the termination of the event.

The National Drought Mitigation Center defines drought five ways:

- **Meteorological drought** is a measure of change in precipitation from normal. Associated conditions include reduced precipitation, high temperatures, high winds, low relative humidity, increased evaporation and transpiration, and reduced runoff, infiltration, and groundwater recharge. Due to climatic differences, what might be considered drought in one location of the state may not be the same elsewhere.
- **Agricultural drought** is a situation where the amount of moisture in the soil no longer meets the needs of a particular crop. Associated conditions include soil water deficiency, reduced water availability for crops, and reduced biomass/yield.
- **Hydrological drought** occurs when surface and sub-surface water supplies are below normal. Associated conditions include reduced streamflow and inflow to lakes, ponds, and wetlands.
- **Socioeconomic drought** occurs when a physical water shortage begins to affect people—individually and collectively, as reflected in the area's economy.
- **Ecological drought** is a prolonged and widespread deficit in naturally available water supplies that create multiple stresses across ecosystems.

Hazard History

Table I-17. Drought Occurrences Last 5 Years



Category	Impact
D0	Ski season is impacted
D1	Some fields are left fallow
	Water levels begin to decline; recreation and other uses impacted
D2	Pastures are brown; hay yields are down and prices are up; producers are selling cattle
	Fire risk increases
	Marshes are drying up, little water is available for waterfowl and wildlife; bears are moving into urban areas
	River flows are low and tributaries are running dry; conservation efforts begin in irrigation districts
D3	Planting is delayed
	Wildfire activity is high
	Waterfowl disease outbreaks increase
	Low oxygen and high river water temperatures are affecting fish
	Reservoirs and lakes are very low compared to normal; irrigation water is scarce
	Pumping well water increases; wells are going dry; homeowners are trucking in potable water
D4	Power generation is reduced

Source: USDM, 2021.

The following table provides information on the previous occurrences of droughts. Three new drought events have occurred since 2016 and five historic events have been added for the 2021 update.

Table I-18. Historic Drought Events

Date	Location	Description
2020* (5/14/2020-12/31/2020)	Coos County	Drought declaration (EO 20-26), based on a Coos County request on 4/24/2020, due to unusually low stream flows, below normal rainfall for the water year (Oct. 1, 2019-Sept. 20, 2020), and one-third of normal rainfall for the month of March 2020.
2018*	Coos County	No drought requested or declared but fall and winter of 2018-2019 saw low water levels and high fire danger.
2015* (6/12/2015-12/31/2015)	Coos County	Drought declaration (EO 15-06) due to drought, low snow pack levels, and low water conditions for 25 counties in Oregon.
2002-2003 (12/1/2002-6/26/2003)	Coos County; Statewide, except Portland metro area and Willamette Valley	The second most intense drought in Oregon's history; 18 counties with state drought declaration (2001); 23 counties state-declared drought (2002); some of the 2001 and 2002 drought declarations were in effect through June or December 2003; Coos and Curry Counties in Region 1 were not under a drought declaration until December of 2002.
1985-1997	Oregon	Generally, a dry period, capped by statewide droughts in 1992 and 1994.

Date	Location	Description
1992	Coos County; Statewide	The winter of 1991-1992 was a moderate El Niño event, which can manifest itself in warmer and drier winters in Oregon; Governor declared a drought for all 36 counties in September 1992.
1988*	Coos County	Extreme drought during general dry period throughout the state spanning 1985-1997.
1976-1981	Western Oregon	1976-1977 was the single driest water year of the century; during a 5-year period of intense drought.
1961	Coos and Curry counties	Abnormally high temperatures in the two counties.
1939-1941*	Oregon	A three-year intense drought; Water Year 1939 was one of the more significant drought years on the Oregon Coast during that period.
1917-1931*	Oregon	A very dry period, punctuated by brief wet spells in 1920-21 and 1927. The 1920s and 1930s, known more commonly as the Dust Bowl, were a period of prolonged mostly drier than normal conditions across much of the state and country; moderate to severe drought affected much of the state except southeastern Oregon.
1924*	Oregon	A prolonged statewide drought that caused major problems for agriculture
1904-1905*	Oregon	A drought period of about 18 months.

Note: * indicates newly listed event for the 2021 NHMP update. Source: OWRD, 2021; Taylor and Hatton, 1999.

Future Climate Conditions: Drought

Because watersheds in Coos County are largely rain-dominated, the drivers of drought and water scarcity are different than across much of the western United States, where mountain snowpack contributes to streamflow (Dalton et al., 2017; Mote et al., 2019). In Coos County, like much of the Pacific Northwest, winters are wet, and summers are dry. Severe drought is rare during the rainy winters on the Oregon coast, but the region is prone to periods of summertime water scarcity, especially when precipitation is lower than average in spring and fall. This scarcity is exacerbated by the lack of natural storage in the snowpack) and built storage in reservoirs. Changes in landcover due to forest management practices that affect shading and water demand, climate-driven shifts in vegetation, and wildfires will likely exacerbate the effects of drought.

Drought, as represented by low summer soil moisture, low summer runoff, and low summer precipitation, is projected to become more frequent in Coos County by the 2050s (Dalton et al, 2022).

Vulnerability Assessment

Drought conditions are not uncommon in Coos County. Drought poses a risk of reduced water availability for communities and agricultural producers during peak demand in late summer. This limits the growth of community development and of overall production of products that have a late summer water demand.

The environmental and economic consequences can be significant, particularly those employed in water-dependent activities (e.g., agriculture, hydroelectric generation, recreation, etc.) Domestic water-users may be subject to stringent conservation measures (e.g., rationing) and could be faced with significant increases in electricity rates. A prolonged drought in forests promotes an increase of insect pests, which in turn, damage trees already weakened by a lack of water. Drought also increases the probability of wildfires in Coos County. In addition, drought and water scarcity add another dimension of stress to species listed pursuant to the Endangered Species Act (ESA) of 1973.

The hazard impact and community vulnerability for drought was assessed and ranked by each jurisdiction via the Hazard Vulnerability Analysis (HVA) process. In ranking the drought hazard, the scenario considered most likely to be a threat was summer low-water conditions that necessitated water conservation efforts be implemented by drinking water providers. See the appendix for a description of the HVA process and the HVA matrix for each jurisdiction.

Table I-19. Drought Hazard Vulnerability Analysis Summary

Jurisdiction	Total	Risk Level	Jurisdiction	Total	Risk Level
Unincorporated Coos County	122	M	City of Powers	162	M
City of Bandon	171	H	Bay Area Hospital District	142	M
City of Coquille	132	M	Haynes Drainage District	120	M
City of Coos Bay	142	M	International Port of Coos Bay	-	-
City of Lakeside	162	H	Port of Bandon	72	M
City of Myrtle Point	189	H	Southern Coos Hospital District	154	M
City of North Bend	98	M			

Source: Coos MJ-NHMP Risk Assessment, March-May 2021.

Risk Reduction Recommendations

The science of risk reduction is an emerging field. These potential drought mitigation actions are listed along with the hazard description so that readers understand the type of mitigation actions being considered or that might be considered current best practices. Source: DLCD.

- Coordinate with local watershed organizations and soil and water conservation districts to implement best practices for water management.
- Develop and implement water conservation plans.
- Support the use of water conservation practices by agricultural, industrial, and municipal water users.

3. Earthquake

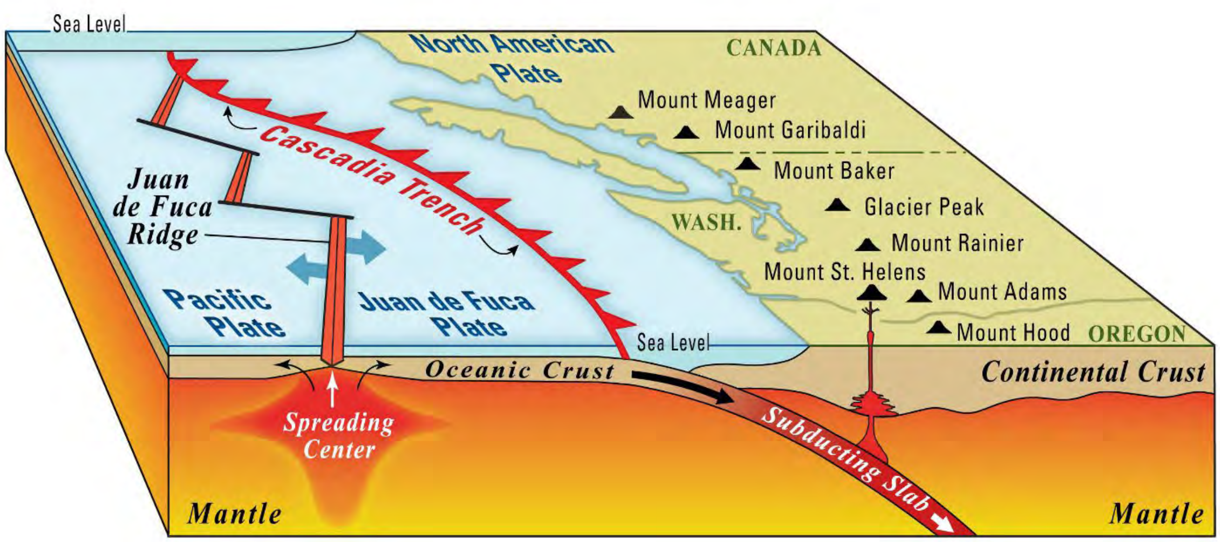
Causes and Characteristics

Oregon and the Pacific Northwest in general are susceptible to earthquakes from four sources: 1) the off-shore Cascadian Fault Zone; 2) deep intra-plate events within the subducting Juan de Fuca Plate; 3) shallow crustal events within the North American Plate; and 4) earthquakes associated with volcanic activity.

Coos County has not experienced any major earthquake events in recent history. Seismic events do, however, pose a significant threat. In particular, a Cascadia Subduction Zone (CSZ) event could produce catastrophic damage and loss of life in Coos County. The geographical position of Coos County makes it also susceptible to deep intraplate events within the subducting Juan de Fuca Plate, and shallow crustal events within the North American Plate.

According to the Oregon NHMP, the return period for the largest of the CSZ earthquakes (Magnitude 9.0+) is 530 years with the last CSZ event occurring 314 years ago in January of 1700. The probability of a 9.0+ CSZ event occurring in the next 50 years ranges from 7 - 12%. Notably, 10 - 20 "smaller" Magnitude 8.3 - 8.5 earthquakes identified over the past 10,000 years affect only the southern half of Oregon and northern California. The average return period for these events is roughly 240 years. The combined probability of any CSZ earthquake occurring in the next 50 years is 37 - 43%.

Figure I-7. Cascadia Subduction Zone



Source: USGS, 2013.

Hazard History

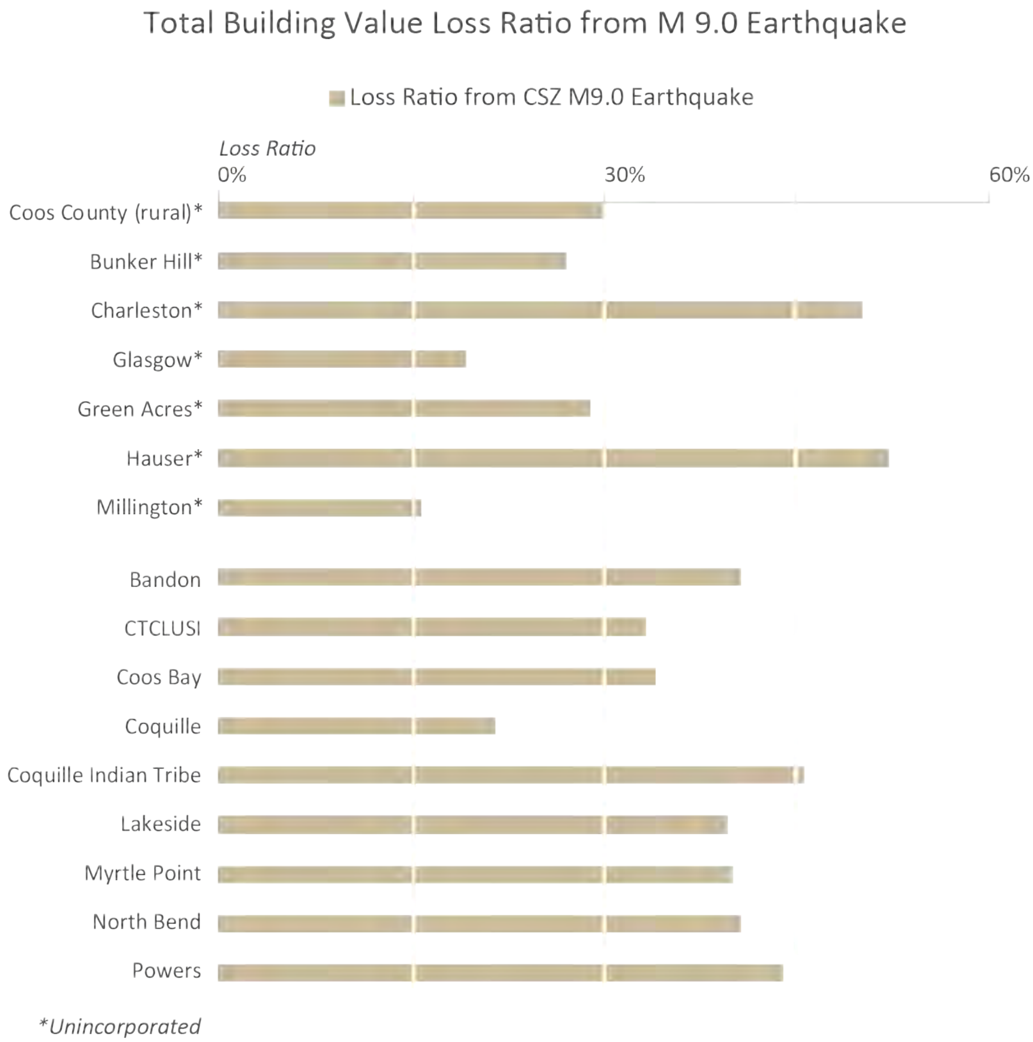
The following table provides information on the previous occurrences of earthquakes. One new earthquake event has occurred since 2016 and six historic events have been added for the 2021 update.

Table I-20. Historic Earthquake Events

Date	Magnitude	Location	Details
Feb. 2021* (02/20/2021)	5.1	180 miles west of Bandon, OR	6.2 mi depth
Aug. 2018* (08/22/2018)	6.2	170 miles west of Coos Bay, OR	6.2 mi depth
Apr. 2012	5.9	168 miles west of Coos Bay, OR	There were no reported damages.
Feb. 2012	6.0	160 miles west of Coos Bay, OR	There were no reported damages.
Oct. 2011	5.3	144 miles west of Coos Bay, OR	
Aug. 2010* (08/28/2010)	5.2	80 miles offshore from Reedsport, OR.	
Feb. 2001* (02/28/2001)	6.8	Nisqually, WA	400 injured; $2 billion in damage; 'Deep' earthquake.
Sept. 1993 (09/21/1993)	5.9 and 6.0	Klamath Falls, OR	Two deaths; $7.5 million in damage to homes, commercial, and government buildings. Two crustal earthquakes; 8.5 and 8.6 km depth respectively. (FEMA-1004-DR-OR).
Mar. 1993 (03/25/1993)	5.6	Scotts Mills, OR (east of Woodburn)	$27 million in damage to homes, schools, businesses, state buildings (Salem). Crustal earthquake; (FEMA-985-DR-OR).
May 1980* (05/18/1980)	5.1	Mt. St. Helens, WA	Associated with eruption.
Jun. 1973* (06/16/1973)	5.6	80 miles offshore from Lincoln City, OR.	
Mar. 1964* (03/28/1964)	9.2	Prince William Sound, AK	140 dead; $311 million in damage. Largest recorded earthquake in the U.S.
Nov. 1962 (11/06/1962)	5.2-5.5	Portland, OR	Damage to many homes (chimneys, windows, etc.) Crustal event 16.0 km depth
Dec. 1941* (12/19/1941)	5.6	Portland, OR	
Nov. 1873	7.3	Offshore from Brookings, OR	Chimneys fell at Port Orford, Grants Pass, and Jacksonville. Intraplate event, Gorda block off the Juan de Fuca plate. No aftershocks.
Jan. 1700 (01/26/1700)	9.0	off Pacific NW coast	Approximately 9.0 earthquake generated a tsunami that struck Oregon, Washington, and Japan; destroyed Native American villages along the coast.

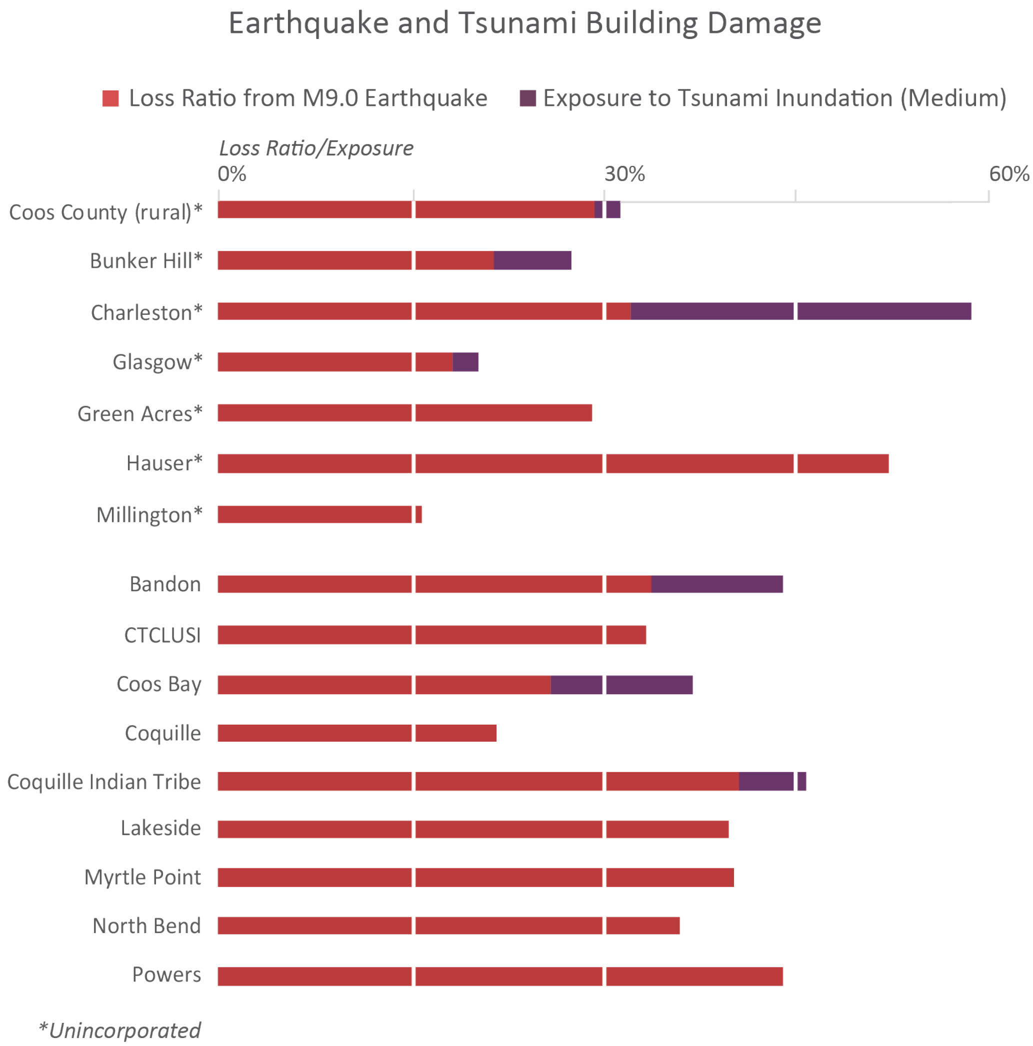
Note: * indicates newly listed event for the 2021 NHMP update. Source: USGS, https://earthquake.usgs.gov/earthquakes/; Sullivan, W.L., 2018.

Figure I-8. Earthquake Loss Ratio by Coos County Community



Source: Williams et al, 2021.

Figure I-9. CSZ M9.0 Event Loss Ratio in Coos County, Earthquake and Tsunami



Source: Williams et al, 2021. Note: Due to the nearly simultaneous timing of a Cascadia subduction zone earthquake and tsunami, loss estimate results have been parsed to avoid double counting. That is, buildings within the (Medium-sized) tsunami zone are reported on the basis of exposure only, while buildings outside the tsunami zone are reported on the basis of Hazus-MH earthquake loss estimates. Tsunami losses to buildings are assumed to be complete within the inundation area.

Vulnerability Assessment

DOGAMI identified locations within the study area that are comparatively more vulnerable or at greater risk to CSZ Mw 9.0 earthquake hazard (Williams et al, 2021):

- Very high liquefaction soils are found throughout most of the populated estuarine portions of Coos County, which include the communities of Bandon, Bunker Hill, Charleston, Coos Bay, Millington, and North Bend.
- Building inventory for the cities of Coquille and Myrtle Point are relatively older than other communities in Coos County, which implies lower seismic building design codes and are more vulnerable to damage during an earthquake. Myrtle Point's estimated loss ratio from a CSZ earthquake alone is 40%. Building code upgrade simulations show that Myrtle Point would

benefit the most from seismic retrofits, loss estimates go from 40% to 22% when pre- and low-code buildings are upgraded to moderate code.

- Because of the liquefaction and landslides, communities will likely be “islands” disconnected from other communities by severed transportation routes. With losses up to 52%, it is very important for a community to be able to respond to emergencies with its own resources.
- Nearly all of the critical facilities (87%) in the communities of Coos County could be nonfunctioning due to a CSZ earthquake.

Figure I-10. Coos Countywide CSZ Mw Earthquake Results

Coos countywide CSZ Mw 9.0 earthquake results (not including buildings or population within the Medium-sized tsunami zone):

- Number of red-tagged buildings: 9,689
- Number of yellow-tagged buildings: 3,659
- Loss estimate: $3,516,968,000
- Loss ratio: 30%
- Nonfunctioning critical facilities: 70
- Potentially displaced population: 11,999

The Natural Hazard Risk Report for Coos County, Oregon has four major findings about earthquakes (Williams et al, 2021):

1. A Cascadia M9 earthquake and tsunami will cause extensive overall damage and losses.

Due to its proximity to the Cascadia subduction zone (CSZ), every community in Coos County will experience significant impact and disruption from a CSZ magnitude 9.0 earthquake event. Event impacts that were examined are limited to earthquake (including ground deformation) and tsunami. Results show that a CSZ M9.0 event will cause approximately 35% to 50% in building losses for most communities. The unincorporated community of Charleston can expect a very high percentage of losses due to tsunami hazard. Other communities like Lakeside, Myrtle Point, North Bend, Powers, and Hauser have little to no tsunami exposure, but still will have high losses from earthquake alone. The high vulnerability of the building inventory (primarily because of the age of construction), high levels of exposure to liquefiable soils, the proximity to the CSZ event, and the amount of development within tsunami zones all contribute the estimated levels of losses expected in the study area.

2. Retrofitting buildings to modern seismic building codes can reduce damages and losses from earthquake

Seismic building codes have a major influence on earthquake shaking damage estimated by Hazus-MH, a software tool developed by the Federal Emergency Management Agency (FEMA) for calculating loss from natural hazards. We examined potential loss reduction from seismic retrofits (modifications that improve building’s seismic resilience) in simulations by using Hazus-MH building code “design level” attributes of pre, low, moderate, and high codes (FEMA, 2012b) in CSZ earthquake scenarios. The simulations were accomplished by upgrading every pre (non-existent) and low seismic code building to moderate seismic code levels in one scenario, and then further by upgrading all buildings to high (current) code in another scenario. We found that retrofitting to at least moderate code was the most cost-effective mitigation strategy because the additional benefit from retrofitting to high code was minimal. In our simulation of upgrading buildings to at least moderate code, the estimated loss for the entire study area went from 30% to 19%. We found further reduction in estimated loss in our simulation to 16% only by upgrading all buildings to high code. Some communities would see greater loss reduction than the study area as a whole due to older building stock constructed at pre or low code seismic building code standards. Some examples are the Cities of Myrtle Point and North Bend, which would see a significant loss reduction (from 40% to 22% and 36% to 21%, respectively) by retrofitting all buildings to at least moderate code. While seismic retrofits are an effective strategy for reducing earthquake shaking damage, it should be noted that earthquake-induced tsunami, landslide, and liquefaction hazards will also be present in some areas, and these hazards require different geotechnical mitigation strategies.

3. Most of the study area's critical facilities are at high risk to a CSZ earthquake and tsunami

Critical facilities were identified and were specifically examined within this report. We have estimated that 88% (83) of Coos County's 94 critical facilities will be non-functioning after a CSZ event, with 13 of those located with the medium tsunami zone. For comparative purposes, 17% (16) of critical facilities are at risk to landslide, 14% (13) are exposed to flood hazard, and 1% (1) are exposed to wildfire.

4. The two biggest causes of displacement to population are a CSZ event (earthquake and tsunami) and landslide

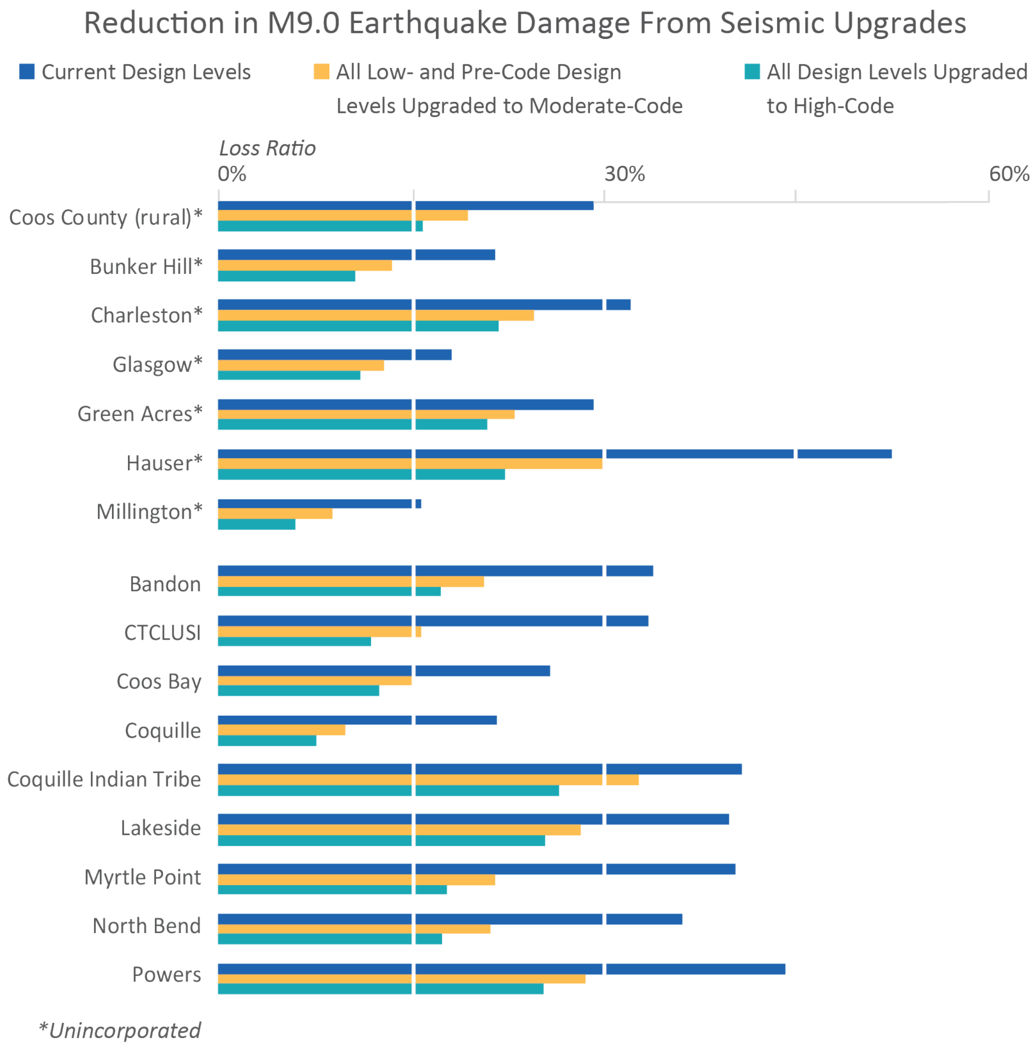
The Coos County Risk Report estimated that 20% of the population in the county would be displaced due to the combination of earthquake and tsunami.

Table I-21. CSZ Earthquake Hazard Vulnerability Analysis Summary

Jurisdiction	Total	Risk Level	Jurisdiction	Total	Risk Level
Unincorporated Coos County	196	H	City of Powers	205	H
City of Bandon	205	H	Bay Area Hospital District	202	H
City of Coquille	205	H	Haynes Drainage District	177	H
City of Coos Bay	202	H	International Port of Coos Bay	196	H
City of Lakeside	205	H	Port of Bandon	205	H
City of Myrtle Point	179	H	Southern Coos Hospital District	205	H
City of North Bend	205	H			

Source: Coos MJ-NHMP Risk Assessment, March-May 2021.

Figure I-11. CSZ M9.0 Reduction in Earthquake Damage from Seismic Upgrades



Source: Williams et al, 2021. Note: Loss estimates shown are for buildings outside the tsunami zone only and are reported on the basis of Hazus-MH earthquake loss estimates. Tsunami losses to buildings are assumed to be complete within the inundation area.

Table I-22. Cascadia Subduction Zone Earthquake Loss Estimates

(all dollar amounts in thousands)

			Total Earthquake Damage*		Earthquake Damage outside of Medium Tsunami Zone							
			Buildings Damaged		Buildings Damaged				Building Design Level Upgraded to at Least Moderate Code			
Community	Total Number of Buildings	Total Estimated Building Value ($)	Sum of Economic Loss	Loss Ratio	Yellow-Tagged Buildings	Red-Tagged Buildings	Sum of Economic Loss	Loss Ratio	Yellow-Tagged Buildings	Red-Tagged Buildings	Sum of Economic Loss	Loss Ratio
Unincorp. County (rural)	18,957	4,476,885	1,354,946	30%	1,606	4,256	1,310,768	29%	1,273	2,752	873,272	20%
Bunker Hill	740	173,872	47,261	27%	86	61	37,528	22%	29	35	23,631	14%
Charleston	1,549	310,927	155,594	50%	124	561	99,432	32%	140	417	76,008	24%
Glasgow	578	125,629	24,408	19%	71	94	22,865	18%	21	71	16,247	13%
Green Acres	367	79,090	23,040	29%	25	87	23,040	29%	11	76	18,263	23%
Hauser	1,022	286,877	149,929	52%	91	429	149,929	52%	177	217	85,514	30%
Millington	506	100,571	15,917	16%	73	34	15,917	16%	18	19	8,930	9%
Total Unincorp. County	23,719	5,553,851	1,771,096	32%	2,077	5,522	1,659,480	30%	1,668	3,588	1,101,864	20%
Bandon	1,962	629,445	257,067	41%	142	551	213,771	34%	171	347	131,333	21%
CTCLUCI	33	12,470	4,271	34%	5	10	4,271	34%	3	5	2,026	16%
Coos Bay	7,220	2,420,579	836,100	35%	604	1,423	632,247	26%	464	886	375,844	16%
Coquille	1,977	606,670	131,036	22%	162	195	131,036	22%	62	113	59,419	10%
Coquille Indian Tribe	100	80,721	36,787	46%	10	21	32,707	41%	4	16	26,245	33%
Lakeside	1,421	242,768	96,156	40%	155	511	96,156	40%	186	327	68,136	28%
Myrtle Point	1,329	383,743	154,830	40%	129	339	154,830	40%	105	209	83,263	22%
North Bend	4,233	1,494,790	614,201	41%	328	898	542,929	36%	193	609	319,391	21%
Powers	556	111,516	49,542	44%	48	219	49,542	44%	68	140	32,084	29%
Total Coos County	42,550	11,536,552	3,951,084	34%	3,659	9,689	3,516,968	30%	2,924	6,240	2,199,607	19%

Source: Williams et al, 2021. Note: *All losses calculated from earthquake inside or outside of Medium tsunami zone.

Risk Reduction Recommendations

The science of risk reduction is an emerging field. These potential actions to address earthquakes are placeholders following the hazard description, so the community and other readers understand the some of the mitigation best practices under consideration. Source: Williams et al, 2021.

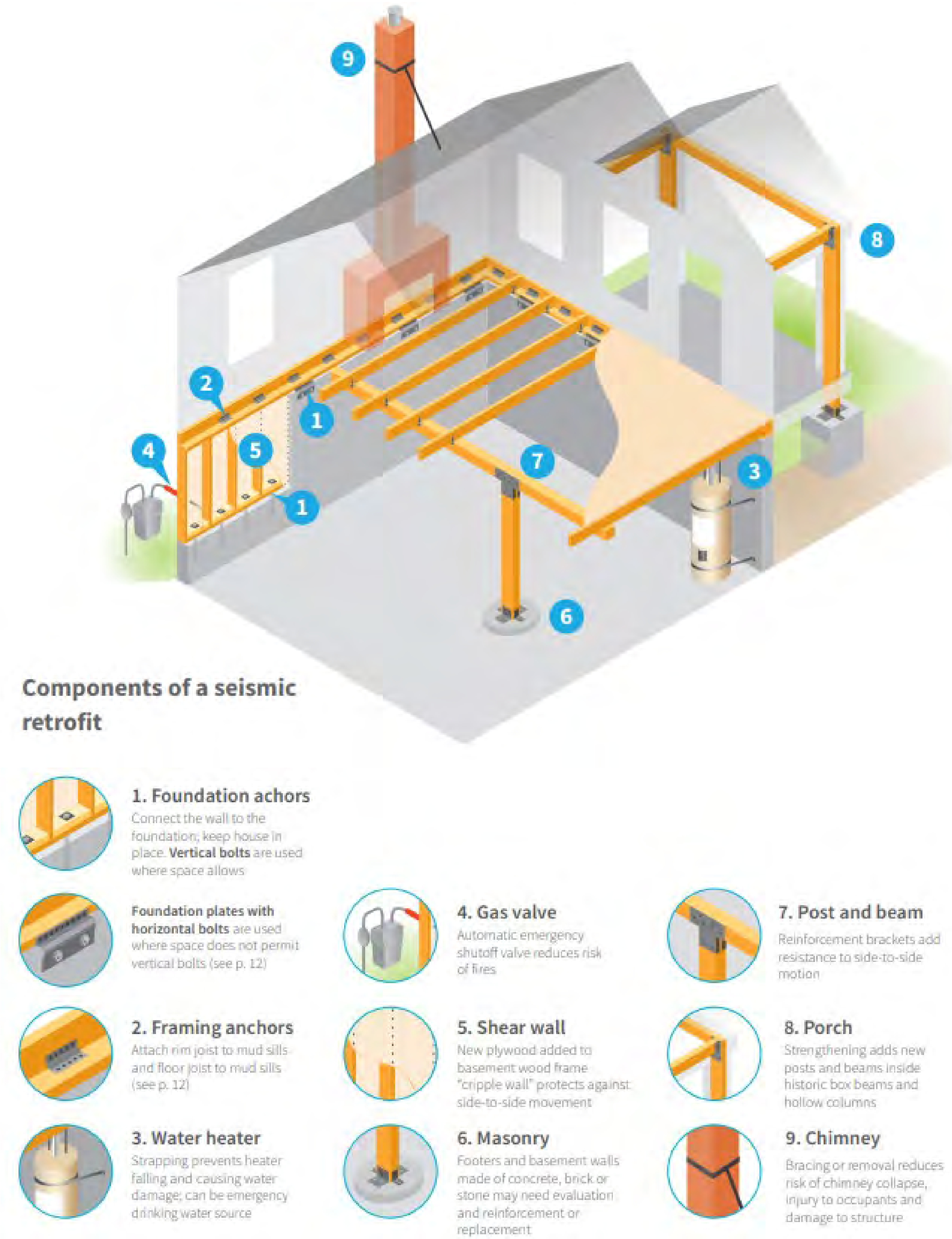
- Evaluate critical facilities for seismic preparedness by identifying structural deficiencies and vulnerabilities to dependent systems (e.g., water, fuel, power).
- Address vulnerabilities of critical facilities. We estimate that 88% of critical facilities (Appendix A: Community Risk Profiles) will be damaged by the CSZ event (includes tsunami), which will have many direct and indirect negative effects on first response and recovery efforts.
- Conduct awareness campaigns to encourage home and business owners to perform seismic retrofits. Our findings indicate that seismic upgrades can significantly reduce losses to buildings.
- Ensure seismic building codes are strictly enforced, especially for manufactured homes.
- Consider implementing regulations in highly liquefiable soil zone areas or using planning to reduce risk.

Seismic Resilience

Building owners and facility managers should consider earthquake preparedness and mitigation efforts, like seismic retrofits of structures and pipe connections. Here are some structural seismic retrofit guides:

- Earthquake Preparedness in the Northwest—Homeowner Guide
- https://www.klamathcounty.org/DocumentCenter/View/5633/Earthquake-Preparedness-in-the-Northwest---Homeowner-Guide
- Seismic Retrofit information from Oregon Construction Contractors Board
- https://www.oregon.gov/ccb/homeowner/Pages/earthquake-retrofit.aspx
- Seismic Retrofit information from Oregon Emergency Management: https://www.oregon.gov/OEM/hazardsprep/Pages/Earthquakes.aspx

Figure I-12. Components of a Seismic Retrofit



Source: Enhabit, Inc. Earthquake Preparedness in the Northwest Homeowner Guide.

4. Flood

Causes and Characteristics

Flooding results when precipitation, weather events, water levels in lakes, diked areas, estuaries and the ocean, and in Coos County, very occasionally snowmelt, creates water flow that exceeds the carrying capacity of rivers, streams, channels, ditches, and other watercourses. There are three sources of flooding risk addressed in this plan: riverine, coastal, and dam failure.

Riverine floods are likely to occur in Coos County from October through April when storms from the Pacific Ocean bring intense rainfall. Major riverine flood sources in Coos County include the Coos, South Fork Coos, Coquille, East Fork Coquille, Middle Fork Coquille, North Fork Coquille, South Fork Coquille, and Willicoma rivers, as well as Ten Mile Creek, Palouse Creek, Larson Creek, Pony Creek, Kentuck Slough, Coalbank Slough, and the Willanch Slough. All the listed rivers are subject to flooding and can cause damage to buildings within the floodplain. In addition to riverine flooding, there are lakes within the coastal margin that are subject to flooding, including North Tenmile Lake, Saunders Lake, and Tenmile Lake.

Figure I-13. Mouth of Coos Bay

Source: Photo by Alex Derr. https://oregonshores.org/

Coastal flooding from the Pacific Ocean and the Coos River and Coquille River estuaries poses a risk to low-lying coastal developments. These risks are dynamic and increasing in variable ways. King Tides provide some insight to how and when winds, tides, riverine flooding, may flood roads and buildings. But sea level rise and ocean wave dynamics can also contribute to flooding and the science is quite clear on the likelihood of significant flood impacts with each small amount of sea level rise. The OCCRI Future Conditions Report for Coos County is appended to this report in full text and should be referenced for guidance on the risks of sea level rise and other sources of coastal flooding.

There is also a risk of flooding by dam failure in Coos County—see the High Hazard Potential Dam Failure chapter.

Hazard History

The following table provides information on the previous occurrences of flooding. Eleven new flood events have occurred since the last plan update and eight historic events have been added for the 2023 update.

Table I-23. Historic Flood Events

Date	Location	Event Type	Magnitude	Details
Apr. 2019*	Myrtle Point; S. Oregon Coast	Flood	33’	Two days of very heavy rainfall combined with snowmelt led to area flooding in southwest Oregon. DR-4452 declared 7/9/19 in Douglas and Curry counties.
Feb. 2019*	S. Oregon Coast	Flood	n/a	Very heavy rain along with the melting of recent snowfall caused flooding at several locations in southern Oregon in late February. South Fork of the Coquille at Myrtle Point, North Fork of the Coquille at Myrtle Point, and the Coquille River at Coquille, and all exceeded flood stage.
Jan. 2019*	Coos and Curry counties	Flood	n/a	A weekend of very heavy rain led to river rises across southern Oregon. The Coquille River at Coquille flooded as well.
Feb. 2017*	Coos and Curry counties	Flood	n/a	High river flows combined with high tide to flood some areas near the southern Oregon coast. Heavy rain combined with snow melt caused flooding along the Coquille River in southwest Oregon.
Jan. 2017*	Coos and Curry counties	Flood	n/a	An extended period of heavy rain combined with snowmelt to cause flooding of the Coquille River and the South Fork of the Coquille River.
Dec. 2016*	Coos and Curry counties	Flood	n/a	Heavy rain brought some areal flooding to parts of southwest Oregon.
Mar. 2016*	Coos County	Flood	n/a	Heavy rains brought flooding to the Coquille River at Coquille on these dates.
Jan. 2016*	Coos County	Flood	n/a	Heavy rain brought flooding to some areas of southwest Oregon, including moderate flooding on the Coquille River at Coquille.

Date	Location	Event Type	Magnitude	Details
Dec. 2015*	Coos and Curry counties	Flood	n/a	A moist pacific front produced heavy rainfall across Northwest Oregon which resulted in river flooding, urban flooding, small stream flooding, landslides, and a few sink holes. After a wet week (December 5 through Dec 11), several rivers were near bank full ahead of another front on December 12th.
Jan. 2014*	Coos County	Flood	n/a	A slow moving front produced heavy rain over Northwest Oregon which resulted in the flooding of eight rivers. Another impact from the rain were a couple of land/rock slides that both blocked two highways. Heavy rain brought flooding to several rivers in southwest Oregon.
Feb. 2014*	Coos County	Flood	n/a	A series of fronts resulted in a prolonged period of rain. Heavy rains caused the Coquille River at Coquille to flood. The flood was categorized as a moderate flood.
Dec. 2012	Oregon Coast	Heavy Rain, Flooding, Landslides		In Coos County, the Coquille River flooded a park and farmland.
Mar. 2012	Coos and Curry Counties	Heavy Rain, Flooding, Mudslides, Landslides		Winds and heavy rains caused flooding, mudslides, and landslides in twelve counties. There was an estimated $5,856,881 in damage to state highways.
Jan. 2012	Coos and Curry Counties	Heavy Rain, Flooding, Landslides		A severe winter storm caused flooding along with landslides and mudslides in Southern Oregon.
Dec. 2008	Coos County	Heavy Rain, Flooding	Flood stage	Brummit Creek and the west fork of Brummit Creek flooded after heavy rains, inundating several homes in Sitkum and closing Sitkum Lane at Milepost 24. The Coquille River rose above flood stage, but did not do any damage.
Dec. 2006	Coos County	Heavy Rain, Flooding	n/a	Two separate floods on the Coquille River inundated several roads, including Highways 42 and 42S.
Dec. 2005	Southwest Oregon	Heavy Rain, dike failure	10 homes damaged	Coalbank Slough south of Coos Bay flooded the Libby and Englewood Diking Districts damaging 10 homes. Damaged properties were the focus of flood mitigation efforts between 2006 and 2008.
Dec. 2004 (12/08/2004-12/09/2004)	W. Oregon	High surf; Heavy rain; Mudslides	25 ft. Surf	A large powerful Pacific storm brought a wide variety of weather to Western Oregon. Heavy rain accompanied this storm resulting in mud slides. Buoys 20 miles off the Oregon Coast reported maximum seas of 25 to 26 feet.
Feb. 2000*	Myrtle Point; Coos County	Flood	n/a	A flood warning was issued for the South Fork of the Coquille River at Myrtle Point.
Dec. 2001	City of Powers	Sanitary sewer overflow	n/a	Bypass of raw sewage into local waterway on 12/14/2001.
Nov. 2001	City of Myrtle Point	Sanitary sewer overflow	n/a	Bypass of raw sewage into local waterway on 11/21/2001.
July 2001	City of North Bend	Sanitary sewer overflow	n/a	Bypass of raw sewage into local waterway on 7/24/2001.

Date	Location	Event Type	Magnitude	Details
May 2001	City of Coos Bay	Sanitary sewer overflow	n/a	Bypass of raw sewage into local waterway on 12/7/2001.
May 2001	City of Myrtle Point	Sanitary sewer overflow	n/a	Bypass of raw sewage into local waterway on 5/15/2001.
May 2001	City of Coos Bay	Sanitary sewer overflow	n/a	Bypass of raw sewage into local waterway on 5/7/2001.
Jan. 2000	City of Powers	Sanitary sewer overflow	n/a	Bypass of raw sewage into local waterway on 1/11/2000.
Jan. 2000	City of Myrtle Point	Sanitary sewer overflow	n/a	Bypass of raw sewage into local waterway on 1/11/2000.
Dec. 1999	City of Myrtle Point	Sanitary sewer overflow	n/a	Bypass of raw sewage into local waterway on 12/7/1999.
Nov. 1999	City of Coquille	Sanitary sewer overflow	n/a	Bypass of raw sewage into local waterway on 11/6/1999.
Feb. 1999	Coos County	Flooding	$5 million in crop damage	$5 million in crop damage resulted from flooding along the Coquille River.
Nov. 1998 (11/30/1998)	Coos and Curry Counties	Flooding	n/a	The Coquille River flooded, including the North Fork at Myrtle Point.
Nov. 1998 (11/23/1998)	Coos County	High Wind, Heavy Rain	n/a	Stormy conditions, with strong winds and heavy rain. Flash flood warnings and small steam advisories issued for the two counties. Coquille River at flood stage.
Mar. 1998	City of Powers	Sanitary sewer overflow	n/a	Bypass of raw sewage into local waterway on 3/23/1998.
Nov. 1996 - Dec. 1996	Five Western States	Heavy Rain, Freezing Rain/Heavy Wet Snow	6-18 in. rain west of the Cascades; 8 in. in 24 hrs. in Coast Range	During the period from mid-November to mid-December 1996, many areas received above-normal precipitation, greatly increasing the snowpack over mid and high elevations. Three sequential storms brought moderate to heavy rain, with the last creating a rain-on-snow event which resulted in incredible amounts of runoff. Presidential Disaster Declaration for continued flooding, landslides, and mudslides from November 17th to December 11th. Oregon State of Emergency declared. Record-breaking precipitation throughout much of Oregon caused local flooding, landslides, and power outages over much of the state from November 18th-20th. All-time one-day precipitation records were set at many locations. North Bend was one of the locations, with a recoded 6.67” of rain in 24 hours.

Date	Location	Event Type	Magnitude	Details
Nov. 1996	Coos County, Oregon Coast	Heavy Rain, Floods	North Bend recorded 6.67" of rain in 24 hours	Road damage from landslides; high velocity flows, damage from erosion and undermining of structures. Record-breaking precipitation throughout much of Oregon caused local flooding, landslides, and power outages over much of the state from November 18th-20th. All-time one-day precipitation records were set at many locations. North Bend was one of the locations, with a recoded 6.67" of rain in 24 hours.
Feb. 1996 (2/4/1996; 2/21/1996)	Oregon Coast	Floods, Debris Flow	7 deaths; 100s of homes destroyed; $1 billion in damage.	A river of subtropical atmospheric moisture flowed above northern Oregon producing very heavy rainfall. Five Oregon residents died, thousands of people were sheltered and hundreds of homes were destroyed. Four days of heavy rain produced a disaster declaration in Coos County (Oregon Executive Order 96-18). Federal disaster aid to Coos County included individual assistance, public assistance (for repair and reconstruction of public facilities) damaged in the February floods in the wake of storms on February 4th and 21st.
Jan. 1995	Coos County	Heavy Rain, Flooding	$3 million in damage	Heavy rain caused $2.5- $3 million worth of damage to roads, highways residences, and parks in Coos County. Coquille River flooded.
Nov. 1991*	Oregon Coast	High Wind, High Surf	25 ft. waves	This slow-moving storm generated 25-foot waves and resulted in damage to buildings, boats, and transmission lines.
Nov.-Dec. 1977*	Western Oregon	Heavy Rain, Floods	n/a	Rain on snow event; $16.5 million in damages.
Jan. 1972*	Western Oregon	Heavy Rain, Floods	n/a	Record flows on coastal rivers.
Dec. 1964 * (12/24/1964)	Oregon	Floods, Heavy Rain, Winter Storm	100-year flood event; Benchmark	The Christmas flood of 1964 was driven by a series of storms, known as atmospheric rivers or "pineapple expresses," that battered the region producing as much as 15 inches of rain in 24 hours at some locations. The combination of heavy rain, melting snow, and frozen ground caused extreme runoff, erosion and flooding.
Dec. 1964 - Jan. 1965*	Oregon	Floods, Heavy Rain, Winter Storm		Rain on snow event; record flood on many rivers.
Mar. 1964*	Oregon Coast	Flood	n/a	n/a
Jan. 1956*	Western Oregon	High Wind, Heavy Rain, Mudslides		Heavy rains, high winds, mud slides resulted in estimated damages of $95,000.
Dec. 1945*	Coquille River	Flood		
Nov. 1909*	Coquille River	Flood		

Note: * indicates newly listed event for the 2021 NHMP update. Source: NOAA Storm Events Database, https://www.ncdc.noaa.gov/stormevents/, accessed 12/2/2019; Oregon NHMP, 2020.

Future Climate Conditions: Flood

The OCCRI report, Future Climate Projections Coos County, Oregon appears in full text in the Appendix. The key messages about flooding from that report are:

- The intensity of extreme precipitation is expected to increase as the atmosphere warms and holds more water vapor.
- In Coos County, the number of days per year with at least 0.75 inches of precipitation is not projected to change substantially. However, by the 2050s, the amount of precipitation on the wettest day and wettest consecutive five days per year is projected to increase by an average of 12% (range -2–25%) and 9% (range -5–23%), respectively, relative to the1971–2000 historical baselines, under the higher emissions scenario.
- In Coos County, the number of days The risk of coastal erosion and flooding on the Oregon coast is expected to increase as climate changes due to sea level rise and changing wave dynamics.
- In Coos County, local sea level is projected to rise by 1.2 to 5.3 feet by 2100. This projection is based on the intermediate-low to intermediate-high global sea level scenarios used in the 2018 U.S. National Climate Assessment. Because these local sea level projections account for estimated trends in vertical land movement, they are relative to the future land position.
- Given these levels of sea level rise, the multiple-year likelihood of a flood reaching four feet above mean high tide is 4–34% by the 2030s, 25–100% by the 2050s, and 100% by 2100.
- At risk within the four-foot inundation zone in Coos County as of the 2010 census are 1062 people, $72 million in property value, 10.9 miles of highways and roads, 9.4 miles of railways, 3 critical facilities, 2 municipal drinking water facilities, 3 potential contaminant sources, and 715 buildings.

Vulnerability Assessment

The 2021 DOGAMI Risk Report (Williams et al, 2021) identified locations within the study area that are comparatively more vulnerable or at greater risk to flood hazard:

- A large portion of the downtown area of the City of Coos Bay is prone to flooding. A large amount of damage ($42 million) could result from 100-year flooding in the City of Coos Bay.
- 100-year flooding from Tenmile Creek and Tenmile Lake would damage many buildings in the City of Lakeside. This community has the highest loss ratios from flooding than any other community in the study area.
- The commercial area by the marina in the City of Bandon is predicted to experience damages from flooding along the Coquille River.
- Flooding along the Coquille River is predicted to damage several buildings in the communities of Coquille and Myrtle Point.

Coos countywide 100-year flood loss:

- Number of buildings damaged: 1,870
- Loss estimate: $125,349,000
- Loss ratio: 1.1%
- Damaged critical facilities: 13
- Potentially displaced population: 2,116

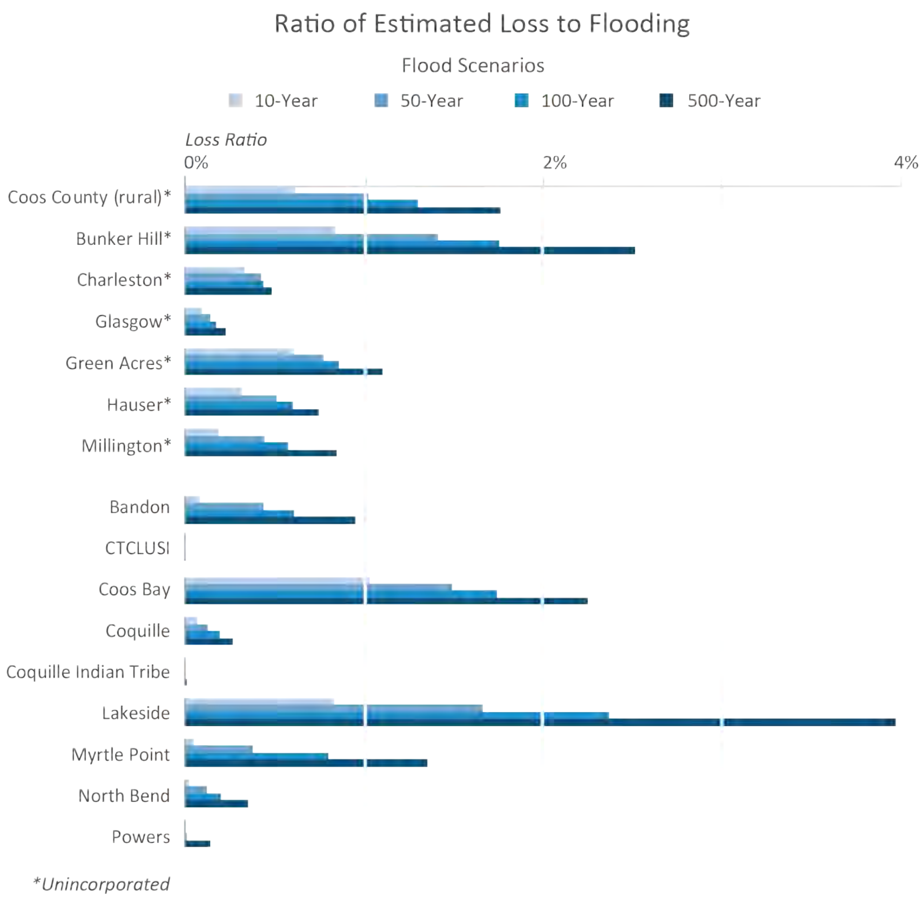
Source: Williams et al, 2021.

Table I-24. Flood Hazard Vulnerability Analysis Summary

Jurisdiction	Total	Risk Level	Jurisdiction	Total	Risk Level
Unincorporated Coos County	161	M	City of Powers	106	M
City of Bandon	159	M	Bay Area Hospital District	157	M**
City of Coquille	169	H	Haynes Drainage District	128	M
City of Coos Bay	171	H*	International Port of Coos Bay	171	H*
City of Lakeside	162	M	Port of Bandon	144	M
City of Myrtle Point	131	M	Southern Coos Hospital District	130	M
City of North Bend	169	H			

Source: Coos MJ-NHMP Risk Assessment, March-May 2021. Rankings are for riverine flooding unless noted: * tidal flooding; **dam failure, ***lake flooding.

Figure I-14. Flood loss Estimates by Coos County Community.



Source: Williams et al, 2021.

Table I-25. Flood Exposure

(all dollar amounts in thousands)

			Small (Low Severity)			Medium (Moderate Severity)			Large (High Severity)			X Large (Very High Severity)			XX Large (Extreme Severity)		
Community	Total Number of Buildings	Total Estimated Building Value ($)	Number of Buildings	Building Value ($)	Percent of Building Value Exposed	Number of Buildings	Building Value ($)	Percent of Building Value Exposed	Number of Buildings	Building Value ($)	Percent of Building Value Exposed	Number of Buildings	Building Value ($)	Percent of Building Value Exposed	Number of Buildings	Building Value ($)	Percent of Building Value Exposed
Unincorp. County (rural)	18,957	4,476,885	234	46,762	1.0%	418	94,049	2.1%	918	200,079	4.5%	2,015	464,241	10%	2,337	544,997	12%
Bunker Hill	740	173,872	1	418	0.2%	6	10,370	6.0%	71	40,907	24%	96	45,748	26%	107	48,463	28%
Charleston	1,549	310,927	247	78,239	25%	267	82,989	27%	465	123,141	40%	1,122	235,075	76%	1,238	254,901	82%
Glasgow	578	125,629	5	407	0.3%	13	2,537	2.0%	24	4,838	3.9%	37	8,339	7%	42	9,270	7.4%
Green Acres	367	79,090	0	0	0%	0	0	0%	0	0	0%	32	5,177	6.5%	45	8,693	11%
Hauser	1,022	286,877	0	0	0%	0	0	0%	1	11	0%	19	16,933	5.9%	52	38,178	13%
Millington	506	100,571	0	0	0%	0	0	0%	3	506	0.5%	44	13,191	13%	54	14,961	15%
Total Unincorp. County	23,719	5,553,851	487	125,826	2.3%	704	189,945	3.4%	1,482	369,483	6.7%	3,365	788,704	14%	3,875	919,463	17%
Bandon	1,962	629,445	145	49,200	7.8%	185	64,742	10%	276	91,553	15%	925	285,412	45%	1,374	431,860	69%
CTCLUCI	33	12,470	0	0	0%	0	0	0%	0	0	0%	0	0	0%	0	0	0%
Coos Bay	7,220	2,420,579	79	43,133	1.8%	319	267,595	11%	624	455,071	19%	1,018	578,485	24%	1,238	634,178	26%
Coquille	1,977	606,670	0	0	0%	0	0	0%	0	0	0%	0	0	0%	1	447	0.1%
Coquille Indian Tribe	100	80,721	0	0	0%	3	4,147	5.1%	6	44,153	55%	37	56,737	70%	44	58,670	73%
Lakeside	1,421	242,768	0	0	0%	0	0	0%	7	4,044	1.7%	43	10,543	4.3%	76	16,944	7.0%
Myrtle Point	1,329	383,743	0	0	0%	0	0	0%	0	0	0%	0	0	0%	0	0	0%
North Bend	4,233	1,494,790	23	6,110	0.4%	75	85,107	5.7%	263	168,526	11%	558	304,613	20%	608	316,952	21%
Powers	556	111,516	0	0	0%	0	0	0%	0	0	0%	0	0	0%	0	0	0%
Total Coos County	42,550	11,536,552	734	224,270	1.9%	1,286	611,536	5.3%	2,658	1,132,830	9.8%	5,946	2,024,494	18%	7,216	2,378,514	21%

Source: Williams et al, 2021.

National Flood Insurance Program (NFIP) in Coos County

Table I-26. National Flood Insurance Program (NFIP) Dates

Jurisdiction	Effective FIRM and FIS	Initial FIRM Date	Last Community Assistance Visit
Coos County	12/7/2018	11/15/1984	8/13/2018
City of Bandon	12/7/2018	8/15/1984	9/20/2001
City of Coos Bay	12/7/2018	8/1/1984	4/1/1992
City of Coquille	12/7/2018	9/28/1984	8/15/2018
City of Lakeside	12/7/2018	8/1/1984	2/22/2019
City of Myrtle Point	12/7/2018	7/16/1984	10/1/1989
City of North Bend	12/7/2018	8/1/1984	8/13/2018
City of Powers	12/7/2018	6/30/1976	N/A

Source: FEMA Community Information System, 04/06/2021, Mitch Paine, FEMA Region 10

Table I-27. National Flood Insurance Program (NFIP) Insurance Information

Jurisdiction	Insurance in Force	Total Paid Claims	Pre-FIRM Claims Paid	Substantial Damage Claims	Total Paid Amount
Coos County	$43,660,300	89	58	12	$1,091,145
City of Bandon	$19,030,400	16	10	0	$129,152
City of Coos Bay	$545,900	0	0	0	$0
City of Coquille	$32,666,800	58	37	7	$1,356,522
City of Lakeside	$5,776,500	8	3	1	$16,527
City of Myrtle Point	$0	10	1	1	$24,497
City of North Bend	$10,264,000	6	3	0	$30,286
City of Powers	$140,000	1	1	0	$964

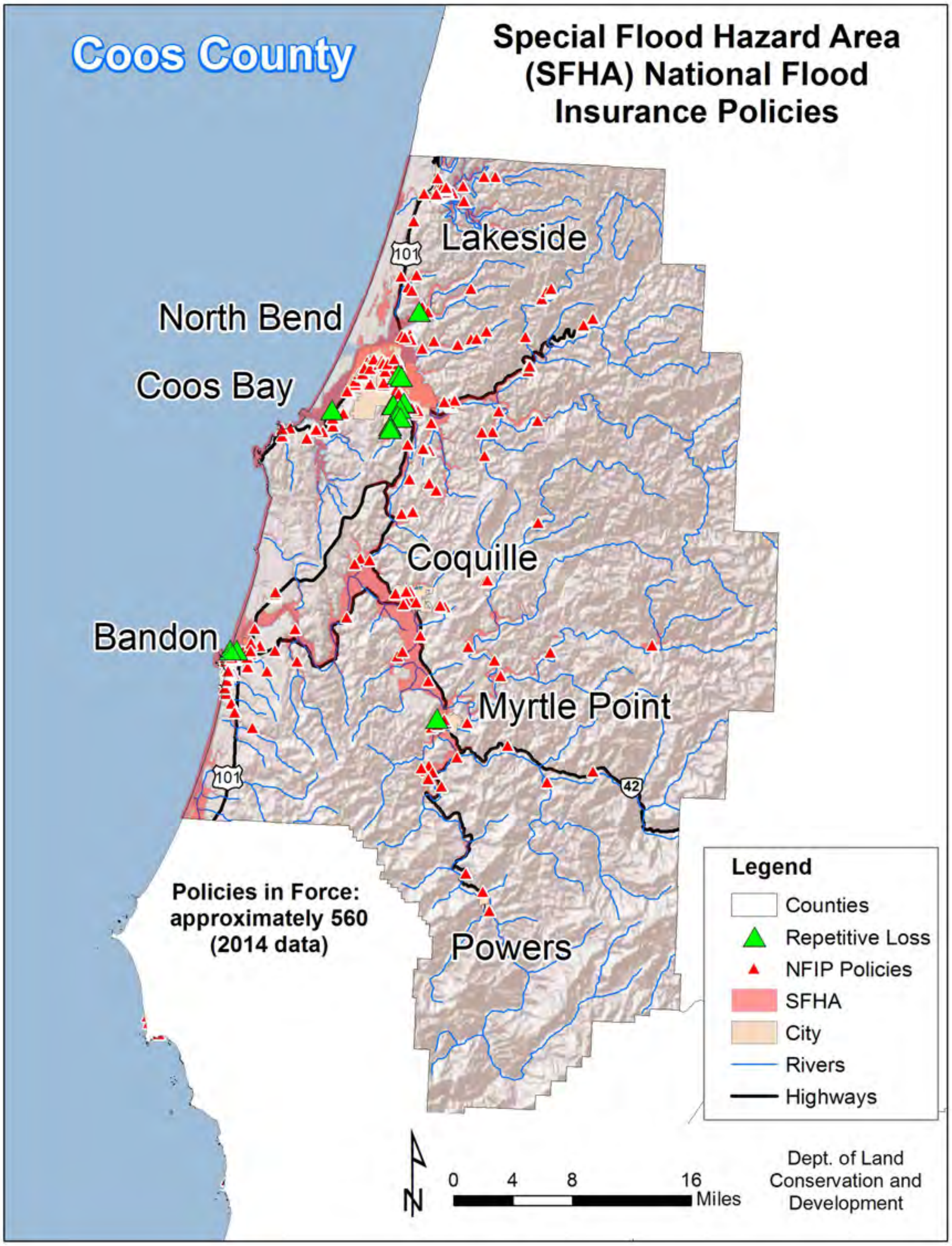
Source: FEMA Community Information System, 04/06/2021, Mitch Paine, FEMA Region 10

Table I-28. NFIP Repetitive Loss & Severe Repetitive Loss Properties and CRS

Jurisdiction	Repetitive Loss Structures	Severe Repetitive Loss Structures	CRS Class Rating
Coos County	10	0	10
City of Bandon	1	0	10
City of Coos Bay	0	0	10
City of Coquille	7	0	10
City of Lakeside	0	0	10
City of Myrtle Point	0	0	10
City of North Bend	0	0	10
City of Powers	0	0	10

Source: FEMA Community Information System, 04/06/2021, Mitch Paine, FEMA Region 10

Figure I-15. Repetitive & Severe Repetitive Loss Properties



Source: Department of Land Conservation and Development, August 2015

Table I-29. Flood Loss Estimates

(all dollar amounts in thousands)

Community	Total Number of Buildings	Total Estimated Building Value ($)	10% (10-yr)			2% (50-yr)			1% (100-yr)*			0.2% (500-yr)		
			Number of Buildings	Loss Estimate	Loss Ratio	Number of Buildings	Loss Estimate	Loss Ratio	Number of Buildings	Loss Estimate	Loss Ratio	Number of Buildings	Loss Estimate	Loss Ratio
Unincorp. County (rural)	18,957	4,476,885	602	27,673	0.6%	825	45,993	1.0%	890	58,390	1.3%	948	79,270	1.8%
Bunker Hill	740	173,872	33	1,463	0.8%	41	2,465	1.4%	50	3,061	1.8%	52	4,379	2.5%
Charleston	1,549	310,927	14	1,050	0.3%	17	1,324	0.4%	18	1,381	0.4%	20	1,517	0.5%
Glasgow	578	125,629	7	120	0.1%	9	183	0.1%	9	227	0.2%	10	292	0.2%
Green Acres	367	79,090	12	485	0.6%	15	613	0.8%	16	681	0.9%	22	877	1.1%
Hauser	1,022	286,877	6	931	0.3%	7	1,475	0.5%	8	1,738	0.6%	8	2,148	0.7%
Millington	506	100,571	6	191	0.2%	11	449	0.4%	13	586	0.6%	18	853	0.8%
Total Unincorp. County	23,719	5,553,851	680	31,913	0.6%	925	52,501	0.9%	1,004	66,064	1.2%	1,078	89,336	1.6%
Bandon	1,962	629,445	21	544	0.1%	74	2,774	0.4%	94	3,855	0.6%	110	6,028	1.0%
CTCLUCI	33	12,470	0	0	0%	0	0	0%	0	0	0%	0	0	0%
Coos Bay	7,220	2,420,579	344	25,021	1.0%	436	36,201	1.5%	468	42,299	1.7%	490	54,591	2.3%
Coquille	1,977	606,670	8	415	0.1%	19	799	0.1%	23	1,207	0.2%	23	1,619	0.3%
Coquille Indian Tribe	100	80,721	0	0	0%	0	0	0%	1	2	0%	1	9	0%
Lakeside	1,421	242,768	49	2,033	0.8%	119	4,044	1.7%	171	5,768	2.4%	248	9,661	4.0%
Myrtle Point	1,329	383,743	17	197	0.1%	60	1,474	0.4%	80	3,081	0.8%	88	5,224	1.4%
North Bend	4,233	1,494,790	12	385	0%	24	1,852	0.1%	27	3,063	0.2%	32	5,360	0.4%
Powers	556	111,516	0	0	0%	0	0	0%	2	11	0%	4	157	0.1%
Total Coos County	42,550	11,536,552	1,131	60,508	0.5%	1,657	99,644	0.9%	1,870	125,349	1.1%	2,074	171,986	1.5%

Source: Williams et al, 2021.

Table I-30. Flood Exposure

			1% (100-yr)*				
Community	Total Number of Buildings	Total Population	Potentially Displaced Residents from Flood Exposure	% Potentially Displaced Residents from Flood Exposure	Number of Flood Exposed Buildings	% of Flood Exposed Buildings	Number of Flood Exposed Buildings Without Damage
Unincorp. County (rural)	18,957	18,664	763	4.1%	938	4.9%	48
Bunker Hill	740	1,376	22	1.6%	53	7.2%	3
Charleston	1,549	2,228	37	1.7%	20	1.3%	2
Glasgow	578	757	6	0.7%	10	1.7%	1
Green Acres	367	406	15	3.6%	21	5.7%	5
Hauser	1,022	1,145	11	1.0%	8	0.8%	0
Millington	506	666	13	1.9%	14	2.8%	1
Total Unincorp. County	23,719	25,242	866	3.4%	1,064	4.5%	60
Bandon	1,962	3,066	60	2.0%	123	6.3%	29
CTCLUCI	33	47	0	0%	0	0%	0
Coos Bay	7,220	15,966	773	4.8%	493	6.8%	25
Coquille	1,977	3,866	24	0.6%	23	1.2%	0
Coquille Indian Tribe	100	313	0	0.0%	1	1.0%	0
Lakeside	1,421	1,699	253	15%	233	16%	62
Myrtle Point	1,329	2,514	119	4.7%	85	6.4%	5
North Bend	4,233	9,651	18	0.2%	29	0.7%	2
Powers	556	687	4	0.6%	4	0.7%	2
Total Coos County	42,550	63,052	2,116	3.4%	2,055	4.8%	185

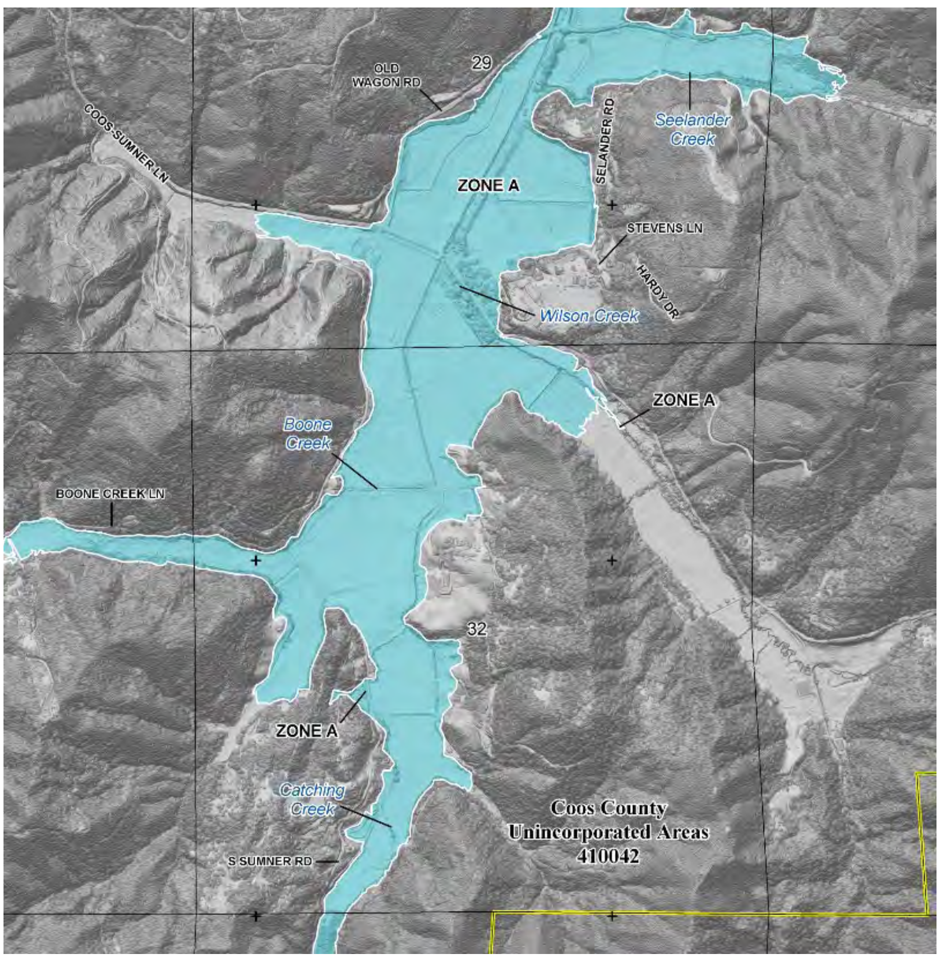
*1% results include coastal flooding source. Source: Williams et al, 2021.

Areas at Risk: Sumner

The Sumner Rural Fire Protection District participated in the 2021-2022 Coos County MJ-NHMP update process by attending numerous meetings and providing specific input (Rob Aton on 5/3/2021) about the flood risk of this unincorporated community served by Sumner Fire. Coos County has many waterways, wetlands, and two estuaries. The settlement areas and roads all follow the course of water as it heads towards the ocean. All this moisture, and low elevation topography, creates great growing conditions for trees. And the forest and waterways are what drive the hazard risk for the community of Sumner.

Flooding in Sumner is caused by Catching Slough, Wilson, and Boone Creeks. Flood waters frequently come over the dikes, South Sumner Road, and Old Wagon Road. Sumner Fire station is on a hill, and in flood conditions there is only water to the west which blocks access to the fire station. Unfortunately, west is the direction of services and the employment centers, and the roads follow the waterways. The local transportation route in Sumner sometimes has 36" of water on it during flood events and results in locals being unable to safely commute to work. People with four-wheel drive vehicles will shuttle residents through the floodwaters, which is a dangerous result of inadequate transportation infrastructure in this unincorporated community.

Figure I-16. Sumner Flood Risk, Zone A



Source: FEMA Map Service Center Note: FIRM 41011C0335F, effective 12/07/2018

Figure I-17. Community of Sumner

Source: DLCD via personal communication with Rob Aton, Sumner RFPD, 5/3/2021

Figure I-18. Sumner Flooding Location

Source: DLCD via personal communication with Rob Aton, Sumner RFPD, 5/3/2021

Risk Reduction Recommendations

The science of risk reduction is an emerging field. These potential flood mitigation actions are listed along with the hazard description so that readers understand the type of mitigation actions being considered or that might be considered current best practices. Source: DOGAMI, DLCD.

- For jurisdictions that participate in the NFIP:
    - Enforce minimum NFIP requirements by implementing the flood ordinance and permitting requirements
    - Consider adopting higher standards such as adding freeboard to base flood elevation requirements (e.g. +1’ or +2’ BFE)
    - Regulate to the 500-year floodplain rather than the 100-year
    - Explore enhanced measures to achieve standing in CRS
    - Encourage the purchase of flood insurance by sending a flood awareness message out in early fall.
- Find opportunities to increase flood water storage areas.
- Relocate or elevate vulnerable structures to above the estimated base flood elevation. In some cases, communities can use FEMA’s property acquisition or “buyout” program to remove structures that have repeatedly flooded in the past.
- Develop incentive programs to encourage flood mitigation retrofits such as: add flood vents, elevate HVAC and electrical equipment, or add flood-resistant materials to buildings built before modern flood code was adopted.
- Address repetitive loss and severe repetitive loss structures using FEMA’s property acquisition or “buyout” program (Flood Management Assistance or FMA) to remove structures that have repeatedly flooded in the past.
- Create more permeable surfaces within urban areas to improve drainage and reduce flood peaks. Large parking lots are great candidates for improved permeability.

5. High Hazard Potential Dam Failure

Effective April 2023, FEMA has new plan update requirements that include additional considerations for high hazard potential dams (HHPDs). The Oregon Water Resources Department's (OWRD) Dam Safety Program is actively working to ensure that Oregonians do not face "unacceptable" risk from HHPDs, by developing action plans for dams that do not meet sufficient safety standards. Dams that pose a high risk to life safety in the event of a failure event are called high-hazard potential dams (HHPDs). In June 2020, FEMA released new grant program guidance for Rehabilitation of High Hazard Potential Dams (FEMA, 2020) and new guidance for inclusion of HHPDs in Local Mitigation Planning Policy that becomes effective April 19, 2023 (FEMA, 2022). The legal definition of high hazard in Oregon is ORS 540.443(5); "high hazard rating" means that the department expects loss of human life to occur if a dam fails. Technical information from reports, analyses, inspections and enforcement actions by the OWRD dam safety program were used to develop this annex to the Coos County MJ-NHMP.

Coos County Dams

The National Inventory of Dams lists fourteen dams in Coos County. According to the National Inventory of Dams, there are a total of two dams with high hazard potential in Coos County—both are owned by the Coos Bay-North Bend Water Board. There are six dams classified with significant hazard potential and six with low hazard potential.

Table I-31. Dams in Coos County (NID)

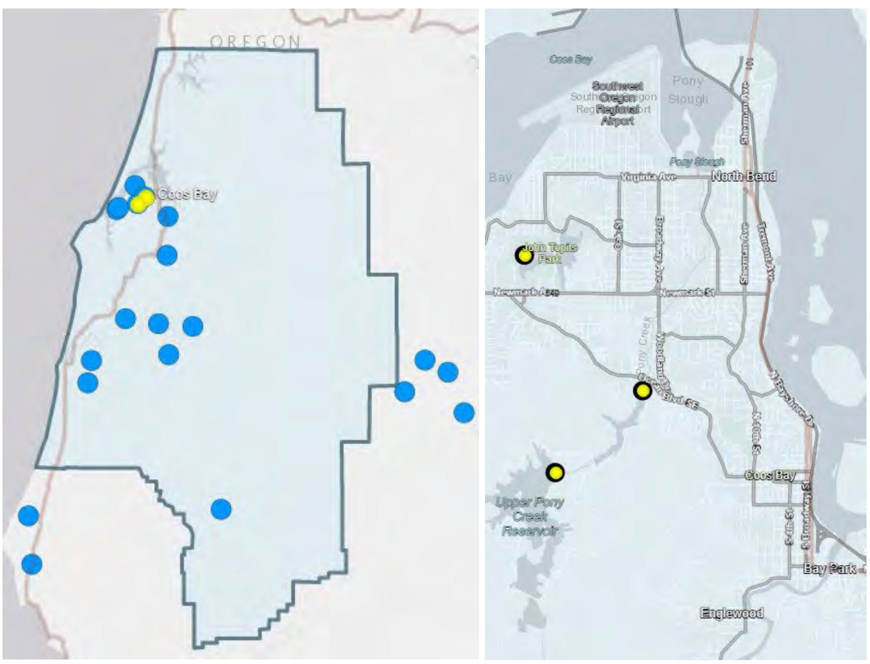
Name	Hazard Potential Classification	NID Height (Ft)	Max Storage (Acre-Ft)	Owner	Purpose/Notes
Pony Creek – Upper	High	77	6,245	Coos Bay – North Bend Water Board	Water Supply/ Earthen Dam in Satisfactory Condition; Assessment 11/06/2020.
Pony Creek – Lower	High	38	400	Coos Bay – North Bend Water Board	Water Supply/ Earthen Dam in Poor Condition; Assessment 09/23/2021.
Jackson Farms Dam	Significant	60	90	James W. Jackson	Irrigation/ Earthen dam
Ring Creek Reservoir	Significant	55	246	City of Coquille	Water Supply/ Earthen dam
Windhurst	Significant	43	470	Windhurst Road Watering Corp.	Irrigation/ Earthen dam
Powers Log Pond	Significant	15	108	Snellstrom Lumber Company	Other/ Earthen dam
Tarheel	Significant	16	100	DOI Bureau of Indian Affairs	Earthen dam
Fourth Creek Reservoir	Significant	12	21	DOI Bureau of Indian Affairs	Water Supply/ Earthen dam
Smith, C.A. Reservoir	Low	10	99	Weyerhaeuser	Other/ Earthen dam
Coquille Plywood Mill	Low	11	180	Roseburg Forest Products	Other/ Earthen dam

Empire Lake, Lower	Low	11.5	192	City of Coos Bay	Water supply/ Gravity dam
Johnson Log Sorting Pond	Low	12.5	491	Coos County Parks Department	Other/ Earthen dam
Clausen Dam	Low	15	64	Douglas Crane	Recreation/ Earthen dam
15ht Hole Dam	Low	25	27.4	Coos Country Club	Recreation/ Water Supply/ NA

Source: USACE (2020). Note: Hazard classifications: High: Failure would present a strong risk for loss of life, annual inspection, Emergency Action Plan (EAP) required. Significant: Failure would present a strong risk for loss of major infrastructure, inspection every 3 years, EAP not required.

There are 2 high hazard potential dams, Pony Creek Upper and Pony Creek Lower dams. As part of the 2023 plan update, the OWRD State Engineer for Water Resources/ Dam Safety Program Manager confirmed that only the Lower Pony Creek Dam is in poor or unsatisfactory condition, as of 9-15-2022. Thus, Coos County has just one dam that meets the criteria for the “high-hazard potential dam" FEMA grant program.

Figure I-19. Coos County High Hazard Dams



Source: NID, 2022. Note: high hazard potential dams (HHPDs) *are in yellow. Lower Pony Creek dam is in the center of the map above; Upper Pony Creek dam is below it and to the southwest. Portions of North Bend neighborhoods and major roadways are below the dam.*

There are 6 Coos County dams rated to present a significant hazard. Failure of a significant hazard dam would cause damage to others property and or infrastructure, but loss of life not probable. These significant hazard dams are Jackson Farms, Windhurst, Rink Creek, and Powers log pond, dams that are regulated by OWRD. There are two additional significant hazard dams in the County, Fourth Creek and Tarheel, that are regulated by the Bureau of Indian Affairs. Hazard rating on many dams has not been screened in detail, and it is possible some of these dams currently rated significant hazard would be high hazard after dam breach inundation analysis. There are 6 low hazard dams in the National Inventory of Dams (NID) for Coos County, plus three low additional hazard dams that meet state but not federal criteria. There are also numerous small ponds that are permitted to store water but do not meet statutory size thresholds. These dams that do not qualify for HHPD funding may need repairs potentially fundable under other programs or may later found to qualify for HHPD if additional studies or changes in development reveal a risk to life safety.

The Oregon Water Resources Department regulates non-Federal dams in Oregon, and these non-Federal dams are inspected on a frequency based on the hazard rating of the dam. Again, Lower Pony Creek dam is the only high hazard potential dam in Coos County. The Lower Pony Creek dam is owned by the Coos Bay North Bend Water Board, a public non-profit entity. The following sections address the FEMA review tool requirements for this natural hazard mitigation plan in order for the Coos Bay North Bend Water Board to receive federal funds for dam removal or rehabilitation.

Risk Assessment

Lower Pony Creek Dam is classified as a high hazard potential dam and has always been rated as a high hazard potential dam. Dams are assigned a hazard rating based on downstream hazard to people and property, not on the condition of the dam. There are many homes, the Water Treatment Plant for all local water supplies, roads and commercial structures below the dam and within the Pony Creek drainage.

A recent seismic engineering investigation of the dam completed by a geotechnical consulting engineering firm identified a loose sand layer below the dam. It is likely this material may liquefy in a Cascadia Subduction Zone Earthquake. OWRD is currently doing a all-risks assessment to compare this dam to other HHPD eligible dams in the state. Based on this the preliminary investigation there is a reasonable likelihood that the dam could fail in a Cascadia Earthquake. The Water Board has been formally notified of the potential unsafe condition on the dam as per ORS 540.458. The dam is currently under formal approximately quantitative risk screening along with all dams eligible for the HHPD funds. OWRD dam safety is aware of no other serious deficiencies on this dam (no significant risk due to storm and extreme flooding, wildfire related issues, or any landslide that could cause overtopping).

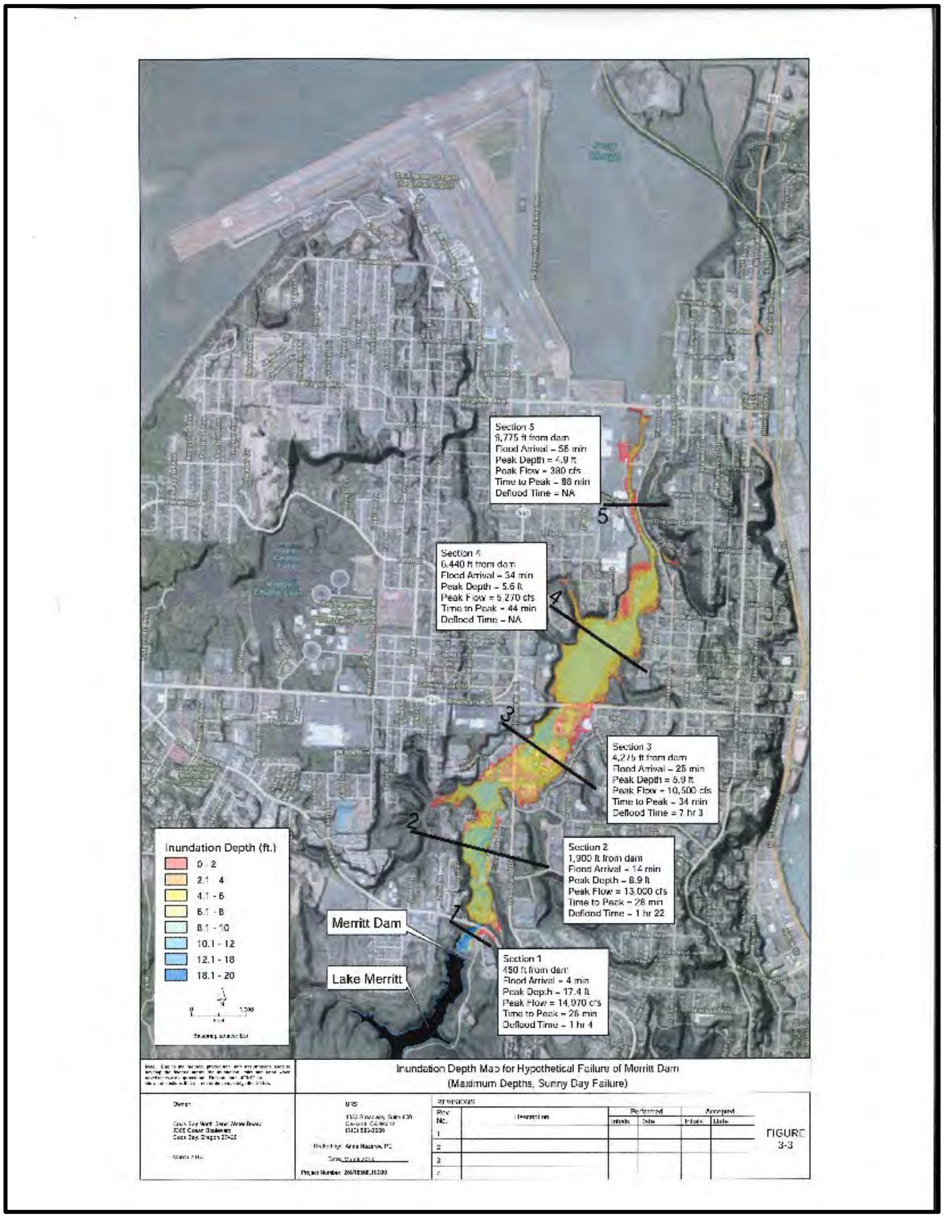
Of extreme importance, the dam and its reservoir are an essential part of the water supply for about 25,000 people. As such, it must be made safe to supply water to the residents, especially when access is limited by the earthquake. The dam is directly above the water treatment plant, with some parts of the plant within 100 feet of the dam.

Lower Pony Creek Dam

High hazard potential dams have Emergency Action Plans that features inundation mapping that allows the development of scenarios of risk and calculation of impacts to the downstream buildings, infrastructure, and populations downstream of the structure. HEC-RAS modeling allows for engineers to understand where the volume of water could be discharged in the event of a dam breach. An initial screening using the DSS Wise Program was conducted for Lower Pony Creek Dam NID OR00070. This inundation model determined that of the 25,000 users of the water system, 408 persons were at risk of dam failure at night and 687 persons during the day. The statistics are based on occupancy and use of the area below the dam, such as residential housing and commercial units.

Population at Risk (PAR):
- Daytime PAR: 687
- Night-time PAR: 408
- Users of the Water System: 25,000

Figure I-20. Lower Pony Creek Dam Inundation Map



Note: This is the HCOM probable maximum flood, dam failure inundation map

Specific Deficiencies

The Coos Bay North Bend Water Board is the owner of two dams for their water supply—Lower and Upper Pony Creek dams. These dams are very close to the Cascadia Subduction Zone. The upper dam has design features that may prepare it for the Cascadia event. The lower dam was not designed for a large earthquake, and recent investigations indicate it could be highly prone to seismic liquefaction damage. For this reason, the Department recommended the Water Board complete a seismic safety analysis of the dam. The Water Board paid $98,563 for a Phase 1 geotechnical investigation and preliminary analysis.

This initial investigation analysis identified loose sand under the dam, with high potential for liquefaction which would cause catastrophic failure. Phase 1 did not include sufficient subsurface exploration for full determination of specific risk or mitigation alternatives. This is a very high-risk scenario, as there is a high population living in the inundation zone, as well as a water treatment plant right below the dam. Dam failure would cause catastrophic loss of life because there would be no significant warning. Dam failure would also destroy the water supply for both Cities.

The full scope of seismic analysis work (Phase 2) is as follows:

- Project Management/Meetings
- Subsurface Investigation
- Laboratory Testing (index testing and cyclic testing)
- Liquefaction Analyses & Residual Strength Analyses
- Finite-Element Deformation Analyses

The dam safety program needs evaluation of soil improvement methods that may also be needed by other dams in Oregon. This project will also include evaluation of soil improvement and other methods for stabilizing this dam, with advice on how these methods could apply to other Oregon dams near the Cascadia Subduction Zone.

OWRD Seismic Analysis

A complete seismic analysis funded by the Oregon Water Resources Department, and not through HHPD grant funding. A reimbursement of engineering analysis costs will be made to the public dam owner. The owner currently has an agreement with a geotechnical engineering firm. OWRD is in coordination on the project with the lead engineer for the Water Board, see planning process description below. Coos Bay-North Bend Water Board is capable of implementation and amenable to acting on OWRD and contract recommendations to improve seismic resilience. The initial seismic analysis will have three deliverables:

1. Determination of specific expected deformation and likelihood of failure of Lower Pony Creek dam in a Cascadia earthquake.

2. Analysis of alternatives for making the Lower Pony Creek dam safe, with emphasis of improvement of soils in place or other means to reduce crest deformation.

3. A Geotechnical Report summarizing all findings and conclusions about Lower Pony Creek dam.

Project Budget

- Estimated cost of design $250,000-300,000

- Estimated costs of rehabilitation $5,000,000 could be $0 to $12,000,000

Mitigation Goals

A water supply reservoir that does not pose a risk of failure in a Cascadia subduction zone earthquake. Under current conditions, failure appears to be likely in such an event, and would result in catastrophic loss of life, and also loss of all water supplies for 25,000 people.

Mitigation Actions

- Fully exercise the Emergency Action Plans for both dams, including a scenario with failure of the lower dam in a CSZ earthquake. Work with OWRD on a failure scenario that occurs with full effects of the earthquake throughout Coos County.
- Complete the final seismic evaluation of the dam.
- Determine the quantitative risk in terms of the likelihood of failure and the loss of life on an annualized basis.
- Determine the most efficient and effective means to prevent failure in a CSZ earthquake.
- Rehabilitate the Lower Pony Creek dam within the next 5 years, in part using funds from the FEMA HHPD program, so that it no longer poses an elevated risk of failure in a CSZ event.

Planning Process

A Formal Notice was sent to the dam owner on April 6, 2021 of a Potentially Unsafe Dam determination for Lower Pony Creek Dam.

Dam Safety has been in close coordination with the Water Board on completion of the seismic analysis. OWRD has funding for this analysis, it is not FEMA HHPD funding. Water Board Staff made a January 20, 2022 a presentation on funding for the geotechnical analysis, and we provided support at this meeting.

OWRD is still working though procedures with the Department of Administrative Services for engineer selection to conduct the final seismic analysis.

OWRD dam safety engineers inspect the dam every year, meeting on site with the chief engineer for the Water Board. Most recently, the dam was inspected on February 11, 2022.

6. Landslide

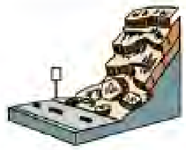
Causes and Characteristics

Coos County is subject to landslide events. Landslides are downhill movements of rock, debris, or soil. The severity or extent of landslides is typically a function of geology and the landslide triggering mechanism. Rainfall initiated landslides tend to be smaller, and earthquake induced landslides may be very large. Even small slides can cause property damage, result in injuries, or take lives.

Landslides are classified according to the type and rate of movement and the type of materials that are transported. In a landslide, two forces are at work: 1) the driving forces that cause the material to move down slope, and 2) the friction forces and strength of materials that act to retard the movement and stabilize the slope. When the driving forces exceed the resisting forces, a landslide occurs. The severity or extent of landslides is typically a function of geology and the landslide triggering mechanism. Rainfall initiated landslides tend to be smaller, and earthquake induced landslides may be very large. Even small slides can cause property damage, result in injuries, or take lives.

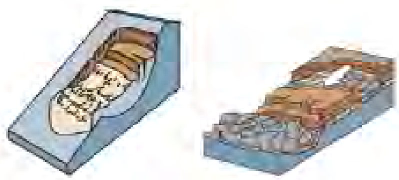
Figure I-21. Allegany One Lane Access Road

Figure I-22. Landslide Types and Processes



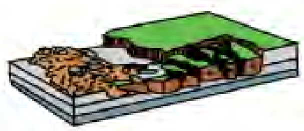
Falls are near-vertical, rapid movements of masses of materials, such as rocks or boulders. The rock debris sometimes accumulates as talus at the base of a cliff.

Topples are distinguished by forward rotation about some pivotal point, below or low in the mass.

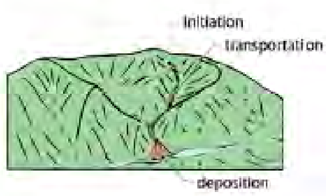


Slides are downslope movement of soil or rock on a surface of rupture (failure plane or shear-zone).

- **Rotational** slides move along a surface of rupture that is curved and concave.
- **Translational** slides displace along a planar or undulating surface of rupture, sliding out over the original ground surface.



Spreads are commonly triggered by earthquakes, which can cause liquefaction of an underlying layer and extension and subsidence of commonly cohesive materials overlying liquefied layers.



Channelized Debris Flows commonly start on a steep, concave slope as a small slide or earth flow into a channel. As this mixture of landslide debris and water flows down the channel, it pick ups more debris, water, and speed, and deposits in a fan at the outlet of the channel.

Earth Flows commonly have a characteristic "hourglass" shape. The slope material liquefies and runs out, forming a bowl or depression at the head.

Complex landslides are combinations of two or more types. A common complex landslide is a slump-earth flow, which usually exhibit slump features in the upper region and earth flow features near the toe.

Source: USGS, 2004.

Hazard History

The following table provides information on the previous occurrences of landslides. Three new landslide events have occurred since 2016.

Table I-32. Historic Landslide Events

Date	Location	Description
2022*	Lakeside	N. Lake Road just south of Sun Lake Rd
Jan. 2022*	Allegany	100+ homes are cut off regularly by a persistent problem area that has been causing problems since 2019.
Ongoing*	Glasgow	East Bay Road, an important route and lifeline, is at risk of being permanently cut off by a slope failure.
Apr. 2012	Coos Bay	Heavy rains caused landfill on Johnson Rock property to slide into Coos Bay's Coalbank Slough.
Mar. 2012	Coos County	Winds and heavy rains caused flooding, mudslides, and landslides in twelve counties. Damages to state highways were estimated at $5,856,881.
Feb. 2004	Coos County	Landslide covered the only paved road leading to the city of Powers, Blocked access to and from the city.
Nov. 1996 -Jan. 1997	Coos County	Severe rains caused multiple landslides in the county. Five homes in Myrtle Creek fell off their foundations when a clear-cut gave way. Bill's Creek Road southeast of Bandon washed out, contributing to flooding in Ferry Creek.
Mar. 1972	Coos County	Landslide due to heavy rains caused $28,000 in damages.
Feb. 1926	Coos County	Landslide closed Roosevelt Highway between Coos Bay and Coquille, causing at least $25,000 in damages.

Note: * indicates newly listed event for the 2021 NHMP update—more detailed information on these events is available in the vulnerability assessment section below. Source: 2016 Coos NHMP; 2021 Coos NHMP Steering Committee, 2022 Coos Emergency Management.

Future Climate Conditions: Landslide

The OCCRI report, Future Climate Projections Coos County, Oregon appears in full text in the Appendix.

In Coos County, the number of days per year on which a threshold for landslide risk, which is based on prior 18-day precipitation accumulation, is exceeded is not projected to change substantially. However, landslide risk depends on multiple factors, and this metric does not reflect all aspects of the hazard.

Vulnerability Assessment

The 2021 DOGAMI Risk Report (Williams et al, 2021) identified locations within the study area that are comparatively more vulnerable or at greater risk to landslide hazard:

- Several inhabited areas in the community of Glasgow are exposed to very high landslide susceptibility.
- The community of Green Acres has a significant amount of exposure (83%) to high and very high landslide susceptibility.

- Exposure to landslide hazard is present for buildings throughout the unincorporated county.
- Additionally, a large portion of undeveloped land in the unincorporated county is deemed high or very high landslide susceptibility, which can be a factor when determining future developments.

Coos countywide landslide exposure (High and Very High susceptibility):

- Number of buildings: 7,123
- Exposure value: $1,583,583,000
- Percentage of exposure value: 14%
- Critical facilities exposed: 16
- Potentially displaced population: 9,550

Source: Williams et al, 2021.

Table I-33. Landslide Hazard Vulnerability Analysis Summary

Jurisdiction	Total	Risk Level	Jurisdiction	Total	Risk Level
Unincorporated Coos County	156	M	City of Powers	156	M
City of Bandon	112	M	Bay Area Hospital District	162	M
City of Coquille	112	M	Haynes Drainage District	96	M
City of Coos Bay	99	M	International Port of Coos Bay	182	H
City of Lakeside	97	M	Port of Bandon	112	M
City of Myrtle Point	109	M	Southern Coos Hospital District	92	M
City of North Bend	97	M			

Source: Coos MJ-NHMP Risk Assessment, March-May 2021.

Risk to Lifelines

Many types of lifeline infrastructure are at some degree of risk from landslides such as railroads, power lines, and highways. In the course of this NHMP update, DOGAMI assessed the relative landslide risk of the county using a lens of structure location and building development. Their risk assessment provides plan holder jurisdictions with the first locally specific loss estimations for a variety of hazards. Because of the detail of the information available, risk mitigation should begin there, with structures. However, Coos Emergency Management is currently coordinating with local partners to improve evacuation infrastructure and in that effort, provided the following specific areas that are vulnerable to landslide.

Evacuation Routes

Coos Emergency Management actively inventories and works to protect access routes that are high priority for evacuation for communities countywide. These efforts include understanding and coordinating to address landslides on access roads, development of evacuation plans in order to understand and map priority evacuation routes, as well as coordination on meeting the criteria for potential funding sources such as conducting this plan update. The following landslide risk areas are evacuation route priorities.

W. Fork Millicoma Rd, Coos Bay (Allegany)

Located on W. Fork Millicoma Road near the intersection with Chemeketa Lane at (43°26'27.97"N, 124° 3'1.22"W), the upper side of the road is subject to landslide due to slope failure. W. Fork Millicoma Road is an important route and lifeline at risk of closure.

Figure I-23. Allegany Landslide Location

Source: Google Earth, Coos Emergency Management, DLCD

Figure I-24. Allegany Landslide at Intersection with Chemeketa Lane

Source: Google Earth, Coos Emergency Management, DLCD

E. Bay Road, North Bend (Glasgow)

Located between the intersections with Hawk Ln and Rose Mountain Ln at (43°25'53.5"N, 124°12'21.7"W) or (43.431539, -124.206019). East Bay Road is an important route and lifeline at risk from a landslide due to slope failure.

Figure I-25. E. Bay Road Landslide Location

Source: Google Earth, Coos Emergency Management, DLCD

Figure I-26. E. Bay Road Landslide Intersection

Source: Google Earth, Coos Emergency Management, DLCD

North Lake Road, Lakeside

Located on a sharp switchback on the outside tip of a ridge, a landslide on the upper side of N. Lake Road just south of Sun Lake Road at (43°35'26.1"N 124°06'02.0"W) or (43.590589, -124.100542) in Lakeside threatens the only access route for the community residing on Sun Lake Road and the surrounding area.

Figure I-27. N. Lake Rd Landslide Location

Source: Google Earth, Coos Emergency Management, DLCD

Risk to Structures

In the landslide exposure table below, Table I-27, very high susceptibility to risk of landslide in the unincorporated county is 7.0% overall (1,206 buildings) and Myrtle Point is 3.7% (64 buildings). These areas and Coos Bay also have significant buildings in the high and moderate susceptibility categories.

Table I-34. Landslide Exposure

			(all dollar amounts in thousands)								
			Very High Susceptibility			**High Susceptibility**			**Moderate Susceptibility**		
Community	**Total Number of Buildings**	**Total Estimated Building Value ($)**	**Number of Buildings**	**Building Value ($)**	**Percent of Building Value Exposed**	**Number of Buildings**	**Building Value ($)**	**Percent of Building Value Exposed**	**Number of Buildings**	**Building Value ($)**	**Percent of Building Value Exposed**
Unincorp. County (rural)	18,957	4,476,885	1,406	314,141	7.0%	2,343	468,534	11%	6,435	1,372,990	31%
Bunker Hill	740	173,872	0	0	0%	42	7,681	4.4%	255	44,854	26%
Charleston	1,549	310,927	0	0	0%	85	16,793	5.4%	304	61,103	20%
Glasgow	578	125,629	131	26,504	21%	63	10,971	8.7%	198	39,009	31%
Green Acres	367	79,090	100	21,050	27%	206	44,330	56%	24	4,008	5.1%
Hauser	1,022	286,877	3	415	0%	99	20,502	7.1%	452	96,894	34%
Millington	506	100,571	4	942	0.9%	63	12,892	13%	110	19,876	20%
Total Unincorp. County	23,719	5,553,851	1,644	363,053	6.5%	2,901	581,703	11%	7,778	1,638,734	30%
Bandon	1,962	629,445	4	672	0.1%	47	12,707	2.0%	285	84,494	13%
CTCLUCI	33	12,470	0	0	0%	0	0	0%	20	5,935	48%
Coos Bay	7,220	2,420,579	15	4,255	0.2%	1,875	473,037	20%	1,701	484,382	20%
Coquille	1,977	606,670	4	1,179	0.2%	198	42,747	7.0%	982	263,510	43%
Coquille Indian Tribe	100	80,721	0	0	0%	1	291	0.4%	32	8,147	10%
Lakeside	1,421	242,768	0	0	0%	105	20,042	8.3%	192	34,725	14%
Myrtle Point	1,329	383,743	64	14,091	3.7%	67	16,518	4.3%	622	158,591	41%
North Bend	4,233	1,494,790	0	0	0%	179	49,187	3.3%	1,401	422,578	28%
Powers	556	111,516	0	0	0%	19	4,102	3.7%	85	16,701	15%
Total Coos County	42,550	11,536,552	1,731	383,249	3.3%	5,392	1,200,334	10%	13,098	3,117,797	27%

Source: Williams et al, 2021.

Risk Reduction Recommendations

The science of risk reduction is an emerging field. These potential landslide mitigation actions are listed along with the hazard description so that readers understand the type of mitigation actions being considered or that might be considered current best practices. They are listed in two categories, risk to lifelines (such as evacuation routes) and risk to structures.

From the Natural Hazard Risk Report (Williams et al, 2021):

- Create modern landslide inventory and susceptibility maps and use in planning and regulations for future development.
- Control storm water in landslide-prone areas.
- Monitor ground movement in high susceptibility areas.
- Implement grading codes, especially in high susceptibility areas.

For Mitigating Risk to Evacuation Routes (Coos EM and DLCD):

- Identify community areas with only one access route
- Define and map rural and urban lifelines, including single-access roads that serve isolated communities.
- Harden or protect access routes that serve as lifelines for rural unincorporated communities.

For Land Use Planning

The following recommendations about zoning and comprehensive plan changes from the Landslide Guide may be useful when regulating hazards. The following examples relate to permitting development in landslide prone areas

Features of strong comprehensive plans:

- Make use of technical information and assistance provided by local, regional, state, and federal agencies regarding natural hazards.
- Clearly link to the implementing provisions (zoning code, building code, etc.)
- Include specific references (e.g., title and date of information) to supporting documents and maps.
- Include or refer to documents, maps, or technical assistance needed to understand impacts of natural hazards.
- Create opportunities to guide growth and development away from natural hazard areas and/or provide for appropriate review of the growth and development when it is in or near a hazard area.
- Consider climate change and the impacts of climate change on natural hazards, and the subsequent vulnerabilities and risks to the community.

Features of strong zoning codes:

- Are supported by and incorporate the best available science-based landslide hazard maps and analysis.
- Employ factors in addition to slope to determine when a geotechnical report is required.

- Define and establish the qualified geoprofessional(s) for the required report in accordance with state licensing regulations.
- Require geotechnical reports to determine whether a proposed development is within the community's risk tolerance level and to properly condition development.
- Link requirements to degree of risk and geotechnical report recommendations.
- Address soil stabilization through grading, erosion control, vegetation management, and water management.
- Are enforced.
- Have information located on the community's website so that the code is clear and accessible.
- Have replaced outdated Unified Building Code or UBC references with current International Building Code or IBC references in the code

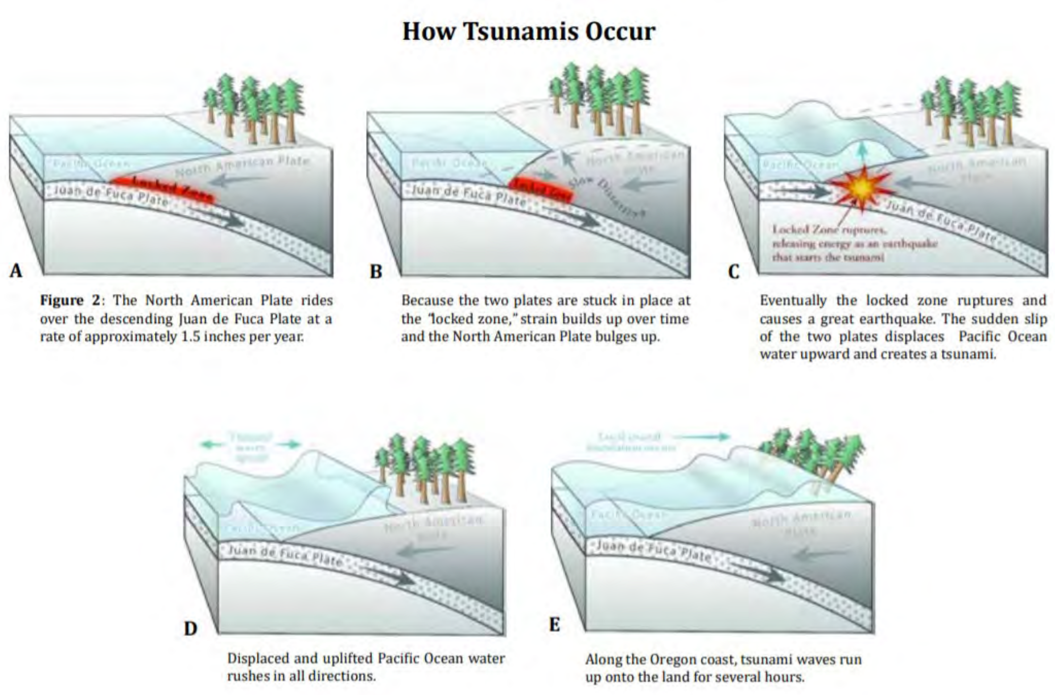
7. Tsunami

Causes and Characteristics

A tsunami generally begins as a single wave but quickly evolves into a series of ocean waves, generated by disturbances from earthquakes, underwater volcanic eruptions, or landslides (includes landslides that start below the water surface and landslides that enter a deep body of water from above the water surface). In these cases, the initial tsunami wave mimics the shape and size of the sea floor deformation that causes it. A tsunami from a local source will likely be stronger, higher and travel farther inland (overland and up river) than a distant tsunami (generated from a distant earthquake event such as in Alaska or Japan). The local tsunami wave may be traveling at 30 mph when it hits the coastline and have heights of 20 to 60 feet, potentially higher depending on the coastal bathymetry (water depths) and geometry (shoreline features). Significant portions of Bandon, Coos Bay, North Bend and Charleston are susceptible to tsunamis, particularly those generated by CSZ events.

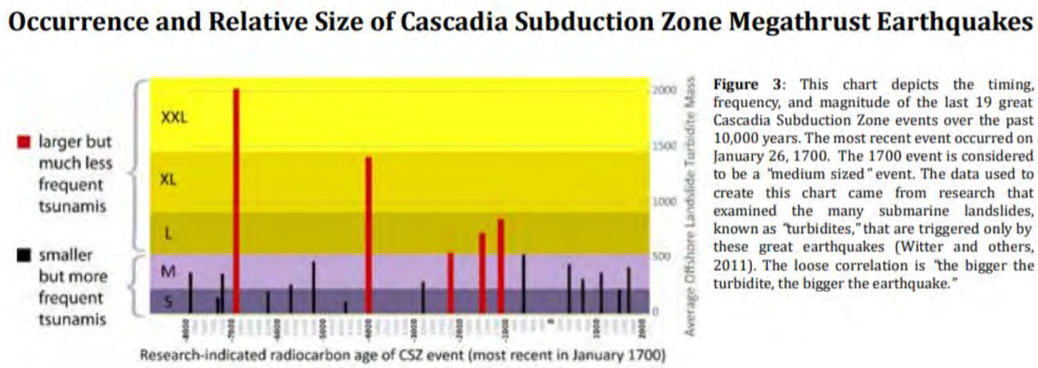
DOGAMI Tsunami Inundation Maps publications incorporate all the best tsunami science available today, including recent publications by colleagues studying the Cascadia Subduction Zone, updated computer simulation models using high-resolution lidar topographic data, and knowledge gained from the 2004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

Figure I-28. Tsunami Generation



Source: DOGAMI, 2013.

Figure I-29. Frequency of CSZ Events in the Geologic Record



Source: DOGAMI, 2013.

Hazard History

The following table provides information on the previous occurrences of tsunamis. one new tsunami event occurred since 2016.

Table I-35. Historic Tsunami Events

Date	Type	Location/ Source	Details
Jan. 2022 (01/15/2022)	Distant	Oregon Coast	A volcanic eruption in Tonga caused King Tide level waves, extensive warnings for 1-3 feet of impacts, but minimal damages along the Oregon coast. The event occurred at 8:30am on a Saturday morning.
Mar. 2011	Distant	Oregon Coast/ Japan	A 9.0 magnitude earthquake originating from Japan caused $6.7 million worth of damages along the Oregon coast. Particularly, there was extensive damage to the Port of Brookings, as well as the Port of Depoe Bay, and Charleston Harbor.
Mar. 1964	Distant	Oregon Coast/ Alaska	A tsunami struck southeastern Alaska following an earthquake beneath Prince William Sound. The tsunami arrived along the Alaskan coastline between 20 and 30 minutes after the quake, devastating coastal villages. The tsunami spread across the Pacific Ocean and caused damage and fatalities in other coastal areas, including Oregon. Coos Bay suffered $20,000 in damages. Along the entire Oregon Coast, damage was estimated to be between $750,000 and $1 million.
Nov. 1952 (11/04/1952)	Distant	Bandon/ Alaska	An earthquake in Kamchatka, Russia caused a four-foot tsunami in Bandon where log decks broke loose from their foundation piers.
Apr. 1946 (04/01/1946)	Distant	Oregon Coast/ Alaska	A tsunami generated by a magnitude 7.8 earthquake in the Aleutian Islands of Alaska killed 165 people and cost over $26 million. The highest inundation waves occurred in Hawaii, where a 12-meter run-up was recorded. The tsunami arrived at the island of Hilo 4.9 hours after the earthquake originated, and 96 people lost their lives. A 10-foot wave was recorded at Coos Bay and Bandon, but no damages were recorded.

Date	Type	Location/ Source	Details
Jan. 1700 (01/26/1700)	CSZ/ Local	Pacific NW coast	Approximately 9.0 earthquake generated a tsunami that struck Oregon, Washington, and Japan; destroyed Native American villages along the coast.

Note: * indicates newly listed event for the 2021 NHMP update. Sources: USGS, https://earthquake.usgs.gov/earthquakes/events/alaska1964/; Sullivan, W.L., 2018.

Vulnerability Assessment

The 2021 DOGAMI Risk Report (Williams et al, 2021) identified locations within the study area that are comparatively more vulnerable or at greater risk to CSZ Mw 9.0 tsunami hazard:

- The City of Bandon is expected to be impacted by a tsunami originating from a CSZ event. Exposure percentage is as high as 10% for the Medium tsunami scenario.
- Developments all along Coos Bay are exposed to tsunami hazard, with Charleston being the most exposed to this hazard.
- The developed area around the Highway 101 bridge near Lakeside is expected to be inundated by a tsunami.

Coos countywide CSZ M9.0 tsunami exposure (Medium tsunami scenario):

- Number of buildings exposed: 1,286
- Exposure value: $611,536,000
- Percentage of exposure value: 5.3%
- Critical facilities exposed: 13
- Potentially displaced population: 1,274

Source: Williams et al, 2021.

The Coos County Risk Report has three major findings about the tsunami hazard.

1. A Cascadia M9 earthquake and tsunami will cause extensive overall damage and losses.

   Due to its proximity to the Cascadia subduction zone (CSZ), every community in Coos County will experience significant impact and disruption from a CSZ magnitude 9.0 earthquake event. Event impacts that were examined are limited to earthquake (including ground deformation) and tsunami. Results show that a CSZ M9.0 event will cause approximately 35% to 50% in building losses for most communities. The unincorporated community of Charleston can expect a very high percentage of losses due to tsunami hazard. Other communities like Lakeside, Myrtle Point, North Bend, Powers, and Hauser have little to no tsunami exposure, but still will have high losses from earthquake alone. The high vulnerability of the building inventory (primarily because of the age of construction), high levels of exposure to liquefiable soils, the proximity to the CSZ event, and the amount of development within tsunami zones all contribute the estimated levels of losses expected in the study area.

2. Most of the study area’s critical facilities are at high risk to a CSZ earthquake and tsunami

Critical facilities were identified and were specifically examined within this report. We have estimated that 88% (83) of Coos County's 94 critical facilities will be non-functioning after a CSZ event, with 13 of those located with the medium tsunami zone. For comparative purposes, 17% (16) of critical facilities are at risk to landslide, 14% (13) are exposed to flood hazard, and 1% (1) are exposed to wildfire.

3. The two biggest causes of displacement to population are a CSZ event (earthquake and tsunami) and landslide

   The Coos County Risk Report estimated that 20% of the population in the county would be displaced due to the combination of earthquake and tsunami.

The hazard impact and community vulnerability for tsunami was assessed and ranked by each jurisdiction via the Hazard Vulnerability Analysis process.

Table I-36. Tsunami Hazard Vulnerability Analysis Summary

Jurisdiction	Total	Risk Level	Jurisdiction	Total	Risk Level
Unincorporated Coos County	180	H	City of Powers	-	-
City of Bandon	205	H	Bay Area Hospital District	172	H
City of Coquille	170	H	Haynes Drainage District	186	H
City of Coos Bay	172	H	International Port of Coos Bay	196	H
City of Lakeside	145	M	Port of Bandon	205	H
City of Myrtle Point	-	-	Southern Coos Hospital District	-	-
City of North Bend	209	H			

Source: Coos MJ-NHMP Risk Assessment, March-May 2021.

Table I-37. Tsunami Exposure

(all dollar amounts in thousands)

Community	Total Number of Buildings	Total Estimated Building Value ($)	Small (Low Severity)			Medium (Moderate Severity)			Large (High Severity)			X Large (Very High Severity)			XX Large (Extreme Severity)		
			Number of Buildings	Building Value ($)	Percent of Building Value Exposed	Number of Buildings	Building Value ($)	Percent of Building Value Exposed	Number of Buildings	Building Value ($)	Percent of Building Value Exposed	Number of Buildings	Building Value ($)	Percent of Building Value Exposed	Number of Buildings	Building Value ($)	Percent of Building Value Exposed
Unincorp. County (rural)	18,957	4,476,885	234	46,762	1.0%	418	94,049	2.1%	918	200,079	4.5%	2,015	464,241	10%	2,337	544,997	12%
Bunker Hill	740	173,872	1	418	0.2%	6	10,370	6.0%	71	40,907	24%	96	45,748	26%	107	48,463	28%
Charleston	1,549	310,927	247	78,239	25%	267	82,989	27%	465	123,141	40%	1,122	235,075	76%	1,238	254,901	82%
Glasgow	578	125,629	5	407	0.3%	13	2,537	2.0%	24	4,838	3.9%	37	8,339	7%	42	9,270	7.4%
Green Acres	367	79,090	0	0	0%	0	0	0%	0	0	0%	32	5,177	6.5%	45	8,693	11%
Hauser	1,022	286,877	0	0	0%	0	0	0%	1	11	0%	19	16,933	5.9%	52	38,178	13%
Millington	506	100,571	0	0	0%	0	0	0%	3	506	0.5%	44	13,191	13%	54	14,961	15%
Total Unincorp. County	23,719	5,553,851	487	125,826	2.3%	704	189,945	3.4%	1,482	369,483	6.7%	3,365	788,704	14%	3,875	919,463	17%
Bandon	1,962	629,445	145	49,200	7.8%	185	64,742	10%	276	91,553	15%	925	285,412	45%	1,374	431,860	69%
CTCLUCI	33	12,470	0	0	0%	0	0	0%	0	0	0%	0	0	0%	0	0	0%
Coos Bay	7,220	2,420,579	79	43,133	1.8%	319	267,595	11%	624	455,071	19%	1,018	578,485	24%	1,238	634,178	26%
Coquille	1,977	606,670	0	0	0%	0	0	0%	0	0	0%	0	0	0%	1	447	0.1%
Coquille Indian Tribe	100	80,721	0	0	0%	3	4,147	5.1%	6	44,153	55%	37	56,737	70%	44	58,670	73%
Lakeside	1,421	242,768	0	0	0%	0	0	0%	7	4,044	1.7%	43	10,543	4.3%	76	16,944	7.0%
Myrtle Point	1,329	383,743	0	0	0%	0	0	0%	0	0	0%	0	0	0%	0	0	0%
North Bend	4,233	1,494,790	23	6,110	0.4%	75	85,107	5.7%	263	168,526	11%	558	304,613	20%	608	316,952	21%
Powers	556	111,516	0	0	0%	0	0	0%	0	0	0%	0	0	0%	0	0	0%
Total Coos County	42,550	11,536,552	734	224,270	1.9%	1,286	611,536	5.3%	2,658	1,132,830	9.8%	5,946	2,024,494	18%	7,216	2,378,514	21%

Source: Williams et al, 2021.

Risk Reduction Recommendations

The science of risk reduction is an emerging field. These potential tsunami mitigation actions are listed along with the hazard description so that readers understand the type of mitigation actions being considered or that might be considered current best practices. Source: Williams et al, 2021 and DLCD.

- Consider local regulations in the high tsunami hazard zone, such as some restrictions to future development.
- Consider relocating fire, police, and emergency response facilities that are vulnerable to tsunami hazard.
- Use the DLCD guide: *Preparing for a Cascadia Subduction Zone Tsunami: A Land Use Guide for Oregon Coastal Communities*
- Consider relocating or retrofitting structures with vulnerable populations (e.g., schools, hospitals, and nursing homes) that are within high tsunami hazard zones.
- Evaluate the community evacuation plan, including consideration for viable vertical evacuation options.
- Build "tsunami evacuation towers" in developed coastal areas that have insufficient evacuation times due to distance from elevated areas or inability of a population to walk or run to safety (modeled in the "Beat the Wave" mapping).
- Expand tsunami evacuation infrastructure.

8. Wildfire

Causes and Characteristics

Wildfires occur in areas with large amounts of flammable vegetation that require a suppression response due to uncontrolled burning. Fire is an essential part of Oregon's ecosystem but can also pose a serious threat to life and property particularly in the state's growing rural communities. Wildfire can be divided into three categories: interface, wildland, and firestorms. The increase in residential development in interface areas has resulted in greater wildfire risk. Fire has historically been a natural wildland element and can sweep through vegetation that is adjacent to a combustible home. New residents in remote locations are often surprised to learn that in moving away from built-up urban areas, they have also left behind readily available fire services providing structural protection.

Wildland-Urban Interface

The lands where community development spreads into forested areas is considered the Wildfire-Urban Interface zone. This area is at high risk of fire and often difficult to protect.

Gorse

Gorse is highly invasive plant with dense growth, waxy foliage, and sharp, long thorns. A non-native from the British Isles, it grows very well on the Oregon Coast and is undaunted by steep cliffs. Thus, it is both extremely difficult to control and due high amounts of oil that occur naturally in the plant, it is also extremely flammable. Gorse ignites easily and burns hot, so gorse-driven fires have very rapid fire movement and are difficult to control.

Figure I-30. Gorse has Threatened the City of Bandon for Nearly a Century

Source: Gorse Action Group, 2021. https://gorseactiongroup.org/gorse-fire-risk/

Gorse: Catastrophic Wildfire Risk for Bandon

Gorse has fueled catastrophic fire, one of which burned the entire city of Bandon in 1936 and notable subsequent fires in 1980, 1999, 2007, and 2015. While patches of gorse occur along the Oregon Coast, it is notable that dense gorse thickets currently cover approximately 60% of a 250-acre area of largely undeveloped land surrounded by urban development inside the City of Bandon's Urban Growth Boundary, posing a significant fire threat to residents and the City of Bandon.

Hazard History

The following table provides information on the previous occurrences of wildfire. Two new wildfire events have occurred since 2016 and no historic events have been added for the 2022 update.

Table I-38. Historic Wildfire Events

Date	Name	Location	Size/Type	Description
Sept. 2020*	North Bank Road Fire	Bandon	350 acres	A fire began across the river from Hwy 42S and destroyed a house and farm.
2018	Wildfire Smoke; Klondike Fire	Coos County	200ppm+	Coos County was impacted with heavy smoke that affected the health of residents in the county.
2017*	Wildfire Smoke; Chetco Bar Fire	Coos County	350ppm+	Smoke inundated Coos County for approximately 3 weeks during summer 2017.
2015	n/a	Bandon-area	Gorse-caused fire	Gorse is a highly invasive plant. Its foliage is waxy and holds high amounts of oil that easily ignite and burn hot, making fire movement very rapid and difficult to control.
2014	Bone Mountain Fire	Coos County	30 acres	Began as a prescribed fire, but due to extremely dry and windy weather, it became out of control and burned 300 acres of land.
2014	Camas Creek Fire	Coos County	40 acres	The Camas Creek Fire burned 40 acres in the same year.
2007	n/a	Bandon-area	Gorse-caused fire	Gorse is a highly invasive plant. Its foliage is waxy and holds high amounts of oil that easily ignite and burn hot, making fire movement very rapid and difficult to control.
2005	n/a	Coos County	178 acres	Camas Creek wildfire burned 178 acres.
1999	n/a	Bandon-area	Gorse-caused fire	Gorse is a highly invasive plant. Its foliage is waxy and holds high amounts of oil that easily ignite and burn hot, making fire movement very rapid and difficult to control.
1980	n/a	Coos County	Gorse-caused fire	Gorse is a highly invasive plant. Its foliage is waxy and holds high amounts of oil that easily ignite and burn hot, making fire movement very rapid and difficult to control.
1966	n/a	Coos County	1,636 acres	Wildfire burns 1,636 acres of state forest.
1965	n/a	Coos County	1,860 acres	1,860 acres of state forest.
1952	Williams River Fire	Coos County	2,679 acres	Williams River fire burns 2,679 acres.
June 1945	Waterfront Fire	Coos Bay	689 acres; Urban Fire	Waterfront fire burns 689 acres.

Sept. 1936	n/a	Bandon	Urban fire	Bandon nearly destroyed; $1,000,000 in damages. The wildfire was fueled primarily by the large amount of gorse that surrounded the community.
Sept. 1936	n/a	Coos and Curry Counties	146,000 ac. Wildfire	Burns 146,000 acres. Temperatures reached 90 degrees and humidity dropped to 6% sparking wildfires throughout the two counties.
1921	n/a	Marshfield	Urban fire	12 businesses and four residences destroyed in front street fire.
1918	n/a	Coquille	Urban fire	City destroyed by fire.
1914	n/a	Bandon	Urban fire	3-block area burned; Damage estimated at close to half a million dollars.
1882	n/a	Coquille	Urban fire	Front Street business district destroyed by fire.
Sept. 1872	n/a	South Slough to Coos Bay	Wildfire Urban Interface (WUI) fire	Coalbank Slough and Coos Bay- fire rages from South Slough, burning as far west as Coalbank Slough, and north to Coos Bay.
1868	n/a	Coos Bay	Wildfire	90% of Elliott State Forest burns. Fire is stopped when it reaches the ocean after burning through 296,000 acres.

Note: * indicates newly listed event for the 2021 NHMP update. Source: 2016 Coos NHMP; Coos County Emergency Management, 2021.

Future Climate Conditions: Wildfire

- Wildfire risk, expressed as the average number of days per year on which fire danger is very high, is projected to increase in Coos County by 11 days (range -6– 30) by the 2050s, relative to the historical baseline, under the higher emissions scenario.
- In Coos County, the average number of days per year on which vapor pressure deficit is extreme is projected to increase by 30 days (range 9–56) by the 2050s, compared to the historical baseline, under the higher emissions scenario.
- The risk of wildfire smoke in Coos County is projected to increase.
- In Coos County, the number of days per year on which the concentration of wildfire-derived fine particulate matter results in poor air quality is projected to decrease by 15%, and the concentration of fine particulate matter is projected to increase by 69%, from 2004–2009 to 2046–2051 under a medium emissions scenario.

Vulnerability Assessment

According to the DOGAMI Risk Report, the locations within the study area that are comparatively more vulnerable or at greater risk to wildfire hazard:

- Wildfire risk is high for hundreds of homes in the low-laying forested areas of the floodplains south of the City of Coos Bay. This area includes Unincorporated Coos County (rural), Bunker Hill, Green Acres, and Millington.
- Many residential buildings in the dune areas within the community of Hauser is at risk to high wildfire hazard.

The high hazard category was chosen as the primary scenario for this report because that category represents areas that have the highest potential for losses. However, a large amount of loss would occur if the moderate hazard areas were to burn, as almost every community has ~30–50% of exposure to moderate wildfire hazard. Still, the focus of this section is on high hazard areas within Coos County to emphasize the areas where lives and property are most threatened.

Coos countywide wildfire exposure (High hazard):

- Number of buildings: 1,050
- Exposure value: $216,525,000
- Percentage of exposure value: 1.9%
- Critical facilities exposed: 1
- Potentially displaced population: 1,375

Source: Williams et al, 2021.

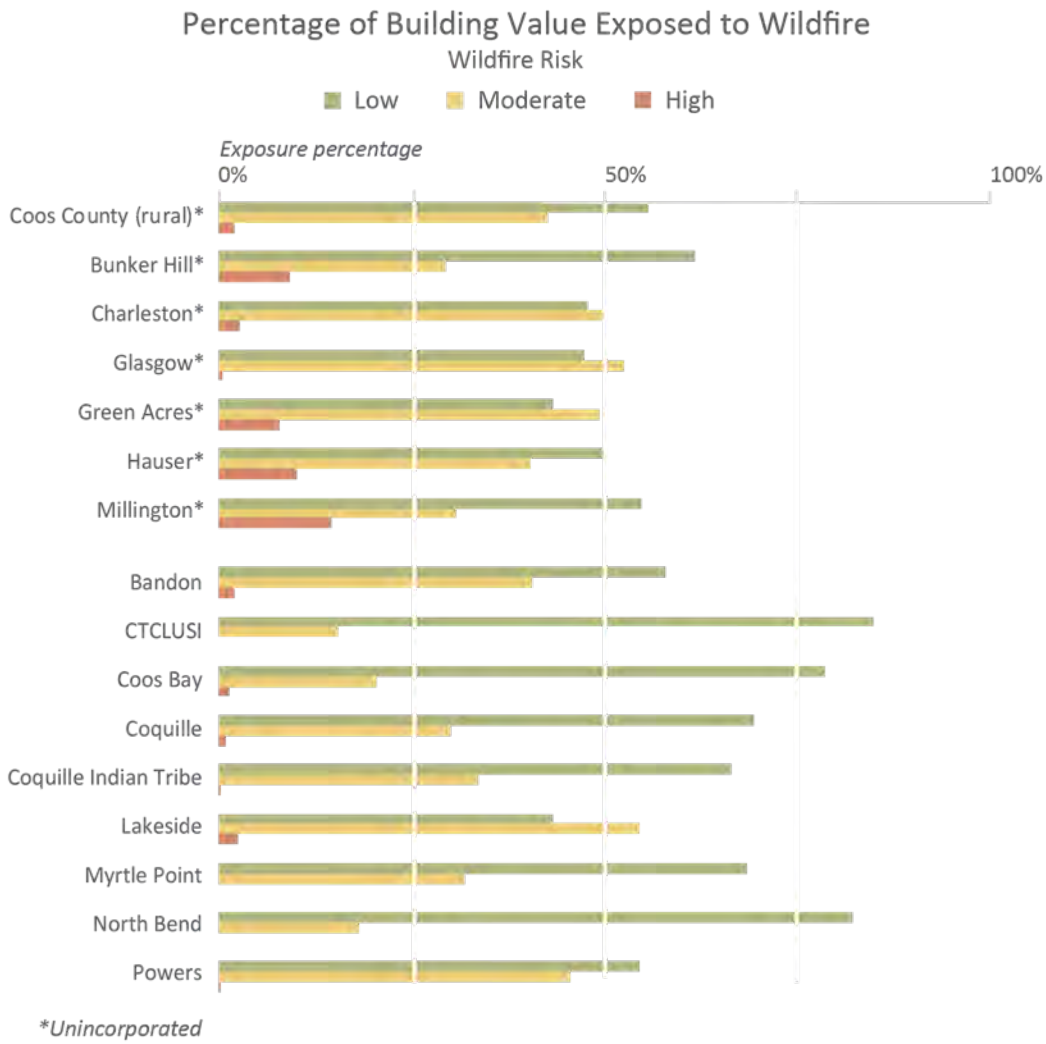
Powers: Powers is very high risk from wildfire. It is only accessible by one paved road. The community is surrounded by forest. There are Forest Service roads that provide secondary egress, but in a wildfire or wind storm event, they may become impassable (CWPP; Coos EM, 5/4/21).

Table I-39. Wildfire Hazard Vulnerability Analysis Summary

Jurisdiction	Total	Risk Level	Jurisdiction	Total	Risk Level
Unincorporated Coos County	145	M	City of Powers	209	H
City of Bandon	191	H	Bay Area Hospital District	170	H*
City of Coquille	163	M	Haynes Drainage District	141	M
City of Coos Bay	170	H	International Port of Coos Bay	229	H*
City of Lakeside	138	M	Port of Bandon	189	H
City of Myrtle Point	172	H**	Southern Coos Hospital District	187	H
City of North Bend	171	H*			

Source: Coos MJ-NHMP Risk Assessment, March-May 2021. Rankings are for wildfire urban interface fire unless noted: *Notes: *Wildfire Smoke: ranked by Port of Coos Bay due to transportation visibility risk; ranked by others for health concerns; ** Conflagration ranked.

Figure I-31. Wildfire Hazard Exposure by Coos County Community



Source: Williams et al, 2021.

Defensible Space

One measure of vulnerability is defensible space. Defensible Space is creating a green landscape, with minimal fuels, creating a low fire danger circumference around your home and other outbuildings for the prevention of wildfire and the slowing of the spread of wildfire.

With Firewise landscaping, you can create survivable space around your home that reduces your wildfire threat. Within the survivable space, remove flammable plants like gorse that contain resins, oils and waxes that burn readily. Knowing how to identify gorse and exercising awareness of fire safety around gorse, particularly in dry seasons, can help to mitigate fire danger.

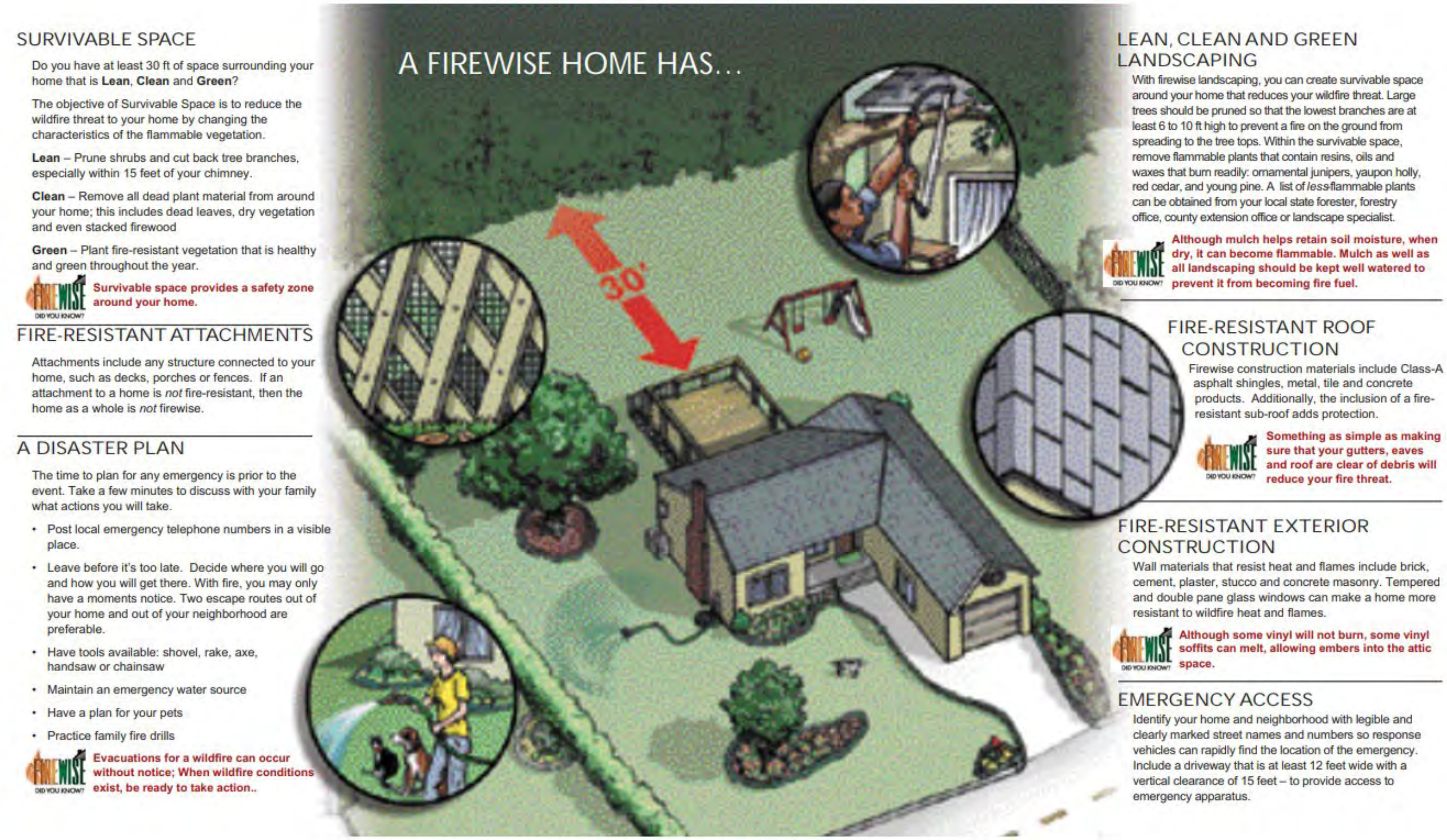
Risk Reduction Recommendations

The science of risk reduction is an emerging field. These potential wildfire mitigation actions are listed along with the hazard description so that readers understand the type of mitigation actions being considered or that might be considered current best practices. Source: DLCD, DOGAMI, Gorse Action Group.

- Make sure residential buildings are surrounded by at least 30 feet of space. For more information and helpful tools, check out the Gorse Action Group's Control and Management webpage.
- Reduce fuel loads near buildings in the fire-prone wildland-urban interface areas (WUI).
- Conduct regular fuel management on your property and near your home:
  - Maintain buffer areas around buildings from trees, brush, and other flammable objects (fences, mulch, etc.)
  - Annually clear roofs and gutters of vegetative debris in buffer areas;
  - Create and maintain fire breaks such as clearing along roads and other areas that can act as firebreaks in a wildfire event.
  - Restore oak and prairie habitats to their natural state of minimal fuels and regular disturbance—many techniques achieve the same goal, but have times and places when they are best ecologically: fire, mowing, grazing, brush cutting, and herbicide. The lowest cost and most efficient approach to fuels management is to achieve and maintain healthy, low-fuel habitats where appropriate (shallow soils, drier areas).
- Use flame-resistant building materials for new projects and construction (decks, e.g.).
- Consider regulating development in wildfire urban interface areas to require flame-resistant materials, sufficient egress for fire equipment, evacuation plans, sufficient on-site water storage for firefighting, etc.
- Establish code provisions that allow the community to quickly respond to a wildfire disaster, such as those that address temporary housing, rebuilding, and readiness for infrastructure upgrade opportunities; as well as considering post-wildfire geologic hazards such as flood, debris flows, and landslides.

Remember, fire risk can change unexpectedly based on weather conditions. Check the Coos Forest Protective Association's website at http://www.coosfpa.net/ or download their mobile app for up-to-date information about fire risk. If you are concerned or have questions, the fire professionals at Coos Forest Protective Association can help. You can reach them at (541) 267-3161.

Figure I-32. Firewise Home Strategies



Source: Lane County Firewise

Figure I-33. Fire Resistant Plants

GORSE ACTION GROUP

Fire Resistant Plants & Garden

What are "fire-resistant" plants?

The *Fire-resistant Plants for Home Landscapes* guide created by OSU Extension (2006) defines fire-resistant plants as "plants that do not readily ignite from a flame or other ignition source". Fire-resistant plant landscaping and removal of flammable material (gorse, dead plants, maintenance of landscaping) is a means of creating "defensible space" around a home. Defensible space is "the area between your home or other structures, where potential fuel (materials or vegetation) have been modified, reduced, or cleared to create a barrier and slow the spread of wildfire toward your home". These protective measures could significantly increase the chance of your home surviving a fire.

The Gorse Action Group has installed a fire-resistant plant demonstration garden at the Bandon Community Youth Center, available for self-guided tours. Please see the back of this handout for more information.

Gorse & fire

Gorse (*Ulex europaeus*), an invasive species found on the south coast of Oregon, is not only detrimental to land managers and native habitats, but is also extremely flammable. Gorse plants contain a high amount of natural oil which makes it extremely flammable. Gorse was the main cause of the town of Bandon burning down in 1936 and caused fires as recently as 2007 and 2015. The seeds are resistant to fire, leaving a source for plants to recolonize after fire. In Coos and Curry Counties, this flammable weed poses a serious risk to over 80,000 residents and 30,000 structures so large-scale control efforts are essential to maintaining public safety.

Gorse regrowth after 2015 fire at Bandon Dunes Golf Resort

9. Wind Storm

Causes and Characteristics

A wind storm is generally a short duration event involving straight-line winds and/or gusts in excess of 50 mph. Although windstorms can affect the entirety of Coos County, they are especially dangerous along the beaches, headlands and coastal bluffs as well as in developed areas with large trees or tree stands. A wind storm will frequently knock down trees and power lines, damage homes, businesses, public facilities, and create tons of storm related debris. Wind storms are a common, chronic hazard in Coos County.

Hazard History

The following table provides information on the previous occurrences of wind storms. X new wind storm events have occurred since 2016 and X historic events have been added for the 2023 update.

Table I-40. Historic Wind Storm Events

Date	Location	Event Type	Magnitude	Details
Nov. 2020 (11/14/2020)	S. Oregon Coast	High Wind	69 mph	One of a series of fronts brought high winds to the southern Oregon coast and south central Oregon.
Jan. 2020 (01/15/2020)	S. Oregon Coast	High Wind	74 mph	An incoming front brought high winds to the southern Oregon coast and the Siskiyou Mountains. Cape Blanco also recorded very strong winds, the peak gust there was 95 mph at 15/1300 PST.
Apr. 2017 (04/06/2017)	S. Oregon Coast	High Wind	70 mph	A strong developing low off the coast brought high winds to a number of locations across southwest and south central Oregon. At the peak of the storm, more than 60,000 people in many cities were without power, mostly in Josephine County. Pacific Power reported the loss of one high voltage line, one major substation and five satellite substations. Many trees were down, including a number onto power lines. Schools were closed across Coos and Curry counties.
Mar. 2016* (03/05/2016)	S. Oregon Coast	High Wind	74 mph	The NOS/NWLON sensor at Port Orford recorded numerous gusts exceeding 57 mph between 15/0719 PST and 15/1054 PST. The peak gust was 78 mph at 15/0942 PST. The Long Prairie RAWS recorded gusts to 61 mph at 15/0813 PST and 15/0913 PST.
Dec. 2015* (12/06/2015)	S. Oregon Coast	High Wind	69 mph	Another in a series of storms brought high winds to portions of southwest and south central Oregon. The NOS-NWLON at Port Orford reported a gust to 69 mph at 06/0212 PST.

Date	Location	Event Type	Magnitude	Details
Feb. 2015* (02/09/2015)	S. Oregon Coast	High Wind	66 mph	The third in a series of fronts brought strong winds to many areas in Southern Oregon. The ODOT sensor at Port Orford recorded several gusts exceeding 57 mph during this interval. The peak gust was 66 mph recorded at 09/0630 PST.
Dec. 2012 (12/19/2012-12/20/2012)	S. Oregon Coast	High Wind	74 mph	The stormy pattern continued as another cold front brought high winds to portions of southern Oregon. The NOS/NWLON unit at Port Orford recorded numerous gusts exceeding 57 mph during this interval. The peak gust was 74 mph at 20/0100 PST. A spotter 2NNE Langlois recorded a gust to 59 mph overnight.
Mar. 2012	Coos County	High Wind, Heavy Rain, Flooding, Mudslides, Landslides	66 mph at Bandon	Damaging winds, heavy rains, flooding, mudslides, landslides, and erosion in Coos and 11 other counties cost nearly $6 million in damages. A strong cold front brought strong winds to many areas in Southern Oregon and Northern California. The Port Orford station reported numerous gusts in excess of 57 mph between 12/0400 PST and 12/2042 PST. The peak gust was 75 mph recorded at 12/2036 PST. A spotter at Bandon reported a gust to 66 mph at 12/1509 PST.
Apr. 2010* (04/04/2010)	S. Oregon Coast	High Wind	75 mph	Strong south winds occurred ahead of a strong cold front which brought severe winds to the south Oregon coast.
Jan. 2010* (01/24/2010)	S. Oregon Coast	High Wind	84 mph	A cold front brought strong winds to the Oregon coast.
Dec. 2007 (12/01/2007-12/03/2007)	S. Oregon Coast	High Wind, Heavy Rain, Mudslides	3 days	Event brought the strongest winds the area has seen since the Columbus Day storm. A series of powerful Pacific storms Dec. 1-3, 2007 brought straight-line winds, rain, and mudslides resulting in Presidential Disaster Declaration; $180 million in damage in the state, power outages and communication isolation for several days, and five deaths attributed to the storm.
Nov. 2007* (11/12/2007)	S. Oregon Coast	High Wind	57 mph	A strong cold front moved onshore this day, bringing high winds to the coast and Coast Range. A High Wind Warning was issued. Wind speeds and gusts at Cape Blanco met High Wind Warning criteria nearly continuously fpr 10 hours. Cape Arago recorded at gust to 51 KT at 12/1101 PST, and the Long Prairie RAWS recorded a gust to 51 KT at 12/0913 PST.
Dec. 2006	S. Oregon Coast	High Wind	90 mph	Windstorms with winds over 90 mph caused $225,000 for Coos, Coos, and Douglas counties.
Nov. 2006	Coos County	High Wind	70 mph	Storms with winds measured at 70 mph created a total of $10,000 in damages.
Nov. 2002	Curry County	Tornado	n/a	Tornado touched down in Brookings causing $500,000 in damage.

Date	Location	Event Type	Magnitude	Details
Feb. 2002	Coos County	Wind Storm	88 mph	Windstorm with 88 mph winds recorded in Bandon. Severe damage to utilities and roads caused by falling trees. State of Emergency declared for Coos, Curry, Douglas, Lane and Linn Counties.
Dec. 1999 (12/08/1999(	S. Oregon Coast	High Wind	80 mph	Strong winds at Cape Blanco; high wind warning issued.
Dec. 1995	Statewide	High Wind	Over 100 mph	Wind gusts of over 100 mph; e.g. Sea Lion Caves gusts to 119 mph. The storm followed the path of Columbus Day Storm (Dec. 1962) and resulted in four fatalities, many injuries, and widespread damage (FEMA-1107-DR-Oregon).
Feb. 1990	Oregon Coast	High Wind	53 mph	Wind gusts resulted in damage to docks, piers, and boats.
Jan. 1990 (01/24/1990)	Statewide	Wind Storm	100 mph wind gusts	One fatality; damaged buildings; falling trees resulted in a disaster declaration in Oregon (FEMA-853-DR-Oregon).
Mar. 1983	Curry County	Tornado	n/a	Tornado touched down in Brookings, causing $25,000 in damage.
Oct. 1967	Western Oregon	Wind Storm	100–110 mph	Severe wind damage along the coast, winds 100 to 110 mph.
Dec. 1964 (12/24/1964)	Oregon	Floods, Heavy Rain, Winter Storm	100-year flood event; 15” rain in 1 day	The Christmas flood of 1964 was an atmospheric river or “pineapple express” event that battered the region producing as much as 15 inches of rain in 24 hours at some locations. The combination of heavy rain, melting snow, and frozen ground caused extreme runoff, erosion and flooding.
Oct. 1962 (10/12/1962)	Coos County; Statewide	Wind Storm	131 mph	Oregon’s most destructive storm, the Columbus Day Windstorm Event, produced a barometric pressure low of 960 mb and resulted in wind speeds of 131 mph on the Oregon coast resulting in 23 fatalities and $170 million in damages.
Feb. 1961	Coos County	Wind Storm	n/a	Heavy gusts and significant rain caused widespread damage in Coos County.
Nov. 1958	Coos County	Wind Storm	80-100 mph	Over a billion board feet of timber was blown down; roads in Coos County largely blocked.
Jan. 1956	Western Oregon	High Wind, Heavy Rain, Mudslides	n/a	Heavy rains, high winds, mud slides resulted in estimated damages of $95,000.
Dec. 1955 (12/29/1955)	Western Oregon	High Wind	up to 90 mph	Wind gusts at North Bend up to 90 mph resulted in significant damage to buildings and farms.

Date	Location	Event Type	Magnitude	Details
Dec. 1951	Statewide	High Wind	60–100 mph	Large windstorm with coastal winds between 60 and 100 mph. Damage across the state.
Nov. 1951	Statewide	High Wind	40–60 mph with 75–80 mph gusts	Winds 40–60 mph with 75–80 mph gusts resulted in widespread damage, especially to transmission lines.
Apr. 1931	Western Oregon	High Wind	78 mph	Wind speeds up to 78 mph resulted in widespread damage.
Jan. 1921	Oregon Coast	High Wind	n/a	Hurricane-force winds along the entire coast.

Note: * indicates newly listed event for the 2021 NHMP update. Sources: NOAA Storm Events Database, 2021. Taylor and Hatton, 1999, Oregon Weather Book.

Future Climate Conditions: Wind Storm

Limited research suggests little if any change in the frequency and intensity of windstorms in the Northwest as a result of climate change.

Vulnerability Assessment

The hazard impact and community vulnerability for wind storm was assessed and ranked by each jurisdiction via the Hazard Vulnerability Analysis process.

Table I-41. Wind Storm Hazard Vulnerability Analysis Summary

Jurisdiction	Total	Risk Level	Jurisdiction	Total	Risk Level
Unincorporated Coos County	213	H	City of Powers	156	M
City of Bandon	196	H	Bay Area Hospital District	204	H
City of Coquille	196	H	Haynes Drainage District	192	H
City of Coos Bay	204	H	International Port of Coos Bay	194	H
City of Lakeside	196	H	Port of Bandon	196	H
City of Myrtle Point	213	H	Southern Coos Hospital District	210	H
City of North Bend	196	H			

- Source: Coos MJ-NHMP Risk Assessment, March-May 2021.

Risk Reduction Recommendations

The science of risk reduction is an emerging field. These potential storm mitigation actions are listed along with the hazard description so that readers understand the type of mitigation actions being considered or that might be considered current best practices.

- Develop and implement hazard tree and vegetation management best practices/programs.
- Promote tree planting projects on private and public properties using 'right tree, right place' methods.
- Educate homeowners about methods to tie down metal roofs and metal sheds.
- Identify major transportation routes at risk during a major winter storm event.
- Implement Oregon Building Code sets standards for structures to withstand 80 mph winds, with additional requirements addressing high exposure areas.
- Assess high exposure areas near developable lands or existing structures to determine the wind load standards necessary for resilient buildings and infrastructure.

10. Winter Storm

Causes and Characteristics

Severe winter storms can consist of rain, freezing rain, ice, snow, cold temperatures, and wind. They originate from troughs of low pressure offshore that ride along the jet stream during fall, winter, and early spring months. Severe winter storms, while possible, do not normally affect Coos County.

Hazard History

The following table provides information on the previous occurrences of winter storms. Two new winter storms events have occurred since 2016 and one historic event has been added for the 2023 update.

Table I-42. Historic Winter Storm Events

Date	Location	Event Type	Magnitude	Details
2019 (02/22/2019-02/26/2019)	Coos County	Heavy Rain, Flooding, Landslides?		DR-4432 Public Assistance categories A, B, C, D, E, F, G
Jan. 2017 (01/01/2017)	S. Oregon Coast	Winter Storm	5.3" snow Lakeside	Two fronts combined with an usually cold air mass already in place to bring heavy snow to many portions of southwest and south central Oregon. This storm had an unusually severe impact due to the low snow levels, all the way down the coastal beaches. Some areas that usually only get a few inches of snow in a season got as much as two feet over several days. There were numerous reports of power outages and tree damage. Traffic along major highways, including Interstate 5, was shut down at times, and there were numerous traffic accidents. Many people were stranded on the roads or in their homes. There were widespread school closures, many closed for the entire week. There was one fatality due to a traffic accident.
2015 (12/06/2015-12/23/2015)	Coos County	Heavy Rain, Flooding, Landslides?		Reported at 3/4/2019 Mtg by J. Rowe.
Mar. 2012	Coos County;	High Wind, Heavy Rain, Flooding, Mudslides, Landslides	66 mph at Bandon	Damaging winds, heavy rains, flooding, mudslides, landslides, and erosion in Coos and 11 other counties cost nearly $6 million in damages. A strong cold front brought strong winds to many areas in Southern Oregon and Northern California. The Port Orford station reported numerous gusts in excess of 57 mph between 12/0400 PST and 12/2042 PST. The peak gust was 75 mph recorded at 12/2036 PST. A spotter at Bandon reported a gust to 66 mph at 12/1509 PST.

Date	Location	Event Type	Magnitude	Details
Mar. 1998* (03/21/1998)	Coos County	Heavy Rain	3.55”	3.55 inches rainfall in 24 hrs. recorded at Coos Bay.
Nov. 1996 - Dec. 1996	Five Western States	Heavy Rain, Freezing Rain/Heavy Wet Snow	6-18" West of the Cascades; 8" in 24 hrs in Coast Range	During the period from mid-November to mid-December 1996, many areas received above-normal precipitation, greatly increasing the snowpack over mid and high elevations. Three sequential storms brought moderate to heavy rain, with the last creating a rain-on-snow event which resulted in incredible amounts of runoff.
Dec. 1964 (12/24/1964)	Oregon	Floods, Heavy Rain, Winter Storm	100-year flood event; Benchmark; 15 inches of rain in 24 hours	The Christmas flood of 1964 was driven by a series of storms, known as atmospheric rivers or “pineapple expresses,” that battered the region producing as much as 15 inches of rain in 24 hours at some locations. The combination of heavy rain, melting snow, and frozen ground caused extreme runoff, erosion and flooding. https://www.usgs.gov/news/christmas-flood-1964
Jan. 1950	Coos County	Severe winter weather	18” snow in Powers; 6” snow in Bandon	Heaviest snow statewide since record keeping started; two-and-a-half-inches in Coos Bay/North Bend, six-inches in Bandon and 18-inches in Powers. Snow, sleet, and freezing rain closed down highways and power lines.

Note: * indicates newly listed event for the 2021 NHMP update. Sources: NOAA Storm Events Database, https://www.ncdc.noaa.gov/stormevents/, accessed 04/20/21, Coos NHMP 2016.

Future Climate Conditions: Winter Storm

- Cold extremes will become less frequent and intense as the climate warms.
- In Coos County, the temperature on the coldest night of the year is projected to increase by an average of 4.5°F (range 2–8°F) by the 2050s, relative to the 1971–2000 historical baselines, under the higher emissions scenario.

Vulnerability Assessment

The hazard impact and community vulnerability for windstorm and winter storms was assessed and ranked by each jurisdiction via the Hazard Vulnerability Analysis process.

Table I-43. Winter Storm Hazard Vulnerability Analysis Summary

Jurisdiction	Total	Risk Level	Jurisdiction	Total	Risk Level
Unincorporated Coos County	213	H	City of Powers	216	H
City of Bandon	129	M	Bay Area Hospital District	188	H
City of Coquille	157	M	Haynes Drainage District	185	H

Jurisdiction	Total	Risk Level	Jurisdiction	Total	Risk Level
City of Coos Bay	188	H	International Port of Coos Bay	192	H
City of Lakeside	144	M	Port of Bandon	157	M
City of Myrtle Point	218	H	Southern Coos Hospital District	187	H
City of North Bend	144	M			

- Source: Coos MJ-NHMP Risk Assessment, March-May 2021.

Risk Reduction Recommendations

The science of risk reduction is an emerging field. These potential storm mitigation actions are listed along with the hazard description so that readers understand the type of mitigation actions being considered or that might be considered current best practices.

- Develop and implement hazard tree and vegetation management best practices/programs.
- Promote tree planting projects on private and public properties using ‘right tree, right place’ methods.
- Educate homeowners about methods to tie down metal roofs and metal sheds.
- Identify major transportation routes at risk during a major winter storm event

D. Community Risk Profiles

The risk summaries for each plan holder jurisdiction can be found in this section. Each summary includes the local risk assessment based upon the hazard analysis process described below, a hazard profile (if applicable) from Open-File Report O-21-04, Natural Hazard Risk Report for Coos County (described on page 15), and details of risk analysis specific to that jurisdiction.

Hazard Analysis Process

Coos County Emergency Management and the participating jurisdictions conducted a local risk assessment as a part of the 2023 Coos County MJ-NHMP update using the Oregon Department of Emergency Management's Hazard Vulnerability Analysis (HVA) methodology. The table of hazard risk ratings and the priorities that resulted from the conversations with each jurisdiction helped to inform the mitigation strategy and actions.

Methodology

A short description of the Oregon Department of Emergency Management (OEM) Hazard Analysis Methodology used is below, but the full description can be found at:

https://www.oregon.gov/lcd/NH/Documents/Apx_9.1.19_OEM_Hazard_Analysis_Methodology_OPT.pdf

In this analysis, severity ratings are applied to the four categories of:

- History
- Vulnerability
- Maximum threat (worst-case scenario)
- Probability

These numbers are aggregated from a severity rating for each of the four categories above that is each pre-assigned a specific weight factor. The assessment identifies three levels of risk: High, Moderate and Low based on total score.

- Low: 1-3 points
- Medium: 4-7 points
- High: 8-10 points

High – 168 to 240 points

High probability of occurrence; at least 50 percent or more of population at risk from hazard; significant to catastrophic physical impacts to buildings and infrastructure; major loss or potential loss of functionality to all essential facilities (hospital, police, fire, EOC and shelters).

Moderate – 96-167 points

Less than 50 percent of population at risk from hazard; moderate physical impacts to buildings and infrastructure; moderate potential for loss of functionality to essential facilities.

Low – 24 to 95 points

Low probability of occurrence or low threat to population; minor physical impacts

Process

Each community ranked hazards as a part of this process. This effort was led and coordinated by the Coos County Emergency Management staff. To complete the HVA (hazard vulnerability analysis) or local risk assessment, jurisdiction representatives first discussed recent events and reviewed updated hazard information to ensure they hold a common understanding of the description, type, location, and extent of each hazard. Next, they identified hazards by choosing a pre-populated template to use and in some cases modified the template, so it fit the best set of hazards for their community or service territory. As ranking hazards often involves thinking through a specific scenario of how a specific hazard might unfold, if a hazard can happen in more than one manner, a jurisdiction may choose to either rank the hazard for each of the likely scenarios or provide one aggregated score. An example would be the question of how to rank both a Cascadia Subduction Zone earthquake event (likely magnitude 7-9) and a crustal fault earthquake event (likely magnitude 5-7). The methodology allows for either a lump (one score) or split approach (two scores).

Next the Hazard Vulnerability Analysis was updated by systematically ranking each hazard through a series of discussions, usually in a meeting with the DLCD Project Manager. As a result, each participating jurisdiction considered each hazard and its potential impact on their community. A short summary of the rational used is also captured in an effort to explain the logic of the ranking and to make future rankings simpler by having a baseline. Two templates were offered representing two approaches to Natural Hazard Identification. One template ranked nine hazards: coastal erosion, drought, earthquake, flood, landslide, tsunami, wildfire, wind storm, and winter storm. The second, longer set ranked fifteen hazards: coastal erosion, drought, earthquake (crustal), earthquake (Cascadia subduction zone event), flood (riverine), flood (dam failure), flood (tidal), landslide, tsunami (distant), tsunami (Cascadia subduction zone event), wildfire smoke, wildfire urban interface, wildfire (conflagration), wind storm, and winter storm. Jurisdictions were given the discretion to rank the hazards that they perceived affect their community.

Table I-44. HVA Template #1

Hazard Vulnerability Analysis Score Sheet: TEMPLATE															
Hazard	History			Probability			Vulnerability			Maximum Threat			Total	H-M-L	Rank
	Severity	Weight	Subtotal	Severity	Weight	Subtotal	Severity	Weight	Subtotal	Severity	Weight	Subtotal			
Coastal Erosion		2	0		7	0		5	0		10	0	0		
Drought		2	0		7	0		5	0		10	0	0		
Earthquake		2	0		7	0		5	0		10	0	0		
Flood		2	0		7	0		5	0		10	0	0		
Landslide		2	0		7	0		5	0		10	0	0		
Tsunami		2	0		7	0		5	0		10	0	0		
Wildfire		2	0		7	0		5	0		10	0	0		
Wind Storm		2	0		7	0		5	0		10	0	0		
Winter Storm		2	0		7	0		5	0		10	0	0		

Unincorporated Coos County

Local Risk Assessment—THIRA

On April 27, 2021 Coos County Emergency Management staff reviewed and ranked the plan hazards in an internal meeting with support of DLCD. On June 13, 2022, Coos County provided additional information to DLCD that ranked the "non-natural" hazards in the county such as those events caused solely by humans or human activity.

Table I-45. Unincorporated Coos County HVA Notes

Hazard	Ranking Logic
Wind Storm	Coos County has severe winds that can reach an excess of 100 mph, causing major damage to property, closing roadways, as well as drying vegetation and creating fire hazards.
Winter Storm	Winter storms bring heavy rainfall which cause yearly flooding, landslides, as well as snow and ice.
Earthquake	Although we have not suffered any recent earthquakes, the potential loss could be 11,999 lives and property damage in excess of $3 Billion.
Tsunami	A Tsunami would displace approximately 20% of the County Population, with complete loss in the inundation zone.
Flood	Floods occur annually when rivers exceed 21 ft. This causes road washout, large amounts of debris, and contamination of the rivers.
Landslide	Landslides occur annually on both rural and main roads, important lifelines for Coos County. Roadways are routes for supplies and life sustaining assistance and landslides major delays annually.
Coastal Erosion	With approximately 50 miles of coastline scattered with homes and industry, as well as wildlife refuges, Coastal Erosion is an ongoing concern with king tides increasing.
Wildfire	A 350-acre fire in 2020 reminds us of how quickly private property and industry can be destroyed. Enhanced dryness from wind and drought and many acres of uncontrolled Gorse keep wildfire as a growing concern.
Drought	Coos County continues to be in abnormally dry conditions due to lack of adequate rainfall. Emergency drought declarations for 2019 and 2020 necessitate drought planning.

Table I-46. Unincorporated Coos County HVA Notes – Other Hazards

Hazard	Ranking Logic
Domestic Terrorism	There have been several incidents of pipe bombs as recently as 2021. In 2021, a device exploded at a cross in a park in Coos Bay. Includes school shootings, ecoterrorism, etc.
Pandemics/ Biological Emergencies	Another event similar to the SARS-COVID-19 event
Hazardous Materials: Transportation & Fixed Sites	County has two major routes for the transport of hazardous materials (Hwy 101 and 42); an airport and port in North Bend have fuel and cargo stored.
Radiological (Non-WMD)	Local hospitals have low-level radioactive materials on site that could be accidentally released. These materials are shipped via commercial servicers like FedEx and are labeled. Sinking boats and vehicles on sand.

Table I-47. Unincorporated Coos County Hazard Vulnerability Analysis – Natural Hazards

Hazard Vulnerability Analysis Score Sheet: Coos County															
Hazard	**History**			**Probability**			**Vulnerability**			**Maximum Threat**			**Total**	**H-M-L**	**Rank**
	Severity	**Weight**	**Subtotal**	**Severity**	**Weight**	**Subtotal**	**Severity**	**Weight**	**Subtotal**	**Severity**	**Weight**	**Subtotal**			
Wind Storm	10	2	20	9	7	63	8	5	40	9	10	90	213	H	1
Winter Storm	10	2	20	9	7	63	8	5	40	9	10	90	213	H	2
Earthquake	7	2	14	6	7	42	10	5	50	9	10	90	196	H	3
Tsunami	7	2	14	8	7	56	8	5	40	7	10	70	180	H	4
Flood	9	2	18	9	7	63	8	5	40	4	10	40	161	M	5
Landslide	10	2	20	8	7	56	10	5	50	3	10	30	156	M	6
Wildfire	8	2	16	7	7	49	6	5	30	5	10	50	145	M	7
Coastal Erosion	5	2	10	10	7	70	1	5	5	5	10	50	135	M	8
Drought	8	2	16	8	7	56	4	5	20	3	10	30	122	M	9

Table I-48. Unincorporated Coos County Hazard Vulnerability Analysis – Other Hazards

Hazard Vulnerability Analysis Score Sheet: Coos County - Other Hazards														
Hazard	**History**			**Probability**			**Vulnerability**			**Maximum Threat**			**Total**	
	Severity	**Weight**	**Subtotal**	**Severity**	**Weight**	**Subtotal**	**Severity**	**Weight**	**Subtotal**	**Severity**	**Weight**	**Subtotal**		
Domestic Terrorism	10	2	20	10	7	70	10	5	50	10	10	100	240	H
Pandemics/ Biological Emerg.	1	2	2	7	7	49	10	5	50	7	10	70	171	H
Hazardous Materials: Transportation & Fixed Sites	1	2	2	7	7	49	1	5	5	1	10	10	66	L
Radiological (Non-WMD)	1	2	2	1	7	7	1	5	5	1	10	10	24	L

Hazard Profile

Table I-49. Unincorporated Coos County Hazard Profile

Community Overview

Community Name	Population	Number of Buildings	Critical Facilities[1]	Total Building Value ($)
Unincorporated Coos County	18,664	18,957	21	4,476,885,000

Hazus-MH Analysis Summary

Hazard	Scenario	Potentially Displaced Residents	% Potentially Displaced Residents	Damaged Buildings	Damaged Critical Facilities	Loss Estimate ($)	Loss Ratio
Flood[2]	1% Annual Chance	763	4.1%	890	0	58,390,000	1.3%
*Earthquake**	*CSZ M9.0 Deterministic*	3,149	17%	5,862	16	1,310,768,000	29%
Earthquake (within Tsunami Zone)		136	0.7%	196	3	44,178,000	1.0%

Exposure Analysis Summary

Hazard	Scenario	Potentially Displaced Residents	% Potentially Displaced Residents	Exposed Buildings	Exposed Critical Facilities	Building Value ($)	Percent of Exposure
Tsunami	*CSZ M9.0 – Medium*	365	2.0%	418	3	94,049,000	2.1%
Tsunami	Senate Bill 379 Regulatory Line	230	1.2%	264	3	62,355,000	1.4%
Landslide	High and Very High Susceptibility	3,411	18%	3,749	3	782,675,000	18%
Wildfire	High Hazard	457	2.4%	402	1	86,157,000	1.9%

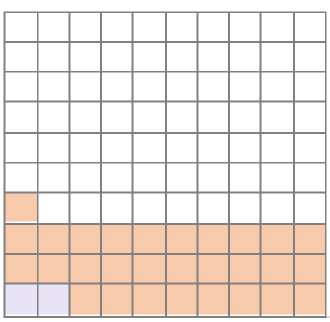
*Earthquake losses were calculated for buildings outside of Medium tsunami zone.

Rows with italicized text and shaded background indicate results should be considered in tandem as they are expected to occur within minutes of one another. Colors correspond to colors in Figure A-1.

[1]Facilities with multiple buildings were consolidated into one building complex.

[2]No damage is estimated for exposed structures with "First floor height" above the level of flooding (base flood elevation).

Figure A-1. Unincorporated Coos County loss ratio from Cascadia subduction zone event.



Each cell represents 1% of building value, so the grid represents 100% of total building value. The magnitude 9.0 CSZ event is predicted to simultaneously produce a damaging earthquake and tsunami. Hazus-MH modeling for loss ratio is available only for earthquake. Buildings with exposure to the tsunami inundation zone are assumed to be completely damaged, which would be 100% loss ratio. To avoid double counting of buildings, the earthquake loss ratio was calculated only for buildings outside of the tsunami zone.

†Each cell represents 1% of building value

= Estimated losses due to tsunami.

= Estimated losses due to earthquake (outside of tsunami zone).

Source: Williams et al, 2021.

City of Bandon

In Bandon, the city and the port share the same local risk assessment to improve coordination. On May 25, 2021, DLCD and Megan Lawrence of Bandon Planning met to rank hazards following input from the Port of Bandon staff on March 4, 2021.

Table I-50. Bandon HVA Notes

Hazard	Ranking Logic
Earthquake: Cascadia	Severe risk to the community due to impact to bridges and other lifelines resulting in isolation.
Tsunami Cascadia	Severe risk to the community due to tsunami inundation following a large earthquake.
Wind Storm	Bandon is quite exposed to coastal wind storm events.
Earthquake	A crustal earthquake would impact the older building stock and displace senior residents.
Wildfire	The community has a history of wildfire connected to gorse infestations which persist as threat.
Tsunami	A distant tsunami could cause impacts to the Port of Bandon which is the community's economic engine.
Drought	A severe drought could impact drinking water supplies.
Flood	Coastal and riverine flooding pose some degree of risk, but lower than most hazards.
Winter Storm	Snow and ice is very unlikely but cause large impacts when they occur due to their infrequency.
Coastal Erosion	A few structures have very high risk, but the majority do not, and it is likely not a life safety issue.
Landslide	Landslide risk is primarily associated with coastal erosion and earthquake risk.

Table I-51. Bandon Hazard Vulnerability Analysis

Hazard Vulnerability Analysis Score Sheet: City of Bandon															
Hazard	History			Probability			Vulnerability			Maximum Threat			Total	H-M-L	Rank
	Severity	Weight	Subtotal	Severity	Weight	Subtotal	Severity	Weight	Subtotal	Severity	Weight	Subtotal			
Earthquake: CSZ	3	2	6	7	7	49	10	5	50	10	10	100	205	H	1
Tsunami: Local CSZ	3	2	6	7	7	49	10	5	50	10	10	100	205	H	2
Wind Storm	10	2	20	8	7	56	8	5	40	8	10	80	196	H	3
Earthquake: Crustal	4	2	8	7	7	49	7	5	35	10	10	100	192	H	4
Wildfire	9	2	18	9	7	63	4	5	20	9	10	90	191	H	5
Tsunami: Distant	7	2	14	8	7	56	7	5	35	7	10	70	175	H	6
Drought	9	2	18	9	7	63	4	5	20	7	10	70	171	H	7
Flood	9	2	18	8	7	56	5	5	25	6	10	60	159	M	8
Winter Storm	4	2	8	8	7	56	7	5	35	3	10	30	129	M	9
Coastal Erosion	8	2	16	8	7	56	3	5	15	3	10	30	117	M	10
Landslide	8	2	16	8	7	56	2	5	10	3	10	30	112	M	11

Hazard Profile

Table I-52. City of Bandon Hazard Profile

Community Overview							
Community Name		Population	Number of Buildings		Critical Facilities[1]	Total Building Value ($)	
Bandon		3,066	1,962		8	629,445,000	
Hazus-MH Analysis Summary							
Hazard	Scenario	Potentially Displaced Residents	% Potentially Displaced Residents	Damaged Buildings	Damaged Critical Facilities	Loss Estimate ($)	Loss Ratio
Flood[2]	1% Annual Chance	60	2.0%	94	1	3,855,000	0.6%
*Earthquake**	CSZ Mw 9.0 Deterministic	837	27%	693	5	213,771,000	34%
Earthquake *(within Tsunami Zone)*		27	0.9%	116	2	43,296,000	6.9%
Exposure Analysis Summary							
Hazard	Scenario	Potentially Displaced Residents	% Potentially Displaced Residents	Exposed Buildings	Exposed Critical Facilities	Building Value ($)	Percent of Exposure
Tsunami	*CSZ Mw 9.0 – Medium*	102	3.3%	185	2	64,742,000	10%
Tsunami	Senate Bill 379 Regulatory Line	82	2.7%	158	2	54,088,000	8.6%
Landslide	High and Very High Susceptibility	57	1.9%	51	0	13,379,000	2.1%
Wildfire	High Hazard	51	1.7%	45	0	11,825,000	1.9%

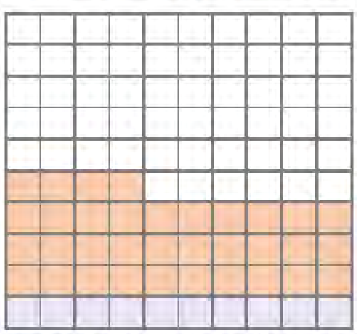
*Earthquake losses were calculated for buildings outside of Medium tsunami zone.

Rows with italicized text and shaded background indicate results should be considered in tandem as they are expected to occur within minutes of one another. Colors correspond to colors in Figure A-8.

[1]Facilities with multiple buildings were consolidated into one building complex.

[2]No damage is estimated for exposed structures with "First floor height" above the level of flooding (base flood elevation).

Figure A-8. City of Bandon loss ratio from Cascadia subduction zone event.



Each cell represents 1% of building value, so the grid represents 100% of total building value. The magnitude 9.0 CSZ event is predicted to simultaneously produce a damaging earthquake and tsunami. Hazus-MH modeling for loss ratio is available only for earthquake. Buildings with exposure to the tsunami inundation zone are assumed to be completely damaged, which would be 100% loss ratio. To avoid double counting of buildings, the earthquake loss ratio was calculated only for buildings outside of the tsunami zone.

†Each cell represents 1% of building value.

= Estimated losses due to tsunami.

= Estimated losses due to earthquake (outside of tsunami zone).

Source: Williams et al, 2021.

City of Coquille

Local Risk Assessment

Each community ranked hazards as a part of this process. City of Coquille staff reviewed and ranked the plan hazards in an internal meeting with support of DLCD in May 2021. Justin Ferren, Scott Sanders, Jolene Delossantos, Hailey Sheldon, and Mark Denning were in attendance.

Table I-53. Coquille HVA Notes

Hazard	Ranking Logic
Drought	No conservation orders or shortages. Multiple sources Rink Cr. reservoir and Coquille R.
Earthquake: Crustal	Understand the data, few reports of noticing these events in the community.
Earthquake: Large CSZ	Every city building and critical facilities need seismic upgrades. Hospital has done seismic and water supply upgrades. Large elderly population located in mobile homes, some across bridges and difficult to reach. Road access is a major source of risk.
Flood: Riverine	High flows from precipitation overload the system; lift station failure (wastewater). Studevant Park floods, GP lot (could), boat dock lost previously.
Landslide	Most are on near surrounding areas 42S, 42 towards Roseburg; occur approx. each decade.
Tsunami: Distant	Risk is low but the floodplain could be affected, and the high school is located there.
Tsunami: Local CSZ	CSZ tsunami would be high impact to floodplain areas.
Wildfire Smoke	Fires from 2020 affected Coquille significantly as did a local fire; ambulance calls in response to wildfire smoke were not numerous, so overall vulnerability is considered low.
Wildfire	0–5-acre fire is average; 15-20 per summer; >5 annual or every other year. 2020 374 ac. Fire on North Bank Road caused by powerlines. WUI: Shelley Ln, Crystal Cr. Rd. where forestland abuts the City.

Table I-54. Coquille Hazard Vulnerability Analysis

Hazard Vulnerability Analysis Score Sheet: City of Coquille															
Hazard	History			Probability			Vulnerability			Maximum Threat			Total	H-M-L	Rank
	Severity	Weight	Subtotal	Severity	Weight	Subtotal	Severity	Weight	Subtotal	Severity	Weight	Subtotal			
Earthquake: CSZ	3	2	6	7	7	49	10	5	50	10	10	100	205	H	1
Wind Storm	10	2	20	8	7	56	8	5	40	8	10	80	196	H	2
Tsunami: Local CSZ	3	2	6	7	7	49	7	5	35	8	10	80	170	H	3
Flood: Riverine	9	2	18	8	7	56	5	5	25	7	10	70	169	H	4
Wildfire	4	2	8	5	7	35	4	5	20	10	10	100	163	M	5
Earthquake: Crustal	4	2	8	7	7	49	5	5	25	8	10	80	162	M	6
Winter Storm	4	2	8	7	7	49	6	5	30	7	10	70	157	M	7
Drought	8	2	16	8	7	56	4	5	20	4	10	40	132	M	8
Tsunami: Distant	7	2	14	8	7	56	3	5	15	3	10	30	115	M	9
Landslide	8	2	16	8	7	56	2	5	10	3	10	30	112	M	10
Wildfire Smoke	8	2	16	8	7	56	1	5	5	1	10	10	87	L	11

Hazard Profile

Table I-55. City of Coquille Hazard Profile

Community Overview				
Community Name	Population	Number of Buildings	Critical Facilities[1]	Total Building Value ($)
Coquille	3,866	1,977	8	606,670,000

Hazus-MH Analysis Summary							
Hazard	Scenario	Potentially Displaced Residents	% Potentially Displaced Residents	Damaged Buildings	Damaged Critical Facilities	Loss Estimate ($)	Loss Ratio
Flood[2]	1% Annual Chance	24	0.6%	23	1	1,207,000	0.2%
*Earthquake**	*CSZ M9.0 Deterministic*	259	6.7%	357	6	131,036,000	22%
Earthquake (within Tsunami Zone)		0	0.0%	0	0	0	0.0%

Exposure Analysis Summary							
Hazard	Scenario	Potentially Displaced Residents	% Potentially Displaced Residents	Exposed Buildings	Exposed Critical Facilities	Building Value ($)	Percent of Exposure
Tsunami	*CSZ M9.0 – Medium*	0	0%	0	0	0	0%
Tsunami	Senate Bill 379 Regulatory Line	0	0%	0	0	0	0%
Landslide	High and Very High Susceptibility	323	8.4%	202	0	43,926,000	7.2%
Wildfire	High Hazard	51	1.3%	22	0	5,181,000	0.9%

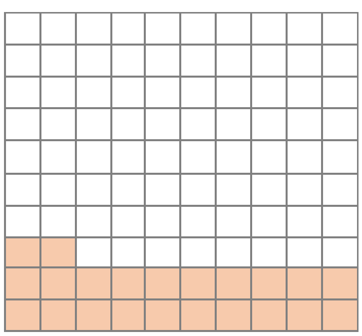
*Earthquake losses were calculated for buildings outside of Medium tsunami zone.

Rows with italicized text and shaded background indicate results should be considered in tandem as they are expected to occur within minutes of one another. Colors correspond to colors in Figure A-10.

[1]Facilities with multiple buildings were consolidated into one building complex.

[2]No damage is estimated for exposed structures with "First floor height" above the level of flooding (base flood elevation).

Figure A-10. City of Coquille loss ratio from Cascadia subduction zone event.



Each cell represents 1% of building value, so the grid represents 100% of total building value. The magnitude 9.0 CSZ event is predicted to simultaneously produce a damaging earthquake and tsunami. Hazus-MH modeling for loss ratio is available only for earthquake. Buildings with exposure to the tsunami inundation zone are assumed to be completely damaged, which would be 100% loss ratio. To avoid double counting of buildings, the earthquake loss ratio was calculated only for buildings outside of the tsunami zone.

†Each cell represents 1% of building value.

= Estimated losses due to tsunami (tsunami damage negligible for this community).

= Estimated losses due to earthquake (outside of tsunami zone).

Source: Williams et al, 2021.

City of Coos Bay

Local Risk Assessment

On April 21, 2021, the City of Coos Bay ranked the hazards affecting the city using the OEM hazard analysis methodology.

Table I-56. Coos Bay HVA Notes

Hazard	Ranking Logic
Wind Storm	Wind storms pose a risk of power outage and road closures.
Earthquake: CSZ Cascadia event	A significant Cascadia Subduction Zone (CSZ) event could paralyze the region for months to years. Bridge failures pose the risk of the isolation.
Earthquake: Crustal	A crustal event poses a risk of impact to the many structures built before seismic building codes were in place.
Winter Storm	The unusual nature of winter conditions in the region poses a risk of power outage and road closures.
Tsunami: Local CSZ	A Cascadia Subduction Zone (CSZ) driven tsunami event could paralyze the region for months to years. Bridge failures pose the risk of the isolation.
Wildfire Smoke	Reduced air quality from regional wildfire smoke poses an additional risk to young, old, and medically sensitive populations.
Flood: Dam failure	The Lower Pony Creek dam is a “high hazard potential” structure that is rated to be in poor condition. Dam failure poses a risk to 400-600 persons depending on the time of day an event occurred. Water supplied by the structure serves 25,000 people.
Tsunami: Distant	A distant tsunami event poses a flood risk that would be difficult to predict, and thus difficult to evacuate.
Wildfire: Urban Interface	Forestlands adjacent to the WUI are closed to the public to protect the city's water supply.
Flood: Tidal	Coastal and riverine flooding pose some degree of risk, but lower than most hazards
Wildfire: Conflagration	While this type of event is unlikely in Coos County, it is not impossible with severe drought and wind conditions.
Flood: Riverine	Coastal and riverine flooding pose some degree of risk, but lower than most hazards
Drought	Conservation plans may be needed to respond to an extended drought.
Landslide	Landslide poses a risk to lifelines (roads, rail, utilities) that serve the region.
Coastal Erosion	Coastal erosion poses some degree of risk, but lower than most hazards.

Table I-57. Coos Bay Hazard Vulnerability Analysis

Hazard Vulnerability Analysis Score Sheet: City of Coos Bay															
Hazard	History			Probability			Vulnerability			Maximum Threat			Total	H-M-L	Rank
	Severity	Weight	Subtotal	Severity	Weight	Subtotal	Severity	Weight	Subtotal	Severity	Weight	Subtotal			
Wind Storm	8	2	16	9	7	63	9	5	45	8	10	80	204	H	1
Earthquake: CSZ	2	2	4	9	7	63	9	5	45	9	10	90	202	H	2
Earthquake: Crustal	2	2	4	9	7	63	9	5	45	8	10	80	192	H	3
Winter Storm	7	2	14	7	7	49	9	5	45	8	10	80	188	H	4
Tsunami: Local CSZ	2	2	4	9	7	63	7	5	35	7	10	70	172	H	5
Wildfire Smoke	7	2	14	8	7	56	6	5	30	7	10	70	170	H	6
Flood: Dam failure	3	2	6	8	7	56	5	5	25	7	10	70	157	M	7
Tsunami: Distant	4	2	8	9	7	63	7	5	35	5	10	50	156	M	8
Wildfire: WUI	4	2	8	7	7	49	5	5	25	7	10	70	152	M	9
Flood: Tidal	4	2	8	8	7	56	5	5	25	6	10	60	149	M	10
Wildfire: Conflagration	2	2	4	7	7	49	5	5	25	7	10	70	148	M	11
Flood: Riverine	3	2	6	8	7	56	5	5	25	6	10	60	147	M	12
Drought	1	2	2	5	7	35	7	5	35	7	10	70	142	M	13
Landslide	1	2	2	6	7	42	3	5	15	4	10	40	99	M	14
Coastal Erosion	1	2	2	4	7	28	2	5	10	3	10	30	70	L	15

Hazard Profile

Table I-58. City of Coos Bay Hazard Profile

Community Overview				
Community Name	Population	Number of Buildings	Critical Facilities[1]	Total Building Value ($)
Coos Bay	15,966	7,220	22	2,420,579,000

Hazus-MH Analysis Summary							
Hazard	Scenario	Potentially Displaced Residents	% Potentially Displaced Residents	Damaged Buildings	Damaged Critical Facilities	Loss Estimate ($)	Loss Ratio
Flood[2]	1% Annual Chance	773	4.8%	468	7	42,299,000	1.7%
*Earthquake**	*CSZ M9.0 Deterministic*	2,732	17%	2,027	16	632,247,000	26%
Earthquake (within Tsunami Zone)		181	1.1%	226	3	203,853,000	8.4%

Exposure Analysis Summary							
Hazard	Scenario	Potentially Displaced Residents	% Potentially Displaced Residents	Exposed Buildings	Exposed Critical Facilities	Building Value ($)	Percent of Exposure
Tsunami	*CSZ M9.0 – Medium*	421	2.6%	319	3	267,595,000	11%
Tsunami	Senate Bill 379 Regulatory Line	53	0.3%	84	2	41,966,000	1.7%
Landslide	High and Very High Susceptibility	3,978	25%	1,890	6	477,292,000	20%
Wildfire	High Hazard	294	1.8%	163	0	32,642,000	1.3%

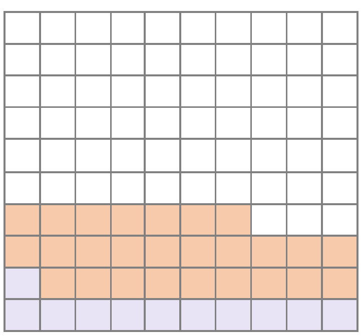
*Earthquake losses were calculated for buildings outside of Medium tsunami zone.

Rows with italicized text and shaded background indicate results should be considered in tandem as they are expected to occur within minutes of one another. Colors correspond to colors in Figure A-10.

[1]Facilities with multiple buildings were consolidated into one building complex.

[2]No damage is estimated for exposed structures with "First floor height" above the level of flooding (base flood elevation).

Figure A-10. City of Coos Bay loss ratio from Cascadia subduction zone event.



Each cell represents 1% of building value, so the grid represents 100% of total building value. The magnitude 9.0 CSZ event is predicted to simultaneously produce a damaging earthquake and tsunami. Hazus-MH modeling for loss ratio is available only for earthquake. Buildings with exposure to the tsunami inundation zone are assumed to be completely damaged, which would be 100% loss ratio. To avoid double counting of buildings, the earthquake loss ratio was calculated only for buildings outside of the tsunami zone.

†Each cell represents 1% of building value.

= Estimated losses due to tsunami (tsunami damage negligible for this community).

= Estimated losses due to earthquake (outside of tsunami zone).

Source: Williams et al, 2021.

City of Lakeside

Local Risk Assessment

Each community ranked hazards as a part of this process. The City of Lakeside staff reviewed and ranked the plan hazards in an internal meeting with support of DLCD in May 2021.

Table I-59. Lakeside HVA Notes

Hazard	Ranking Logic
Earthquake: CSZ	A significant Cascadia Subduction Zone (CSZ) event could paralyze the region for months to years. Bridge failures pose the risk of the isolation.
Wind Storm	Wind storms pose a risk of power outage and road closures.
Earthquake: Crustal	A crustal event poses a risk of impact to the many structures built before seismic building codes were in place.
Drought	A severe drought poses a threat to the drinking water supply of the city.
Flood	A flood poses a threat to the sanitary sewer system of the city.
Tsunami: Local	While the city is outside of the tsunami zone, regional impacts could last months to years.
Winter Storm	The unusual nature of winter conditions in the region poses a risk of power outage and road closures.
Wildfire	While a large wildfire event is unlikely in Coos County, it is not impossible with severe drought and wind conditions.
Landslide	Landslide poses a risk to lifelines (roads, rail, utilities) that serve the region.
Tsunami: Distant	Risk is low but the floodplain could be affected.

Table I-60. Lakeside Hazard Vulnerability Analysis

Hazard Vulnerability Analysis Score Sheet: City of Lakeside															
Hazard	History			Probability			Vulnerability			Maximum Threat			Total	H-M-L	Rank
	Severity	Weight	Subtotal	Severity	Weight	Subtotal	Severity	Weight	Subtotal	Severity	Weight	Subtotal			
Earthquake: CSZ	3	2	6	7	7	49	10	5	50	10	10	100	205	H	1
Wind Storm	10	2	20	8	7	56	8	5	40	8	10	80	196	H	2
Earthquake: Crustal	4	2	8	7	7	49	7	5	35	10	10	100	192	H	3
Drought	8	2	16	8	7	56	4	5	20	7	10	70	162	H	4
Flood	8	2	16	8	7	56	4	5	20	7	10	70	162	M	5
Tsunami: Local	3	2	6	7	7	49	4	5	20	7	10	70	145	M	6
Winter Storm	4	2	8	3	7	21	7	5	35	8	10	80	144	M	7
Wildfire	4	2	8	5	7	35	5	5	25	7	10	70	138	M	8
Landslide	4	2	8	7	7	49	2	5	10	3	10	30	97	M	9
Tsunami: Distant	2	2	4	8	7	56	1	5	5	3	10	30	95	L	10

Hazard Profile

Table I-61. City of Lakeside Hazard Profile

Community Overview

Community Name	Population	Number of Buildings	Critical Facilities[1]	Total Building Value ($)
Lakeside	1,699	1,421	3	242,768,000

Hazus-MH Analysis Summary

Hazard	Scenario	Potentially Displaced Residents	% Potentially Displaced Residents	Damaged Buildings	Damaged Critical Facilities	Loss Estimate ($)	Loss Ratio
Flood[2]	1% Annual Chance	253	15%	171	1	5,768,000	2.4%
*Earthquake**	*CSZ M9.0 Deterministic*	572	34%	666	3	96,156,000	40%
Earthquake (within Tsunami Zone)		0	0%	0	0	0	0%

Exposure Analysis Summary

Hazard	Scenario	Potentially Displaced Residents	% Potentially Displaced Residents	Exposed Buildings	Exposed Critical Facilities	Building Value ($)	Percent of Exposure
Tsunami	*CSZ M9.0 – Medium*	0	0%	0	0	0	0%
Tsunami	Senate Bill 379 Regulatory Line	12	0.7%	18	1	4,912,000	2.0%
Landslide	High and Very High Susceptibility	113	6.6%	105	0	20,042,000	8.3%
Wildfire	High Hazard	50	2.9%	43	0	6,144,000	2.5%

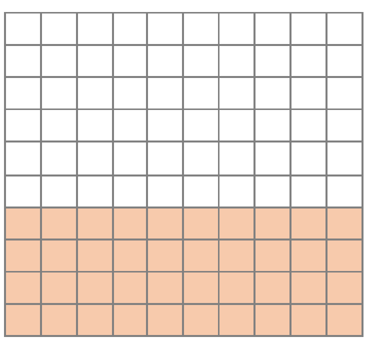
*Earthquake losses were calculated for buildings outside of Medium tsunami zone.

Rows with italicized text and shaded background indicate results should be considered in tandem as they are expected to occur within minutes of one another. Colors correspond to colors in Figure A-10.

[1]Facilities with multiple buildings were consolidated into one building complex.

[2]No damage is estimated for exposed structures with "First floor height" above the level of flooding (base flood elevation).

Figure A-10. City of Lakeside loss ratio from Cascadia subduction zone event.



Each cell represents 1% of building value, so the grid represents 100% of total building value. The magnitude 9.0 CSZ event is predicted to simultaneously produce a damaging earthquake and tsunami. Hazus-MH modeling for loss ratio is available only for earthquake. Buildings with exposure to the tsunami inundation zone are assumed to be completely damaged, which would be 100% loss ratio. To avoid double counting of buildings, the earthquake loss ratio was calculated only for buildings outside of the tsunami zone.

†Each cell represents 1% of building value.

= Estimated losses due to tsunami (tsunami damage negligible for this community).

= Estimated losses due to earthquake (outside of tsunami zone).

Source: Williams et al, 2021.

City of Myrtle Point

Local Risk Assessment

Each community ranked hazards as a part of this process. On April 21, 2021, the City of Myrtle Point ranked the hazards affecting the city using the OEM hazard analysis methodology.

Table I-62. Myrtle Point HVA Notes

Hazard	Ranking Logic
Winter Storm	Power outages and travel interruptions, including access to individuals at risk.
Wind Storm	Power outages and travel interruptions, including access to individuals at risk.
Earthquake: Crustal	Aged infrastructure and buildings built prior to the 1990s pose a risk.
Drought	Water supply vulnerabilities.
Earthquake: Large CSZ	Aged infrastructure and buildings built prior to the 1990s pose a risk.
Wildfire: Conflagration	Myrtle Point has significant natural fire breaks but is situated rurally and proximate to forests.
Wildfire: Urban Interface	Myrtle Point has significant natural fire breaks but is situated rurally and proximate to forests.
Flood: Riverine	Riverine flooding poses some degree of risk, but lower than most hazards
Wildfire Smoke	Smoke inundated the community for a week or more on multiple occasions since the last plan update.
Landslide	Landslide poses a risk to lifelines (roads, rail, utilities) that serve the region.

Table I-63. Myrtle Point Hazard Vulnerability Analysis

Hazard Vulnerability Analysis Score Sheet: City of Myrtle Point															
Hazard	History			Probability			Vulnerability			Maximum Threat			Total	Rank	Rank
	Severity	Weight	Subtotal	Severity	Weight	Subtotal	Severity	Weight	Subtotal	Severity	Weight	Subtotal			
Winter Storm	10	2	20	9	7	63	9	5	45	9	10	90	218	H	1
Wind Storm	10	2	20	9	7	63	8	5	40	9	10	90	213	H	2
Earthquake: Crustal	7	2	14	7	7	49	10	5	50	8	10	80	193	H	3
Drought	8	2	16	9	7	63	8	5	40	7	10	70	189	H	4
Earthquake: CSZ	4	2	8	3	7	21	10	5	50	10	10	100	179	H	5
Wildfire: Conflagration	4	2	8	7	7	49	9	5	45	7	10	70	172	H	6
Wildfire Urban Interface	4	2	8	7	7	49	8	5	40	6	10	60	157	M	7
Flood: Riverine	9	2	18	9	7	63	4	5	20	3	10	30	131	M	8
Wildfire Smoke	7	2	14	8	7	56	9	5	45	1	10	10	125	M	9
Landslide	5	2	10	7	7	49	4	5	20	3	10	30	109	M	10

Hazard Profile

Table I-64. City of Myrtle Point Hazard Profile

Community Overview							
Community Name		Population	Number of Buildings		Critical Facilities[1]		Total Building Value ($)
Myrtle Point		2,514	1,329		6		383,743,000
Hazus-MH Analysis Summary							
Hazard	Scenario	Potentially Displaced Residents	% Potentially Displaced Residents	Damaged Buildings	Damaged Critical Facilities	Loss Estimate ($)	Loss Ratio
Flood[2]	1% Annual Chance	119	4.7%	80	1	3,081,000	0.8%
*Earthquake**	*CSZ M9.0 Deterministic*	455	18%	468	6	154,830,000	40%
Earthquake (within Tsunami Zone)		0	0%	0	0	0	0%
Exposure Analysis Summary							
Hazard	Scenario	Potentially Displaced Residents	% Potentially Displaced Residents	Exposed Buildings	Exposed Critical Facilities	Building Value ($)	Percent of Exposure
Tsunami	*CSZ M9.0 – Medium*	0	0%	0	0	0	0%
Tsunami	Senate Bill 379 Regulatory Line	0	0%	0	0	0	0%
Landslide	High and Very High Susceptibility	239	9.5%	131	2	30,609,000	8.0%
Wildfire	High Hazard	0	0%	0	0	0	0%

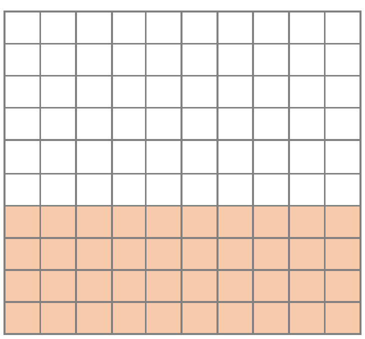
*Earthquake losses were calculated for buildings outside of Medium tsunami zone.

Rows with italicized text and shaded background indicate results should be considered in tandem as they are expected to occur within minutes of one another. Colors correspond to colors in Figure A-10.

[1]Facilities with multiple buildings were consolidated into one building complex.

[2]No damage is estimated for exposed structures with "First floor height" above the level of flooding (base flood elevation).

Figure A-10. City of Myrtle Point loss ratio from Cascadia subduction zone event.



Each cell represents 1% of building value, so the grid represents 100% of total building value. The magnitude 9.0 CSZ event is predicted to simultaneously produce a damaging earthquake and tsunami. Hazus-MH modeling for loss ratio is available only for earthquake. Buildings with exposure to the tsunami inundation zone are assumed to be completely damaged, which would be 100% loss ratio. To avoid double counting of buildings, the earthquake loss ratio was calculated only for buildings outside of the tsunami zone.

†Each cell represents 1% of building value.

= Estimated losses due to tsunami (tsunami damage negligible for this community).

= Estimated losses due to earthquake (outside of tsunami zone).

Source: Williams et al, 2021.

City of North Bend

Local Risk Assessment

Each community ranked hazards as a part of this process. North Bend staff reviewed and ranked the plan hazards with support of DLCD in April 2021. The rankings are being shared and affirmed internally in May 2021.

Table I-65. North Bend HVA Notes

Hazard	Ranking Logic
Coastal Erosion	Low degree of erosion impact on the City of North Bend at this time; in the future the airport may be affected.
Drought	North Bend has not had any conservation orders or heavy water users that could be regulated in a drought event. The risk in this ranking is lower than in 2016/2008 despite the regional trend towards dryness.
Earthquake	Forty-one percent of North Bend building stock is at risk from a Cascadia earthquake and tsunami event. Earthquake types are combined and while there is one more crustal event in the history, the overall impact is anticipated to be lower.
Flood	Much of North Bend is tidally influenced and has some risk of dam failure but riverine impacts are only moderate, so this hazard is being ranked as flood in general to capture this range of potential impacts.
Landslide	There is a slide area along Tremont Ave./Highway 101.
Tsunami	Twenty percent of the community (558 buildings) is at risk from an XL tsunami (very high severity).
Wildfire Smoke	Smoke inundated the community for a week or more on multiple occasions since the last plan update.
Wind Storm	Downed trees and powerlines down cause power outages and damages to buildings.
Winter Storm	Heavy rain and winds are the primary threat. Limited or no ice and snow occurs in North Bend during winter storm events.
Coastal Erosion	Low degree of erosion impact on the City of North Bend at this time; in the future the airport may be affected.

Table I-66. North Bend Hazard Vulnerability Analysis

Hazard Vulnerability Analysis Score Sheet: City of North Bend															
Hazard	History			Probability			Vulnerability			Maximum Threat			Total	H-M-L	Rank
	Severity	Weight	Subtotal	Severity	Weight	Subtotal	Severity	Weight	Subtotal	Severity	Weight	Subtotal			
Tsunami	5	2	10	7	7	49	10	5	50	10	10	100	209	H	1
Earthquake	3	2	6	7	7	49	10	5	50	10	10	100	205	H	2
Wind Storm	10	2	20	8	7	56	8	5	40	8	10	80	196	H	3
Wildfire Smoke	5	2	10	8	7	56	5	5	25	8	10	80	171	H	4
Flood	9	2	18	8	7	56	5	5	25	7	10	70	169	H	5
Winter Storm	4	2	8	3	7	21	7	5	35	8	10	80	144	M	6
Wildfire	4	2	8	5	7	35	4	5	20	7	10	70	133	M	7
Drought	8	2	16	6	7	42	4	5	20	2	10	20	98	M	8
Landslide	4	2	8	7	7	49	2	5	10	3	10	30	97	M	9
Coastal Erosion	3	2	6	7	7	49	1	5	5	1	10	10	70	L	10

Hazard Profile

Table I-67. City of North Bend Hazard Profile

Community Overview							
Community Name		Population	Number of Buildings		Critical Facilities[1]		Total Building Value ($)
North Bend		9,651	4,233		12		1,494,790,000
Hazus-MH Analysis Summary							
Hazard	Scenario	Potentially Displaced Residents	% Potentially Displaced Residents	Damaged Buildings	Damaged Critical Facilities	Loss Estimate ($)	Loss Ratio
Flood[2]	1% Annual Chance	18	0.2%	27	0	3,063,000	0.2%
*Earthquake**	*CSZ M9.0 Deterministic*	1,576	16%	1,225	9	542,929,000	36%
Earthquake (within Tsunami Zone)		25	0.3%	55	2	71,271,000	4.8%
Exposure Analysis Summary							
Hazard	Scenario	Potentially Displaced Residents	% Potentially Displaced Residents	Exposed Buildings	Exposed Critical Facilities	Building Value ($)	Percent of Exposure
Tsunami	*CSZ M9.0 – Medium*	55	0.6%	75	2	85,107,000	5.7%
Tsunami	Senate Bill 379 Regulatory Line	29	0.3%	51	2	72,394,000	4.8%
Landslide	High and Very High Susceptibility	408	4.2%	179	3	49,187,000	3.3%
Wildfire	High Hazard	0	0%	0	0	0	0%

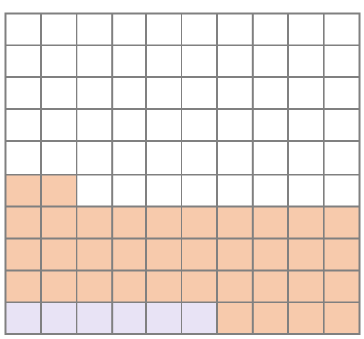
*Earthquake losses were calculated for buildings outside of Medium tsunami zone.

Rows with italicized text and shaded background indicate results should be considered in tandem as they are expected to occur within minutes of one another. Colors correspond to colors in Figure A-11.

[1]Facilities with multiple buildings were consolidated into one building complex.

[2]No damage is estimated for exposed structures with "First floor height" above the level of flooding (base flood elevation).

Figure A-11. City of North Bend loss ratio from Cascadia subduction zone event.



Each cell represents 1% of building value, so the grid represents 100% of total building value. The magnitude 9.0 CSZ event is predicted to simultaneously produce a damaging earthquake and tsunami. Hazus-MH modeling for loss ratio is available only for earthquake. Buildings with exposure to the tsunami inundation zone are assumed to be completely damaged, which would be 100% loss ratio. To avoid double counting of buildings, the earthquake loss ratio was calculated only for buildings outside of the tsunami zone.

†Each cell represents 1% of building value.

= Estimated losses due to tsunami.

= Estimated losses due to earthquake (outside of tsunami zone).

Source: Williams et al, 2021.

City of Powers

Local Risk Assessment

Each community ranked hazards as a part of this process. City of Powers staff reviewed and ranked the plan hazards in an internal meeting with support of DLCD in May 2021; coordination with the Mayor by staff is ongoing.

Table I-68. Powers HVA Notes

Hazard	Ranking Logic
Drought	Water supply is drawn from the S. Fork Coquille R. River water levels were low a few years ago but intake/supply was managed, and supply issues avoided. Conservation orders occurred in 1970s, but not lately.
Earthquake: CSZ Cascadia event	Powers would be cut off in a CSZ event. Alternative routes exist for emergency access but require a 4x4 vehicle.
Earthquake: Crustal	Seismic upgrades are ongoing or being considered for water treatment plant, sanitary sewer, and City Hall. Bridge upgrades are a high priority for Powers.
Flood	Riverine flooding for Powers is low risk. A Log Pond above residences with overflow piping and a berm that could overflow could affect < 12 homes (~3% of homes). River runs through town but in a lower terrace; only a couple of houses exposed. Floods do not cause problems unless there is a landslide upstream. An event occurred 20 miles outside of town in which a clay bank gave way that caused a turbidity issue for the water treatment plant. Local flooding from standing water and a lack of drainage are being addressed by a Stormwater Master Plan that is underway.
Landslide	Rain inundation results in slides on main access roads; high priority for Powers.
Wildfire	Entire community in the wildfire urban interface.
Wildfire Smoke	Local senior population at risk.
Wind Storm	Power outages anytime there is a light wind; this is a ubiquitous hazard, so common a threat it is almost low priority.
Winter Storm	Occur multiple times per year. Severe effects with power outage b/c of absence of backup power. Most notable outage in 2020 was for 3 days.

Table I-69. Powers Hazard Vulnerability Analysis

Hazard Vulnerability Analysis Score Sheet: City of Powers															
Hazard	History			Probability			Vulnerability			Maximum Threat			Total	H-M-L	Rank
	Severity	Weight	Subtotal	Severity	Weight	Subtotal	Severity	Weight	Subtotal	Severity	Weight	Subtotal			
Winter Storm	9	2	18	9	7	63	9	5	45	9	10	90	216	H	1
Wildfire	5	2	10	7	7	49	10	5	50	10	10	100	209	H	2
Earthquake: CSZ	3	2	6	7	7	49	10	5	50	10	10	100	205	H	3
Earthquake: Crustal	4	2	8	7	7	49	8	5	40	10	10	100	197	H	4
Drought	8	2	16	8	7	56	4	5	20	7	10	70	162	M	5
Landslide	4	2	8	4	7	28	8	5	40	8	10	80	156	M	6
Wind Storm	4	2	8	4	7	28	8	5	40	8	10	80	156	M	7
Wildfire Smoke	5	2	10	5	7	35	5	5	25	7	10	70	140	M	8
Flood	3	2	6	5	7	35	7	5	35	3	10	30	106	M	9

Hazard Profile

Table I-70. City of Powers Hazard Profile

Community Overview

Community Name	Population	Number of Buildings	Critical Facilities[1]	Total Building Value ($)
Powers	687	556	4	111,516,000

Hazus-MH Analysis Summary

Hazard	Scenario	Potentially Displaced Residents	% Potentially Displaced Residents	Damaged Buildings	Damaged Critical Facilities	Loss Estimate ($)	Loss Ratio
Flood[2]	1% Annual Chance	4	0.6%	2	0	11,000	0%
*Earthquake**	*CSZ M9.0 Deterministic*	252	37%	267	4	49,542,000	44%
Earthquake (within Tsunami Zone)		0	0%	0	0	0	0%

Exposure Analysis Summary

Hazard	Scenario	Potentially Displaced Residents	% Potentially Displaced Residents	Exposed Buildings	Exposed Critical Facilities	Building Value ($)	Percent of Exposure
Tsunami	*CSZ M9.0 – Medium*	0	0%	0	0	0	0%
Tsunami	Senate Bill 379 Regulatory Line	0	0%	0	0	0	0%
Landslide	High and Very High Susceptibility	26	3.7%	19	1	4,102,000	3.7%
Wildfire	High Hazard	0	0%	1	0	135,000	0.1%

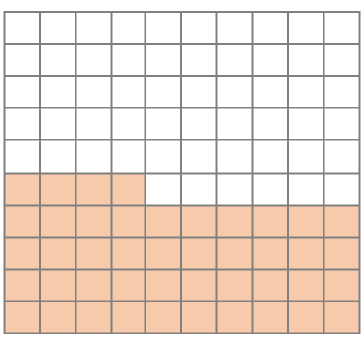
*Earthquake losses were calculated for buildings outside of Medium tsunami zone.

Rows with italicized text and shaded background indicate results should be considered in tandem as they are expected to occur within minutes of one another. Colors correspond to colors in Figure A-11.

[1]Facilities with multiple buildings were consolidated into one building complex.

[2]No damage is estimated for exposed structures with "First floor height" above the level of flooding (base flood elevation).

Figure A-11. City of Powers loss ratio from Cascadia subduction zone event.



Each cell represents 1% of building value, so the grid represents 100% of total building value. The magnitude 9.0 CSZ event is predicted to simultaneously produce a damaging earthquake and tsunami. Hazus-MH modeling for loss ratio is available only for earthquake. Buildings with exposure to the tsunami inundation zone are assumed to be completely damaged, which would be 100% loss ratio. To avoid double counting of buildings, the earthquake loss ratio was calculated only for buildings outside of the tsunami zone.

†Each cell represents 1% of building value.

= Estimated losses due to tsunami.

= Estimated losses due to earthquake (outside of tsunami zone).

Source: Williams et al, 2021.

Port of Coos Bay

As Oregon's Gateway and through its designation as a state port, the Port of Coos Bay is uniquely positioned to influence the local economy. The Port's involvement in regional economic development allows it to implement dynamic programs to help generate new industrial operations in the bay area. This role allows the Port to support continued growth and development of Oregon's south coast.

In 2015, the Port of Coos Bay completed the Strategic Business Plan. This business plan was developed to articulate the planning, facility and capital improvement needs of the Oregon International Port of Coos Bay over a 20-year planning horizon. The plan complies with the strategic business plan requirements of Business Oregon and is designed to be a flexible document that guides the Port Commission in setting priorities and policies.

Local Risk Assessment

Each community ranked hazards as a part of this process. On April 21, 2021, DLCD and Port of Coos Bay staff met to rank hazards. Please refer to the hazard profiles for the cities of North Bend and Coos Bay, as well as Unincorporated Coos Bay for

Table I-71. Port of Coos Bay HVA Notes

Hazard	Ranking Logic
Wildfire Smoke	Wildfire smoke interferes with the navigation of ships into port. Smoke inundated the community for a week or more on multiple occasions since the last plan update.
Earthquake: Large CSZ	A large earthquake would catastrophically damage port infrastructure.
Tsunami: Local CSZ	A large earthquake and resulting tsunami would catastrophically damage port infrastructure.
Wind Storm	Wind storms pose a risk of power outage and road closures.
Winter Storm	Winter storms pose a risk of power outage and road closures.
Landslide	Landslides are an issue for the rail line managed by the Port.
Flood: Tidal	Coastal flooding poses some degree of risk, but lower than most hazards
Tsunami: Distant	Risk is low but the floodplain could be affected, including businesses.
Earthquake: Crustal	A crustal earthquake would impact the older building stock and port infrastructure.
Coastal Erosion	Coastal erosion poses some degree of risk, but lower than most hazards.
Flood: Riverine	Riverine flooding poses some degree of risk, but lower than most hazards.
Wildfire	While a large wildfire event is unlikely in Coos County, it is not impossible with severe drought and wind conditions.
Drought	The Port does not manage water supply.

Table I-72. Port of Coos Bay Vulnerability Analysis

Hazard Vulnerability Analysis Score Sheet: Port of Coos Bay															
Hazard	History			Probability			Vulnerability			Maximum Threat			Total	H-M-L	Rank
	Severity	Weight	Subtotal	Severity	Weight	Subtotal	Severity	Weight	Subtotal	Severity	Weight	Subtotal			
Wildfire Smoke	8	2	16	9	7	63	10	5	50	10	10	100	229	H	1
Earthquake: Large CSZ	2	2	4	6	7	42	10	5	50	10	10	100	196	H	2
Tsunami: Local CSZ	2	2	4	6	7	42	10	5	50	10	10	100	196	H	3
Wind Storm	8	2	16	9	7	63	9	5	45	7	10	70	194	H	4
Winter Storm	8	2	16	8	7	56	8	5	40	8	10	80	192	H	5
Landslide	8	2	16	8	7	56	6	5	30	8	10	80	182	H	6
Flood: Tidal	9	2	18	9	7	63	6	5	30	6	10	60	171	H	7
Tsunami: Distant	4	2	8	9	7	63	7	5	35	5	10	50	156	M	8
Earthquake: Crustal	8	2	16	9	7	63	3	5	15	6	10	60	154	M	9
Coastal Erosion	8	2	16	8	7	56	7	5	35	3	10	30	137	M	10
Flood: Riverine	8	2	16	8	7	56	4	5	20	3	10	30	122	M	11
Wildfire	1	2	2	5	7	35	3	5	15	4	10	40	92	L	12
Drought	0	2	0	0	7	0	0	5	0	0	10	0	0	n/a	13

Port of Bandon

Local Risk Assessment

Each community ranked hazards as a part of this process. On April 21, 2021, DLCD and the Port of Bandon staff met to rank hazards. The notes and rankings were revised in a January 4, 2023 meeting with DLCD and Jeff Griffin. Please refer to the DOGAMI Hazard Profile for the City of Bandon.

Table I-73. Port of Bandon HVA Notes

Hazard	Ranking Logic
Earthquake: Large CSZ	A significant Cascadia Subduction Zone (CSZ) event could paralyze the region for months to years. Bridge failures pose the risk of the isolation.
Tsunami: Local CSZ	A significant Cascadia Subduction Zone (CSZ) earthquake and resulting tsunami event could paralyze the region for months to years. Bridge failures pose the risk of the isolation.
Wind Storm	Wind storms pose a risk of power outage and road closures.
Earthquake: Crustal	A crustal earthquake would impact the older building stock and port infrastructure.
Wildfire	While a large wildfire event is unlikely in Coos County, it is not impossible with severe drought and wind conditions.
Tsunami: Distant	Risk is low but the floodplain could be affected, including businesses.
Winter Storm	Winter storms pose a risk of power outage and road closures.
Wildfire Smoke	Smoke inundated the community for a week or more on multiple occasions since the last plan update. The health impacts are the primary concern for the community.
Flood	Coastal and riverine flooding poses a high risk to port infrastructure, businesses, residential areas and a critical care facility.
Coastal Erosion	Coastal erosion poses a moderate threat to near-beach development, but at the mouth of the river there is high risk to impacts from coastal erosion.
Landslide	Landslide poses a risk to lifelines (roads, rail, utilities) that serve the region.
Drought	Drought may have severe effects to the Coquille River salmon fishery which is a major economic driver in the Port District.

Table I-74. Port of Bandon Hazard Vulnerability Analysis

Hazard Vulnerability Analysis Score Sheet: Port of Bandon															
Hazard	History			Probability			Vulnerability			Maximum Threat			Total	H-M-L	Rank
	Severity	Weight	Subtotal	Severity	Weight	Subtotal	Severity	Weight	Subtotal	Severity	Weight	Subtotal			
Flood	4	2	8	8	7	56	8	5	40	10	10	100	204	H	1
Earthquake: Large CSZ	3	2	6	4	7	28	10	5	50	10	10	100	184	H	2
Tsunami: Local CSZ	3	2	6	4	7	28	10	5	50	10	10	100	205	H	3
Wind Storm	10	2	20	8	7	56	7	5	35	7	10	70	181	H	4
Wildfire	5	2	10	8	7	56	7	5	35	8	10	80	181	H	5
Tsunami: Distant	7	2	14	8	7	56	7	5	35	7	10	70	175	H	6
Coastal Erosion	8	2	16	8	7	56	3	5	15	8	10	80	167	M	7
Earthquake: Crustal	4	2	8	7	7	49	7	5	35	7	10	70	162	M	8
Winter Storm	8	2	16	8	7	56	7	5	35	5	10	50	157	M	9
Wildfire Smoke	8	2	16	8	7	56	5	5	25	5	10	50	147	M	10
Landslide	4	2	8	7	7	49	3	5	15	4	10	40	112	M	11
Drought	3	2	6	3	7	21	3	5	15	3	10	30	72	M	12

Bay Area Hospital

As the Medical Center for Oregon's South Coast, Bay Area Hospital offers a comprehensive range of diagnostic and therapeutic services. The hospital's inpatient and outpatient services include medical, surgical, pediatric, critical care, home health, outpatient and acute inpatient psychiatric, oncology, obstetrical, and other specialties. Located at 1775 Thompson Rd, Coos Bay, OR 97420

Local Risk Assessment

Each community ranked hazards as a part of this process. On April 29, 2021, DLCD and Bay Area Hospital staff member Jeremy Pittz met to rank hazards.

Table I-75. Bay Area Hospital HVA Notes

Hazard	Ranking Logic
Wind Storm	Wind storms pose a risk of power outage and road closures.
Earthquake: Large CSZ	A significant Cascadia Subduction Zone (CSZ) event could paralyze the region for months to years. Bridge failures pose the risk of the isolation.
Earthquake: Crustal	A crustal earthquake could impact the older building stock and community infrastructure.
Winter Storm	Winter storms pose a risk of power outage and road closures.
Tsunami: Local CSZ	A significant Cascadia Subduction Zone (CSZ) earthquake and resulting tsunami event could paralyze the region for months to years. Bridge failures pose the risk of the isolation.
Wildfire Smoke	During 2020 wildfires, hospital facility staff had concerns about HVAC system handling high levels of smoke.
Landslide	Significant risk to supply chain and patient transport by landslides on major highways, on a near-annual basis.
Flood: Dam failure	The Lower Pony Creek dam is a "high hazard potential" structure that is rated to be in poor condition. Dam failure poses a risk to 400-600 persons depending on the time of day an event occurred. Water supplied by the structure serves 25,000 people.
Tsunami: Distant	Risk is low but the floodplain could be affected, including businesses.
Wildfire: Urban Interface	Forestlands adjacent to the WUI are closed to the public to protect the city's water supply.
Flood: Tidal	Coastal and riverine flooding pose some degree of risk, but lower than most hazards
Wildfire: Conflagration	While a large wildfire event is unlikely in Coos County, it is not impossible with severe drought and wind conditions.
Flood: Riverine	Coastal and riverine flooding pose some degree of risk, but lower than most hazards
Drought	The Hospital does not manage water supply.
Coastal Erosion	n/a Does not affect the jurisdiction and outside of the scope of authority.

Table I-76. Bay Area Hospital Vulnerability Analysis

Hazard Vulnerability Analysis Score Sheet: Bay Area Hospital															
Hazard	History			Probability			Vulnerability			Maximum Threat			Total	H-M-L	Rank
	Severity	Weight	Subtotal	Severity	Weight	Subtotal	Severity	Weight	Subtotal	Severity	Weight	Subtotal			
Wind Storm	8	2	16	9	7	63	9	5	45	8	10	80	204	H	1
Earthquake: Large CSZ	2	2	4	9	7	63	9	5	45	9	10	90	202	H	2
Earthquake: Crustal	2	2	4	9	7	63	9	5	45	8	10	80	192	H	3
Winter Storm	7	2	14	7	7	49	9	5	45	8	10	80	188	H	4
Tsunami: Local CSZ	2	2	4	9	7	63	7	5	35	7	10	70	172	H	5
Wildfire Smoke	7	2	14	8	7	56	6	5	30	7	10	70	170	H	6
Landslide	8	2	16	8	7	56	8	5	40	5	10	50	162	M	7
Flood: Dam failure	3	2	6	8	7	56	5	5	25	7	10	70	157	M	8
Tsunami: Distant	4	2	8	9	7	63	7	5	35	5	10	50	156	M	9
Wildfire: Urban Interface	4	2	8	7	7	49	5	5	25	7	10	70	152	M	10
Flood: Tidal	4	2	8	8	7	56	5	5	25	6	10	60	149	M	11
Wildfire: Conflagration	2	2	4	7	7	49	5	5	25	7	10	70	148	M	12
Flood: Riverine	3	2	6	8	7	56	5	5	25	6	10	60	147	M	13
Drought	1	2	2	5	7	35	7	5	35	7	10	70	142	M	14

Hazard Profile

Table I-77. City of Coos Bay Hazard Profile

Community Overview				
Community Name	Population	Number of Buildings	Critical Facilities[1]	Total Building Value ($)
Coos Bay	15,966	7,220	22	2,420,579,000

Hazus-MH Analysis Summary							
Hazard	Scenario	Potentially Displaced Residents	% Potentially Displaced Residents	Damaged Buildings	Damaged Critical Facilities	Loss Estimate ($)	Loss Ratio
Flood[2]	1% Annual Chance	773	4.8%	468	7	42,299,000	1.7%
*Earthquake**	*CSZ M9.0 Deterministic*	2,732	17%	2,027	16	632,247,000	26%
Earthquake (within Tsunami Zone)		181	1.1%	226	3	203,853,000	8.4%

Exposure Analysis Summary							
Hazard	Scenario	Potentially Displaced Residents	% Potentially Displaced Residents	Exposed Buildings	Exposed Critical Facilities	Building Value ($)	Percent of Exposure
Tsunami	*CSZ M9.0 – Medium*	421	2.6%	319	3	267,595,000	11%
Tsunami	Senate Bill 379 Regulatory Line	53	0.3%	84	2	41,966,000	1.7%
Landslide	High and Very High Susceptibility	3,978	25%	1,890	6	477,292,000	20%
Wildfire	High Hazard	294	1.8%	163	0	32,642,000	1.3%

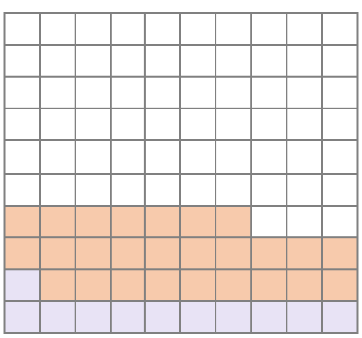
*Earthquake losses were calculated for buildings outside of Medium tsunami zone.

Rows with italicized text and shaded background indicate results should be considered in tandem as they are expected to occur within minutes of one another. Colors correspond to colors in Figure A-10.

[1]Facilities with multiple buildings were consolidated into one building complex.

[2]No damage is estimated for exposed structures with "First floor height" above the level of flooding (base flood elevation).

Figure A-10. City of Coos Bay loss ratio from Cascadia subduction zone event.



Each cell represents 1% of building value, so the grid represents 100% of total building value. The magnitude 9.0 CSZ event is predicted to simultaneously produce a damaging earthquake and tsunami. Hazus-MH modeling for loss ratio is available only for earthquake. Buildings with exposure to the tsunami inundation zone are assumed to be completely damaged, which would be 100% loss ratio. To avoid double counting of buildings, the earthquake loss ratio was calculated only for buildings outside of the tsunami zone.

†Each cell represents 1% of building value.

= Estimated losses due to tsunami (tsunami damage negligible for this community).

= Estimated losses due to earthquake (outside of tsunami zone).

Source: Williams et al, 2021.

Southern Coos Hospital

Local Risk Assessment

Each community ranked hazards as a part of this process. On April 21, 2021, DLCD and Southern Coos Hospital staff met to rank hazards. Please refer to the DOGAMI Hazard Profile for the City of Bandon.

Table I-78. Southern Coos HVA Notes

Hazard	Ranking Logic
Earthquake	A significant Cascadia Subduction Zone (CSZ) earthquake and resulting tsunami event could paralyze the region for months to years. Bridge failures pose the risk of the isolation.
Wind Storm	Wind storms pose a risk of power outage and road closures.
Winter Storm	Winter storms pose a risk of power outage and road closures.
Wildfire	While a large wildfire event is unlikely in Coos County, it is not impossible with severe drought and wind conditions.
Flood	Coastal and riverine flooding pose some degree of risk to lifelines, but lower than most hazards
Tsunami	A significant Cascadia Subduction Zone (CSZ) earthquake and resulting tsunami event could paralyze the region for months to years. Bridge failures pose the risk of the isolation.
Drought	The Hospital does not manage water supply.
Landslide	Landslide poses a risk to lifelines (roads, rail, utilities) that serve the region.
Coastal Erosion	This is an issue that affects the community, but not the hospital directly.

Table I-79. Southern Coos Vulnerability Analysis

Hazard Vulnerability Analysis Score Sheet: Southern Coos Hospital															
Hazard	History			Probability			Vulnerability			Maximum Threat			Total	H-M-L	Rank
	Severity	Weight	Subtotal	Severity	Weight	Subtotal	Severity	Weight	Subtotal	Severity	Weight	Subtotal			
Earthquake	3	2	6	7	7	49	10	5	50	10	10	100	205	H	1
Wind Storm	10	2	20	10	7	70	8	5	40	8	10	80	210	H	2
Winter Storm	8	2	16	8	7	56	7	5	35	8	10	80	187	H	3
Wildfire	8	2	16	8	7	56	5	5	25	9	10	90	187	H	4
Flood	5	2	10	5	7	35	5	5	25	6	10	60	130	H	5
Tsunami	3	2	6	7	7	49	7	5	35	7	10	70	160	M	6
Drought	4	2	8	8	7	56	4	5	20	7	10	70	154	M	7
Landslide	4	2	8	7	7	49	3	5	15	2	10	20	92	M	8
Coastal Erosion	0	2	0	0	7	0	0	5	0	0	10	0	0	n/a	0

Haynes Drainage District

Local Risk Assessment

The Haynes Drainage District joined the Coos County MH-NHMP as a new plan holder during this update. Each community ranked hazards as a part of this process. On April 21, 2021, DLCD and Haynes Drainage District board member met to rank hazards.

Table I-80. Haynes Drainage District HVA Notes

Hazard	Ranking Logic
Coastal Erosion	A few structures have very high risk, but the majority do not, and it is likely not a life safety issue.
Wind Storm	Wind storms pose a risk of power outage and road closures.
Tsunami	A significant Cascadia Subduction Zone (CSZ) earthquake and resulting tsunami event could paralyze the region for months to years. Bridge failures pose the risk of the isolation.
Winter Storm	Winter storms pose a risk of power outage and road closures.
Earthquake	A significant Cascadia Subduction Zone (CSZ) event could paralyze the region for months to years. Bridge failures pose the risk of the isolation.
Wildfire	While a large wildfire event is unlikely in Coos County, it is not impossible with severe drought and wind conditions.
Flood	Coastal and riverine flooding pose some degree of risk, but lower than most hazards
Drought	The District does not manage water supply.
Landslide	Landslide poses a risk to lifelines (roads, rail, utilities) that serve the region.

Table I-81. Haynes Drainage District Vulnerability Analysis

Hazard Vulnerability Analysis Score Sheet: Southern Coos Hospital															
Hazard	History			Probability			Vulnerability			Maximum Threat			Total	H-M-L	Rank
	Severity	Weight	Subtotal	Severity	Weight	Subtotal	Severity	Weight	Subtotal	Severity	Weight	Subtotal			
Coastal Erosion	8	2	16	8	7	56	8	5	40	8	10	80	192	H	1
Wind Storm	8	2	16	8	7	56	8	5	40	8	10	80	192	H	2
Tsunami	4	2	8	4	7	28	10	5	50	10	10	100	186	H	3
Winter Storm	8	2	16	7	7	49	8	5	40	8	10	80	185	H	4
Earthquake	3	2	6	3	7	21	10	5	50	10	10	100	177	H	5
Wildfire	5	2	10	3	7	21	8	5	40	7	10	70	141	M	6
Flood	1	2	2	3	7	21	5	5	25	8	10	80	128	M	7
Drought	2	2	4	8	7	56	4	5	20	4	10	40	120	M	8
Landslide	4	2	8	4	7	28	4	5	20	4	10	40	96	M	9

Hazard Profile

Table I-82. Unincorporated Community of Glasgow Hazard Profile

Table A-6. Unincorporated community of Glasgow hazard profile.

Community Overview							
Community Name		Population	Number of Buildings		Critical Facilities[1]		Total Building Value ($)
Glasgow		757	578		1		125,629,000
Hazus-MH Analysis Summary							
Hazard	Scenario	Potentially Displaced Residents	% Potentially Displaced Residents	Damaged Buildings	Damaged Critical Facilities	Loss Estimate ($)	Loss Ratio
Flood[2]	1% Annual Chance	6	0.7%	9	0	227,000	0.2%
*Earthquake**	*CSZ M9.0 Deterministic*	92	12%	165	0	22,865,000	18%
Earthquake (within Tsunami Zone)		2	0.3%	9	0	1,542,000	1.2%
Exposure Analysis Summary							
Hazard	Scenario	Potentially Displaced Residents	% Potentially Displaced Residents	Exposed Buildings	Exposed Critical Facilities	Building Value ($)	Percent of Exposure
Tsunami	*CSZ M9.0 – Medium*	7	1.0%	13	0	2,537,000	2.0%
Tsunami	Senate Bill 379 Regulatory Line	3	0.4%	6	0	2,878,000	2.3%
Landslide	High and Very High Susceptibility	227	30%	194	0	37,475,000	30%
Wildfire	High Hazard	3	0.4%	2	0	550,000	0.4%

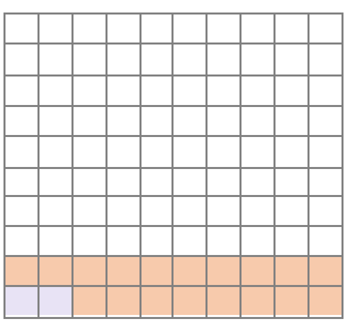
*Earthquake losses were calculated for buildings outside of Medium tsunami zone.

Rows with italicized text and shaded background indicate results should be considered in tandem as they are expected to occur within minutes of one another. Colors correspond to colors in Figure A-4.

[1]Facilities with multiple buildings were consolidated into one building complex.

[2]No damage is estimated for exposed structures with "First floor height" the level of flooding (base flood elevation).

Figure A-4. Unincorporated community of Glasgow loss ratio from Cascadia subduction zone event.



Each cell represents 1% of building value, so the grid represents 100% of total building value. The magnitude 9.0 CSZ event is predicted to simultaneously produce a damaging earthquake and tsunami. Hazus-MH modeling for loss ratio is available only for earthquake. Buildings with exposure to the tsunami inundation zone are assumed to be completely damaged, which would be 100% loss ratio. To avoid double counting of buildings, the earthquake loss ratio was calculated only for buildings outside of the tsunami zone.

†Each cell represents 1% of building value.

= Estimated losses due to tsunami.

= Estimated losses due to earthquake (outside of tsunami zone).

Source: Williams et al, 2021.

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II. MITIGATION STRATEGY

The Mitigation Strategy outlines Coos County's strategy to reduce or avoid vulnerabilities to the identified hazards. Specifically, this strategy presents a mission and specific goals and actions thereby addressing the mitigation strategy requirements contained in 44 CFS 201.6(c). The Coos County Multi-Jurisdictional Natural Hazard Mitigation Plan (Coos County NHMP) Update Steering Committee reviewed and updated the mission, goals, and action items documents in this plan.

A. Mission & Goals

The Plan mission states the purpose and defines the primary functions of Coos County's NHMP. It is intended to be adaptable to any future changes made to the Plan and need not change unless the community's environment or priorities change. During the 2023 NHMP update process, the Steering Committee decided the mission accurately describes the purpose of the plan. The Steering Committee believes the concise nature of the mission statement allows for a comprehensive approach to mitigation planning.

The mission of the Coos County NHMP is to create a disaster-resilient Coos County.

This mission can be achieved by increasing public awareness, documenting the resources for risk reduction and loss-prevention, and identifying activities to guide the county towards building a safer, more disaster resilient community.

2023 Coos County Mitigation Goals

Mitigation plan goals are statements of direction that the Coos County citizens, and public and private partners can take while working to reduce the county's risk from natural hazards. These statements of direction form a bridge between the broad mission statement and particular action items. The goals listed here serve as checkpoints as agencies and organizations begin implementing mitigation action items. Plan goals are listed below; this is not a prioritized list.

Goal 1: Save lives and reduce injuries.

Goal 2: Minimize and prevent damage to public and private buildings and infrastructure.

Goal 3: Reduce economic losses.

Goal 4: Protect natural and cultural resources.

Goal 5: Increase cooperation and coordination among private entities, and local, state, and federal agencies.

Goal 6: Update natural hazard sections of the comprehensive plan and integrate local NHMPs with comprehensive plans, other local plans, and implementing measures.

Goal 7: Increase education, outreach, awareness, and collaboration.

During the 2023 NHMP update process, Coos County Emergency Management reviewed the plan goals and decided to refine the existing goals by deleting two and retaining seven of the 2016 goals. This change deleted "Goal 4: Provide more opportunities for development outside of mapped hazardous areas" because this is more of an outcome rather than a goal from an emergency management perspective. In addition, "Goal 9: Incorporate current data (by reference) into local NHMPs, comprehensive plans, and implementing measures" was nearly identical in meaning to Goal 7.

B. Completed & Ongoing Mitigation Actions

This section documents the long-term mitigation efforts and groundwork for the 2023 plan update mitigation actions by describing ongoing, complete, and past mitigation actions in order to present the mitigation history and practice implemented in Coos County. Sources for this section include the 2016 Coos County NHMP, the 2020 State NHMP, and others.

Multi-Hazard Mitigation Activities

- In 2021, the Coos County Emergency Communications Plan update is a $4.5 million-dollar multi-jurisdictional effort underway funded by a county tax levy and other sources. This plan will replace all twenty-two communication towers and includes backup power.
- Coos County Emergency Management distributes preparedness materials such as the brochure *Are you Ready? Preparing for Disasters and Terrorism in Coos County*, available online: https://www.co.coos.or.us/sheriff/page/are-you-ready-booklet
- Coos County Emergency Management coordination of Community Emergency Response Team (CERT) volunteers to support community preparedness and response.
- Updated CERT, MRC, ARES, RACES, Posse volunteer lists in Everbridge.
- Developed specific evacuation plans and training/exercises for mobile home parks.

Coastal Erosion Mitigation Activities

- Coos County Comprehensive Plan (Section 5.10) was updated in 2016 to outline policies for "Dunes, Ocean, and Coastal Lake Shorelands." Coastal shorelands are categorized by whether or not they are suitable for development. Development in areas considered "Not Suitable" is prohibited. Development in "Suitable" and "Limited Suitability" areas contain development restrictions that are designed to limit exposure to coastal erosion and prevent damage to natural features. Policy # 10 states that Coos County shall: [P]refer non-structural solutions to problems of erosion and flooding to structural solutions in ocean, coastal lake or minor estuary shorelands. Where shown to be necessary, water and erosion control -structures, such as jetties, bulkheads, seawalls, and similar protective structures and fill shall be designed to minimize adverse impacts on water currents, erosion, and accretion patterns. This policy is based "on the recognition that non-structural solutions are often more cost effective as corrective measures but that carefully designed structural solutions are occasionally necessary."
- Buildings in residential, commercial, and industrial zones areas subject to coastal erosion may be protected by riprap if they were built prior to October 1977 or if they are public facilities. Due to the detrimental impacts of riprap, buildings built after October 1977 cannot use riprap.

Drought Mitigation Activities

- Coos County addresses the drought hazard through water conservation measures and water monitoring during the dry summer months.
- USDA Farm Service works with local farmers to develop continuity of operations plans in the event of drought conditions in the county.
- Many rural residents in Coos County rely on groundwater wells for their water needs. In some years these rural wells have run dry in the late summer. To address this need, local water districts sell water to rural residents.

Earthquake Mitigation Activities

- Coos County implements the International Building Code which includes regulations that address the strength of buildings to withstand certain seismic hazards.
- Coos County Comprehensive Plan (Section 5.11) "Natural Hazards" includes policies that support the State Building Code Division's building code enforcement program to provide maximum structural protection to safeguard against seismic hazards.
- Recent Public Works shop renovation in Coquille included seismic upgrades.
- The Coos County Dispatch Center renovation was completed in June 2020 and included seismic upgrades (~$600,000).
- Included information on fire prevention in earthquake education via the website, events, CERT, etc.

Flood Mitigation Activities

- Coos County and the cities maintain ditches along public roadways and culverts to ensure good road system drainage.
- Coos County and the seven participating municipal governments are participants in the National Flood Insurance Program (NFIP). These jurisdictions have adopted a floodplain overly zone or similar ordinance as required to comply with FEMA floodplain regulations, including adoption of the FEMA Flood Insurance Rate Map (FIRM)
  - Coos County Comprehensive Plan (Section 5.11) supports participation in the NFIP and adopts the FIRM. Coos County Land Use and Development Ordinance (Article 4.6.2) provides development guidelines for land in the floodplain.
- Coos County conducts dredging in the Coquille River to reduce the impacts of flooding.
- In 2006, FEMA elevated five properties and acquired five properties in the Libby Drainage District and Englewood Diking District that were flooded during severe storms in 2005/2006. Funding was provided through the Hazard Mitigation Grant Program (DR-1632 HMGP). Only one property had not been elevated (as of 2016) and is still vulnerable to flooding.

Landslide Mitigation Activities

- The Coos County Road Department regularly monitors known landslide areas.
- Coos County Development Code contains regulations for development on steep slopes, including:
  - Fire Safety Standard (Section 4.4.700): Dwellings cannot be located on a slope steeper than 40%.
  - Subdivisions and Partitions (Section 6.5): Regulations for lot size and placement of dwellings and roadways based on slope. Roadways require a geologic report to be completed.

Tsunami Mitigation Activities

- Coos County participates in the Oregon Coast Tsunami Hazard program which has published tsunami evacuation maps for all major incorporated and unincorporated communities located in the tsunami inundation zone. Coos County also posts this and other information about the tsunami hazard on its website.

- Coos County Development Code (Section 4.6.281) has regulations for “Coastal High Hazard Areas” subject to high velocity waters, including but not limited to, storm surge or tsunamis. These areas are designated on the FIRM as Zone V1-V30, VE or V.
- Install/improve tsunami evacuation signage and infrastructure; developed evacuation plans and educated the community about evacuation routes and practices; tsunami areas are clearly identified so you know you are in a tsunami area. During the period 2016-2022, this work occurred primarily in the Coos Bay, North Bend, and Charleston areas.
- North Bend Fire Department built a new station outside of the tsunami zone.

Wildfire Mitigation Activities

- Coos County Development Code (Section 4.4.400) contains regulations for setbacks for rural developments for a fire break around new development. Section 4.8.700 contains fire safety regulations for any new development in the forest zone.
- Coos County completed a Community Wildfire Protection plan in 2011 to better address the risk of wildfire and to develop appropriate mitigation action items.
- Coos Forest Protection Association (CFPA) actively promotes wildfire mitigation in Coos County, with a focus on encouraging the creation of defensible space around structures.
- CFPA conducts wildfire mitigation outreach programs in local schools, state parks, county fairs, and home shows.
- CFPA actively promotes the Firewise program—the primary federal program addressing interface fire. Firewise is a program developed within the National Wildland-Urban Interface Fire Protection Program and offers online wildfire protection information and checklists, as well as listings of other publications, videos, and conferences.
- CFPA has been working with 33 property owners identified as having a moderate risk to wildfires as defined by Oregon Senate bill 360.

Wind Storm Mitigation Activities

- Coos County and Municipal Road/Public Works Departments conduct regular maintenance on vegetation along roadways, including the removal of hazard trees where they pose a risk to public rights-of-way in the event of a wind storm.
- Coos County and Municipal Road/Public Works Departments have mutual aid agreements and other collaboration with local utilities for response to storm debris, impacted power lines, and slide events.

Winter Storm Mitigation Activities

- Coos County and Municipal Road/Public Works Departments conduct regular maintenance on vegetation along roadways, including the removal of hazard trees where they pose a risk to public rights-of-way in the event of a wind storm.
- Coos County and Municipal Road/Public Works Departments have mutual aid agreements and other collaboration with local utilities for response to storm debris, impacted power lines, and slide events.

C. Mitigation Actions 2023

Action items identified through the planning process are an important part of the mitigation plan. Action items are detailed recommendations for activities that local departments, citizens, and others could engage in to reduce risk. Due to resource constraints, Coos County is listing a set of high priority actions in an effort to focus attention on an achievable set of high leverage activities over the next five-years.

Table II-1. 2023 Mitigation Actions

Action Item #	Lead	Mitigation Action	Status/ Description	Hazards addressed	Priority	Timeline /Cost	Goals met by Action	Coos County	City of Bandon	City of Coos Bay	City of Coquille	City of Lakeside	City of Myrtle Point	City of North Bend	City of Powers	Port of Coos Bay	Port of Bandon	Bay Area Hospital	S. Coos Hospital	Haynes D. District
23-MH-01	Coos County Emergency Management (CCEM)	Upgrade Communication Tower Backup Power and batteries.	**New CCEM action for 2023.** Communication towers need budget for batteries, replacement equipment, damage, etc. There are 22 communication towers. Towers have batteries for backup power, these need to be replaced.	Multi-Hazard	H	6-18 months/ $1.1 million	1, 2, 3, 4, 5, 7	**X**		**X**				**X**				**X**	**X**	
23-MH-02	Coos County Emergency Management	Fund Communication Tower Operations and Maintenance.	**New CCEM action for 2023.** Problem Statement: Current Tower project is managed by a Sheriff Dept. captain with many other responsibilities. Funding is needed for staff time to conduct O&M on the current project (operations and maintenance) into the future. Tower infrastructure needs are technical and need a dedicated staff position. Port of Coos Bay: Rail Line towers and infrastructure are critical infrastructure.	Multi-Hazard	H	6-18 months/ $25k annually	1, 2, 3, 4, 5, 7	**X**		**X**				**X**		**X**		**X**	**X**	
23-MH-03	Coos County Emergency Management	Establish mutual aid agreements between government agencies and commercial businesses in the event of an emergency (e.g., fuel, heavy equipment, food, etc.); Expand MOUs to include the reciprocity of medical professionals between isolated communities.	Ongoing CCEM action 16-MH-05: Access database developed; questionnaires about available supplies held by local businesses were sent out by CCEM in 2018. Have MOUs for shelters from 1990s-2000s that need to be revisited. Medical reciprocity was identified as a priority at the October 2021 Steering Committee meeting.	Multi-Hazard	H	1-3 years/ low cost	1, 2, 3, 4, 5, 7	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	

Action Item #	Lead	Mitigation Action	Status/ Description	Hazards addressed	Priority	Timeline /Cost	Goals met by Action	Coos County	City of Bandon	City of Coos Bay	City of Coquille	City of Lakeside	City of Myrtle Point	City of North Bend	City of Powers	Port of Coos Bay	Port of Bandon	Bay Area Hospital	S. Coos Hospital	Haynes D. District
23-MH-04	Coos County Emergency Management Individual Jurisdictions: All	Develop and disseminate information regarding current evacuation routes; conduct regular tsunami evacuation drills; develop a plan to identify and improve alternate evacuation routes to I-5 for wildfire and tsunami, meaning county road routes that are yet to be identified.	Combined: 16-MH-04 and 16-TS-01 CCEM is receiving increasing requests for fire evacuation routes. Implementation needs include printing evacuation route maps, funding for staff time coordination, further planning, data collection. Ongoing: Coquille 10-EQ-01 & 10-MH-04: Fire Dept. is working with Public Works and the City of Coos Bay for mapping assistance. Coos Bay 16-MH-03/Lakeside 16-MH-07/ Myrtle Point 10-MH-04. Powers 16-MH-04: Identify and map all roads, private drives, logging trails to increase the ability of firefighters to locate and gain access to provide services and/or evacuations.	Multi-Hazard	H	1-3 years/ low cost	1, 5, 7	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	
23-MH-05	Coos County Public Works and Cities, especially Bandon on behalf of Gorse Action Group	Through multi-agency coordination, implement abatement efforts to control noxious weeds, specifically Gorse, Scotch Broom, and Butterfly Bush.	Ongoing: 16-MH-06 The Gorse Action Group is lead on fire-prone weed abatement. A wide array of control, monitoring, and coordination strategies are underway. Ongoing Bandon 16-WF-01: A multi-district gorse abatement plan was created by the Gorse Action Group in 2019. The city hired a part time Vegetation Management Coordinator and Code Compliance Officer who are responsible for the plans ongoing implementation and enforcement. The City has obtained services from a gorse removal contactor and purchased equipment to abate noxious vegetation within public rights-of-ways and City owned property. Coquille 10-WF-01: Work is currently underway along the Coquille River Walk. Lakeside 16-WF-01/ North Bend 16-WF-01/Powers 16-WF-01	Multi-Hazard	H	1-10 years/ varies	2, 3, 4, 5, 7	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**

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23-MH-06	Coos County Emergency Management	Coordinate with state and federal partners on conducting regular disaster exercises.	Ongoing/ Revised 16-EQ-02: Conduct regular earthquake safety drills. Coos County participated in the 2017 Cascadia Rising Triton Exercise. Myrtle Point City staff conduct annual earthquake drill; need to add post-earthquake operational scenario.	Multi-Hazard	H	1-3 years/ low cost	1, 5, 7	X	X	X	X	X	X	X	X	X	X	X	X	X
23-MH-07	Individual jurisdictions: All	Ensure all critical facilities have backup power in place to continue operations during power outages.	Revised: 16-WS-02 High priority for Lakeside	Multi-Hazard	H	2-5 years	1, 2, 3, 4, 5	X	X	X	X	X	X	X	X	X	X	X	X	X
23-MH-08	Individual jurisdictions: All	Ensure all critical facilities have emergency operations plans in place to deal with power outages.	Revised: 16-WS-02 Lakeside Wastewater Treatment and FD have these. FD has mobile medical. Southern Coos Hospital has an Emergency Preparedness Plan updated March 2022.	Multi-Hazard	H	2-5 years	1, 2, 3, 4, 5	X	X	X	X	X	X	X	X	X	X	X	X	X
23-MH-09	Individual jurisdictions: All	Continue to implement and enhance public education programs.	CCEM: Update the preparedness brochure *Are you Ready? Preparing for Disasters and Terrorism in Coos County*, available online: https://www.co.coos.or.us/sheriff/page/are-you-ready-booklet Increased Tsunami evacuation signage, participation in annual Shake Out day. **Ongoing** Bandon 16-MH-04/ Coquille 10-MH-03/ Coos Bay 16-MH-04/ Myrtle Point 10-MH-04/ Lakeside 16-MH-04/ North Bend: 16-MH-04/ Powers 16-MH-03	Multi-Hazard	H	Ongoing/ low cost	1, 2, 3, 4, 5, 7	X	X	X	X	X	X	X	X	X	X	X	X	X
23-MH-10	Coos County Emergency Management	Educate and encourage major businesses, service providers, schools, and governmental organizations to develop continuity of operations plans.	Ongoing CCEM 16-MH-07/ Coquille 10-MH-05/ Myrtle Point 10-MH-06	Multi-Hazard	M	1-3 years/ low cost	1, 2, 3, 5, 7	X	X	X	X	X	X	X	X	X	X	X	X	X

Action Item #	Lead	Mitigation Action	Status/ Description	Hazards addressed	Priority	Timeline /Cost	Goals met by Action	Coos County	City of Bandon	City of Coos Bay	City of Coquille	City of Lakeside	City of Myrtle Point	City of North Bend	City of Powers	Port of Coos Bay	Port of Bandon	Bay Area Hospital	S. Coos Hospital	Haynes D. District
23-MH-11	Coos County Emergency Management	Have local emergency responders take post-disaster building and structure safety assessment training.	Started/ Revised: Now multi-hazard instead of just Earthquake (16-EQ-03). CCEM coordinating the trainer for a class entitled "post-earthquake safety evaluation" with funding from local fire departments for their staff.	Multi-Hazard	M	1-3 years/ low cost	1, 2, 5	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**					
23-MH-12	Coos County Emergency Management	Educate the public about the dangers of downed power lines after a windstorm.	Ongoing: 2010 action item by Coos Curry Electric Coop.	Multi-Hazard	M	1-3 years/ low cost	1, 2, 3, 7	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**					
23-MH-13	Individual jurisdictions: Planning Depts Cities	Utilize the most current available hazard data to update the Goal 7 section of the City's Comprehensive Plan.	Bandon 16-MH-02 This action item is ongoing but was partially completed in the 2020 adoption of the Hazards Overlay Zone. Coos Bay 16-MH-02 Not Started. Coos County completed 16-MH-01, 16-MH-02, 16-MH-03 in last update. Ongoing Coquille 10-MH-02; Lakeside 16-MH-02; Myrtle Point 10-MH-02; North Bend 16-MH-03; Powers 16-MH-02	Multi-Hazard	M	1-3 years/ low cost	1, 2, 3, 4, 6		**X**	**X**	**X**	**X**	**X**	**X**	**X**					

Action Item #	Lead	Mitigation Action	Status/ Description	Hazards addressed	Priority	Timeline /Cost	Goals met by Action	Coos County	City of Bandon	City of Coos Bay	City of Coquille	City of Lakeside	City of Myrtle Point	City of North Bend	City of Powers	Port of Coos Bay	Port of Bandon	Bay Area Hospital	S. Coos Hospital	Haynes D. District
23-MH-14	Individual jurisdictions: All	Establish a cache of a disaster relief resources for displaced residents; stock containers in public locations with emergency response supplies.	All jurisdictions are considering disaster caches. Bandon: 16-MH-03 revised to include plans to complete container repair, inventory, and local coordination for on-going maintenance and future improvements. Coos Bay: As of 7/1/2021, the city has resources in four locations to provide shelter, water, and food for 1600 people for two weeks North Bend: has begun developing their cache. Port of Coos Bay: There is potential for cooperation at the Port's Charleston Marina. Southern Coos: Have disaster trailer, 70-80 days of supplies.	Multi-Hazard	M	1-3 years/ low cost	1, 3, 5, 7	X	X	X	X	X	X	X	X	X	X	X	X	X
23-MH-15	Individual jurisdictions: All	Develop a disaster recovery plan.	Bandon: 16-MH-05 Revised/Ongoing Southern Coos: EPP has all components of disaster cycle.	Multi-Hazard	M	3-5 years/ low cost	1, 2, 3, 4, 5, 7	X	X	X	X	X	X	X	X	X	X	X	X	X
23-MH-16	Individual jurisdictions: All	Develop a mass care plan and coordinate related activities such as disaster caches.	Cities of Bandon and Coos Bay and unincorporated Eastside have caches. Conversations ongoing with faith-based groups. Southern Coos: Regular coordination with Coos EM	Multi-Hazard	M	1-3 years/ low cost	1, 2, 3, 4, 5, 7	X	X	X	X	X	X	X	X	X	X	X	X	X

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23-MH-17	Individual jurisdictions: CCEM, Cities	Ensure the ability to provide clean water in the case of emergencies: drinking water for people, domestic animals; water for hand washing, showers, hygiene, and medical uses; water for dish washing, shelter/congregate facility maintenance (to prevent outbreaks of insects, disease, etc.)	**New CCEM action for 2023.** Water is integral for all recovery scenarios and a number of hazards can potentially impact natural sources. Southern Coos: Has two seismically resilient 1,500 gal. holding tanks of stored water; have a reverse osmosis filtration system.	Multi-Hazard	M	1-3 years/ $50-150k	1, 2, 3, 4	X	X	X	X	X	X	X	X	X	X	X	X	X
23-MH-18	Individual jurisdictions: All	Secure equipment and structure repair supplies for disaster recovery including how to address equipment impacted by salt water, fire, etc.	**New CCEM action for 2023.** Isolated/coastal communities should plan to address recovery needs for the first 3-6 weeks following a Cascadia Subduction Zone event.	Multi-Hazard	M	1-3 years/ $50-150k	1, 2, 3, 4	X	X	X	X	X	X	X	X	X	X	X	X	X
23-MH-19	Individual jurisdictions: All	Build and maintain a community/ evacuation center that can serve as a command center and kitchen.	All cities and unincorporated communities could benefit from this due to their potential isolation. Bandon: Sprague Theater at City Park. Lakeside 16-MH-05 North Bend has a community center (large auditorium with kitchen facilities) that needs enhancement. Southern Coos: MOUs with local churches to augment capacity for the hospital.	Multi-Hazard	M	1-3 years/ $50-150k	1, 2, 3, 4	X	X	X	X	X	X	X	X	X	X	X	X	X

Action Item #	Lead	Mitigation Action	Status/ Description	Hazards addressed	Priority	Timeline /Cost	Goals met by Action	Coos County	City of Bandon	City of Coos Bay	City of Coquille	City of Lakeside	City of Myrtle Point	City of North Bend	City of Powers	Port of Coos Bay	Port of Bandon	Bay Area Hospital	S. Coos Hospital	Haynes D. District
23-MH-20	Port of Coos Bay/ Port of Bandon	Establish a resiliency plan and then develop the infrastructure necessary to move equipment and supplies into the county via the ports and rail following a disaster.	In the event of a Cascadia earthquake and tsunami event, widespread damage to bridges and road systems would prevent delivery of supplies and equipment. Smaller flood or other events could close bridges, resulting in long alternate routes. Ports could support an ocean-based resupply effort, or a more resilient transportation system, if the port districts owned their own equipment (e.g., cranes), docks designed for this purpose, and/or sufficient warehouse space (possibly outfitted with refrigeration, other capabilities). Currently, private businesses lease port space and are the owners of the equipment & space that would be necessary in the event of a disaster. Port of Coos Bay: The new container ship facility being constructed on the North Spit is a privately funded project on Port land. The Port will be doing improvements to the rail line to move the containers but needs plans and designs to do so. Partners: OEM, FEMA	Multi-Hazard	M	2 - 5 years/ $50-150k for a plan	1, 2, 3, 4	X	X	X				X		X	X			
23-MH-21	Individual jurisdictions: Cities; Coos County	Enhance strategies for debris management.	Lakeside 16-MH-08; Powers 16-MH-05; North Bend 16-MH-06 Revised 23-WS-01 to remove storm hazard specificity because this action applies to tsunami, other hazards. Port of Coos Bay: Charleston Marina has heavy equipment that can clean things up.	Wind Storm	M	6-18 mo./ staff time	1, 2, 3, 4, 5	X	X	X	X	X	X	X	X	X	X	X		

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North Bend 23-MH-01	City of North Bend	Develop a risk assessment for sea level rise and tsunami risk for the airport and industrial lands. Consider a feasibility study for relocating industrial lands and/or the Southwest Regional Airport.	The industrial lands in North Bend are subject to sea level rise and risk of tsunami. Additional information is needed about the severity and timing of these impacts on the core of the economy in North Bend. This assessment may include a feasibility study for expanding the UGB to include North Spit lands for annexation to replace existing industrial zoned lands. New action for 2023.	Multi-Hazard	M	5 - 10 years/ $250k	2, 3, 4, 6	X						X		X				
23-CE-01	Coos County Planning; Cities	Reduce risk of coastal erosion through hazard mapping and regulation; seek updates to beach, dune, and other coastal data. Update code as data is improved.	Current/ Revised: Adoption of Coos County Beaches and Dunes Goal 18 Development code and suitability maps. https://www.coastalatlas.net/coos-all-hazards/.	Coastal Erosion	H	1-3 years/ staff time	2, 3, 4	X	X	X			X			X	X			
23-EQ-01	Individual jurisdictions or departments: All	Retrofit schools, fire departments, hospitals, and other critical facilities to withstand seismic activity.	Ongoing: Coquille 10-EQ-01 seeking seismic firehall upgrades. Lakeside 16-EQ-01 Seismic Retrofit Grant Program used to improve: Bandon City Hall, Bandon Police Department, Myrtle Point Fire & Ambulance Station. Southern Coos: Built in 1999. Outside of tsunami zone; anticipate minimal seismic impacts.	Earthquake	H	5-10 years/ high cost	1, 2, 3, 4	X	X	X	X	X	X	X	X	X	X	X	X	X

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23-EQ-02	Individual jurisdictions or departments: All	Retrofit bridges and other community lifelines, including rail infrastructure, to withstand seismic activity.	North Bend: Seismic retrofits of bridges is a priority, incl. Vermont ($700k), Virginia, Broadway, Crowell and Newmark Street bridges over Pony Creek. Port of Coos Bay: Coos Bay Rail Line is a lifeline priority and needs funding for rail bridge retrofits. There are 121 rail line water crossings with bridges that could benefit from seismic retrofit, but FEMA or other funds could be needed to do this infrastructure upgrade.	Earthquake	H	2-5 years/ high cost	1, 2, 3, 4	X	X	X	X	X	X	X	X	X	X	X	X	X
Coquille 23-EQ-01	City of Coquille	Seismic Upgrade Fire Station #1	Fire Station #1 not capable of withstanding earthquake forces. Strategy: Obtain grant funding for seismic upgrades, then go out for bond a to upgrade or build a new station. New for 2023; continuation of Coquille Action # 10-EQ-01.	Earthquake	H	2-5 years/ $2.5M – $10M	1, 2, 3, 4				X									
23-EQ-03	Coos County Emergency Management	Educate the community about the benefits of earthquake preparedness, including CERT and earthquake insurance.	Ongoing/Revised: 16-EQ-01 insurance education is being added to preparedness outreach.	Earthquake	M	1-3 years/ low cost	2, 3, 4, 7	X	X	X	X	X	X	X	X	X	X	X	X	X
23-FL-01	Individual jurisdictions: Cities; Coos County Planning	Address Repetitive Loss Properties, including buy outs. *Coos County:* Consult with property owners and explore mitigation actions for repetitive flood loss properties in Coos County. *Bandon:* Identify the single listed Repetitive Loss building and periodically explore opportunities to complete a property buy-out in collaboration with state and federal partners.	Continued/ Ongoing: Coos County, Bandon, and Coos Bay (Ongoing 16-FL-01) are the sole jurisdictions that have repetitive loss properties. Continued as repetitive loss qualifies the jurisdiction for Flood Mitigation Assistance (FMA) funding. The Oregon NFIP coordinator is available to answer questions from jurisdictions.	Flood	M	1-3 years/ staff time	1, 2, 3, 4, 5	X	X	X										

Action Item #	Lead	Mitigation Action	Status/ Description	Hazards addressed	Priority	Timeline /Cost	Goals met by Action	Coos County	City of Bandon	City of Coos Bay	City of Coquille	City of Lakeside	City of Myrtle Point	City of North Bend	City of Powers	Port of Coos Bay	Port of Bandon	Bay Area Hospital	S. Coos Hospital	Haynes D. District
23-FL-02	Individual jurisdictions: Cities; Coos County Planning	Ensure continued compliance with the National Flood Insurance Program (NFIP) through enforcement of local floodplain ordinance.	Floodplain development permits required for construction within floodplain. Ongoing: Coquille 10-FL-01/ Lakeside 16-MH-06/ Myrtle Point: 10-FL-01/ North Bend: 16-FL-01	Flood	M	1-3 years/ staff time	1, 2, 3, 4	X	X	X	X	X	X	X	X					
23-FL-03	Individual jurisdictions: Cities; Coos County	Develop a plan that includes a review of current stormwater capabilities and determines the necessity for new or additional mitigation actions.	North Bend: 16-FL-02 Master plan identified. Powers: Storm water master plan in progress to evaluate the storm drainage system and draft a report/plan for mitigation activities to ease flooding from storm water	Flood	M	2-5 years/ $50-200k	2, 3, 4, 5, 6	X	X	X	X	X	X	X	X	X	X			X
23-LS-01	Individual jurisdictions: Cities; Coos County Road Dept.	Continue to track and mitigate landslide events by developing data, designs, funding requests, and appropriate mitigation measures for implementation.	Current/ Revised: Coquille 10-LS-01 &10-LS-02/ Lakeside 16-LS-01 / Myrtle Point 10-LS-01 & 10-LS-02; North Bend 16-LS-01 & 16-LS-02; Powers 16-LS-01. Written to expand opportunities for funding requests. Based on two prior actions: 1) Work with DOGAMI to identify and map high risk slide areas to create an accurate logistical assessment. 2) Evaluate current and high hazard slide areas for mitigation prioritization and explore mitigation possibilities.	Landslide	H	Ongoing/ various	1, 2, 3, 4, 5	X	X	X	X	X	X	X	X	X	X	X		X
23-WF-01	Coos County Planning Dept.	Ensure new development in the wildfire urban interface (WUI) uses wildfire mitigation measures such as fire-resistant building materials, firebreaks, and access for fire trucks.	Ongoing/ Revised: Coos County advises best practices at the planning desk.	Wildfire	M	1-3 years/ staff time	1, 2, 3, 4	X	X	X	X	X	X	X	X					

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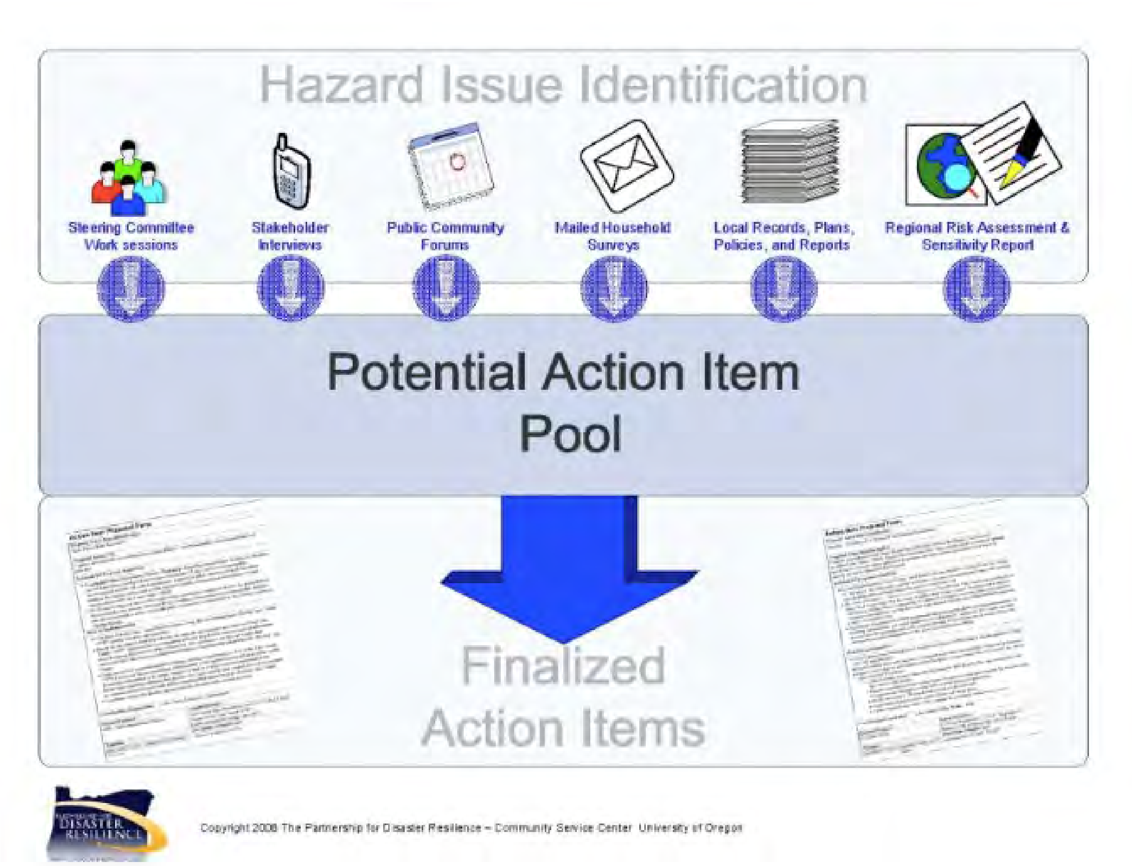
23-WF-02	Individual jurisdictions: Cities; Coos County	Implement wildfire actions identified in the Coos County Community Wildfire Protection Plan; Update the CWPP with community input.	CCEM is developing a plan to update the CWPP. CCEM works closely with CFPA on evacuation and rural fire mitigation. Powers Ongoing 16-WF-02 Southern Coos: Fire team has worked to create a significant fire break around facility.	Wildfire	M	1-3 years/ staff time	1, 2, 3, 4	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**

Action Item Development

Mitigation actions can be developed at any time during the planning process and can come from a variety of sources, including participants in the planning process, noted deficiencies in local capability, or issues identified through the risk assessment. The rationale for proposed mitigation actions is based on the information documented in the Risk Assessment. Development of action items was a multi-step process that involved consideration of Coos County Emergency Management recommendations; Coos County Community Survey Results; review of maps, the DOGAMI Risk Report, and OCCRI Future Conditions Report, followed by brainstorming, discussion, review, and revisions in collaboration with the implementing jurisdictions. The figure below illustrates the general process.

Figure II-1. Development of Action Item Pool



Source: Oregon Partnership for Disaster Resilience, 2008.

Project Prioritization Process

Jurisdictions are required to identify a process for prioritizing potential actions. Prioritization includes strategic planning such as that which results from leadership by the County emergency management office or from coordination with the plan holder steering committee to determine which mitigation actions can be completed using staff time, which ones can be supported by decision makers, and which ones will need collaboration for implementation.

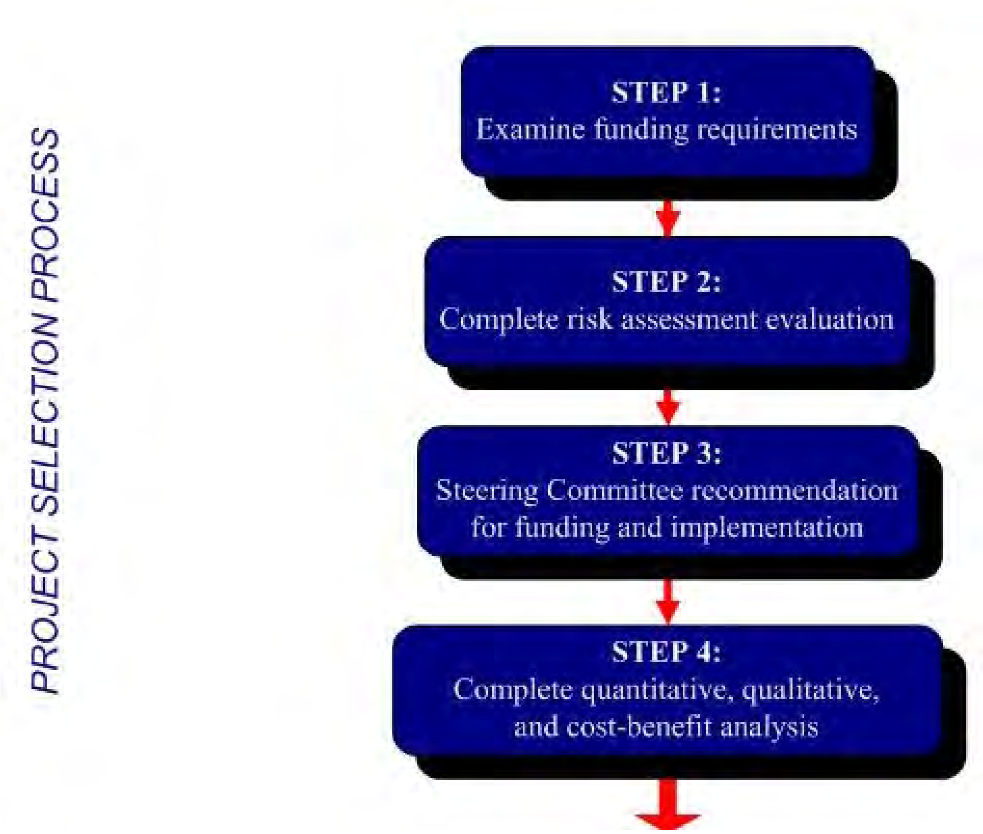
For the 2023 Coos County MJ-NHMP, the overall prioritization strategy includes:

The Lead entity supporting the mitigation action defines the first priority ranking—listing low, medium, or high for each proposed action. A low ranking may be a project that does not need funding, needs less than $5,000 in funding, or is unlikely to receive funding. A medium ranking may be applied to ongoing projects, projects that can be funded by capital improvement budgets, or new projects that need to undergo a period of outreach and awareness building with constituents. High ranked projects are those projects that must be done before other efforts can occur, such as resilience development in lifelines. Lifeline system work is often high priority—communication lifelines such as towers, broadband, etc. needs to be resilient so that critical facilities and other systems can function.

Once the actions all have an initial ranking, they are sorted. This provided the groundwork for a key step in the prioritization process--sorting the mitigation actions by low, medium, and high. Actions are next prioritized within the high-medium-low categories.

Potential mitigation activities often come from a variety of sources; therefore, the project prioritization process needs to be flexible. Committee members, local government staff, other planning documents, or the risk assessment may be the source to identify projects. Figure II-2 illustrates the project development and prioritization process.

Figure II-2. Action Item and Project Review Process



Source: Oregon Partnership for Disaster Resilience.

Step 1: Examine funding requirements (and capacity)

The first step in prioritizing the Plan's action items is to determine which mitigation actions can be completed using staff time, which ones can be supported by decision makers, and which ones will need collaboration for implementation. As the purpose of the NHMP is to qualify plan holders for funding, looking at the FEMA funding sources that are open for application is a good place to begin. Examples of mitigation funding sources include but are not limited to: FEMA's Building Resilient Infrastructure and Communities (BRIC), Flood Mitigation Assistance (FMA) program, Hazard Mitigation Grant Program (HMGP), Community Development Block Grants (CDBG), local general funds, and private foundations, among others. Please see Appendix B Funding: Recovery Resource Guide, for a more comprehensive list of potential grant programs.

Because grant programs open and close on differing schedules, the Steering Committee will examine upcoming funding streams' requirements to determine which mitigation activities would be eligible. The Steering Committee may consult with the funding entity, Oregon Department of Emergency Management (OEM), or other appropriate state or regional organizations about eligibility requirements. This examination of funding sources and requirements will happen during the Steering Committee's plan maintenance meetings.

Step 2: Complete risk assessment evaluation

The second step in prioritizing the Plan's action items is to examine which hazards the selected actions are associated with and where these hazards rank in terms of community risk. The Steering Committee will determine whether or not the Plan's risk assessment supports the implementation of eligible mitigation activities. This determination will be based on the location of the potential activities, their proximity to known hazard areas, and whether community assets are at risk. The Steering Committee will additionally consider whether the selected actions mitigate hazards that are likely to occur in the future, or are likely to result in severe/ catastrophic damages.

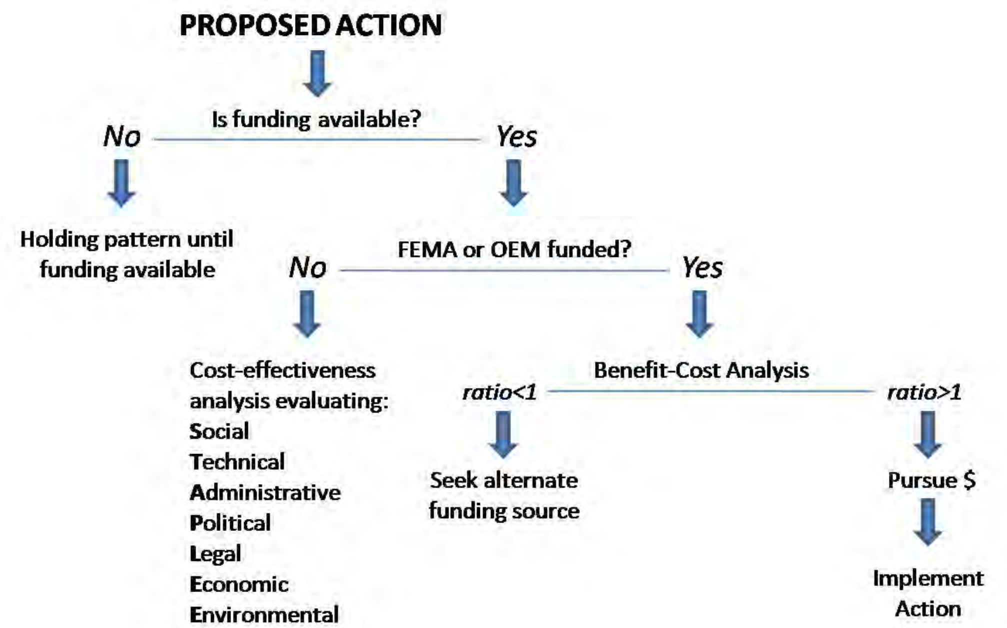
Step 3: Steering Committee Recommendation

Based on the steps above, the Steering Committee will recommend which mitigation activities should be moved forward. If the Steering Committee decides to move forward with an action, the coordinating organization designated on the action item form will be responsible for taking further action and, if applicable, documenting success upon project completion. The Steering Committee will convene a meeting to review the issues surrounding grant applications and to share knowledge and/or resources. This process will afford greater coordination and less competition for limited funds.

Step 4: Complete quantitative and qualitative assessment, and economic analysis

The fourth step is to identify the costs and benefits associated with the selected natural hazard mitigation strategies, measures, or projects. Two categories of analysis that are used in this step are: (1) benefit/cost analysis, and (2) cost-effectiveness analysis. Conducting benefit/cost analysis for a mitigation activity assists in determining whether a project is worth undertaking now, in order to avoid disaster-related damages later. Cost-effectiveness analysis evaluates how best to spend a given amount of money to achieve a specific goal. Determining the economic feasibility of mitigating natural hazards provides decision makers with an understanding of the potential benefits and costs of an activity, as well as a basis upon which to compare alternative projects. Figure 4-2 shows decision criteria for selecting the appropriate method of analysis.

Figure II-3. Action Item and Project Review Process



Source: Oregon Partnership for Disaster Resilience.

If the activity requires federal funding for a structural project, the Steering Committee will use a FEMA-approved cost-benefit analysis tool to evaluate the appropriateness of the activity. A project must have a benefit/cost ratio of greater than one in order to be eligible for FEMA grant funding.

For non-federally funded or nonstructural projects, a qualitative assessment will be completed to determine the project's cost effectiveness. The Steering Committee will use a multivariable assessment technique called STAPLE/E to prioritize these actions. STAPLE/E stands for Social, Technical, Administrative, Political, Legal, Economic, and Environmental. Assessing projects based upon these seven variables can help define a project's qualitative cost effectiveness. OPDR at the University of Oregon's Community Service Center has tailored STAPLE/E technique for use in natural hazard action item prioritization.

Mitigation Action Table

The Mitigation Actions 2023 table uses the following components:

Action Item #: The action item number is the result of the mitigation action prioritization process. It should be finalized once the action item table is fully populated. The assigned number is used to reference the 2016 (or previous) action item status as seen in Section D Mitigation Action 2016 Status.

Lead: The lead organization is the public agency with the regulatory responsibility to address natural hazards, or that is willing and able to organize resources, find appropriate funding, or oversee activity implementation, monitoring and evaluation. The lead organization and main contact for the Coos County MJ-NHMP is Coos County Emergency Management.

As each action item must be reported on during each 5-year plan update cycle, it is important that the Lead entity be the owner or primary implementing entity.

Mitigation Action: Each mitigation action item includes a title and a brief description of the proposed action.

Status/ Description: This column indicates the previous action item number if relevant. Next, a problem statement is made, along with any relevant description or partners. Then, specific status updates by jurisdiction are listed. Finally, a potential funding source should be listed. Mitigation actions should be fact-based and tied directly to issues or needs identified throughout the planning process. In order to focus these mitigation actions for FEMA programs, it is important to develop a problem statement that focuses the mitigation action on a specific hazard that will be mitigated and the vulnerable population or asset at risk which will be at lower risk after the project is completed. Where possible, identify potential funding sources for the mitigation action. Example funding sources can include: the federal Hazard Mitigation Grant Program (HMGP), Building Resilient Infrastructure and Communities (BRIC) and Flood Mitigation Assistance (FMA) Programs; state funding sources such as the Oregon Seismic Rehabilitation Grant Program; or local funding sources such as capital improvement or general funds. A mitigation action may have multiple funding sources. The funding sources are identified general as short- or long-term (see below) and includes an element of funding capacity of the jurisdiction for that action. See Appendix B1 Funding: Recovery Resource Guide for additional information on funding opportunities.

Hazards Addressed: While many mitigation actions in the 2023 Coos County MJ-NHMP are multi-hazard in nature, jurisdictions were advised to focus on articulating specific hazard risks when developing a problem statement in order to best align with FEMA funding.

Priority: The Lead entity supporting the mitigation action defined the first priority ranking—listing low, medium, or high for each proposed action. This provided the groundwork for a key step in the prioritization process--sorting the mitigation actions by low, medium, and high.

Timeline/ Cost: The potential timeline and a cost estimate gives form to a mitigation action by moving it out of the realm of “idea” and into “action”. Even if an action is well defined, a specific timeline makes it very clear how much fundraising time there is, and the cost sets a target for that fundraising. It is nearly impossible to begin even a cursory cost-benefit analysis without this information. Bids, estimates, or similar projects are all evidence-based sources of cost information. However, simply choosing a number of zeros goes a long way. Example: a $5,000 outreach effort is different from a $50,000 one.

Goals met by Action: The plan goals addressed by each mitigation action are identified as a means for monitoring and evaluating how well the mitigation plan is achieving its goals, following implementation.

Plan holder check boxes: However, many of the mitigation actions within this plan apply to either some or all of the participating plan holders. As such, the affected jurisdictions have a check mark on the right side of the matrix. These checkmarks have two meanings—that of a supporting role or a potential future lead role. Circumstances and jurisdiction needs often change during the five-year period that the plan is effective.

Authorities and Capabilities

To achieve risk reduction, it is necessary to consider natural hazards mitigation in jurisdictional planning processes, from land use to infrastructure to emergency response.

The 2023 Coos County MJ-NHMP includes a range of mitigation actions that, when implemented, will reduce loss from hazard events in the County. Coos County and the participating cities currently address statewide planning goals and legislative requirements through their comprehensive land use plans, capital improvements plans, mandated standards, and building codes. Plans and policies already in existence have support from local residents, businesses, and policy makers. Many land use, comprehensive, and strategic plans are updated regularly, and can adapt easily to changing conditions and needs. Implementing the MJ-NHMP's action items through such plans and policies increases their likelihood of being supported and implemented. The jurisdictions will work to incorporate the mitigation actions into existing programs and procedures.

Each jurisdiction engages in comprehensive planning and other processes within which mitigation can be considered and accomplished. However, it is not yet generally embedded in the context of these conversations. For most jurisdictions this will constitute a type of awareness campaign and require a change in organizational culture or political opinion in order to secure approval from the boards, councils, and commissions that guide them. Steering Committee members will be responsible for communicating the importance and necessity of integrating mitigation goals, objectives, and actions into the everyday business of the jurisdiction to those within their individual organizational structures responsible for developing and implementing the various planning and operations documents and processes. Steering Committee members will also engage in those planning and operations processes to the extent necessary and appropriate to ensure that mitigation goals, objectives, and actions are duly considered and incorporated as applicable and feasible.

Jurisdictions have a wide array of authorities that can be effective in reducing risk from hazards. In order to put these to work, it is necessary to articulate how the authority can, should, and will be used to address natural hazards. Considering natural hazards mitigation in jurisdictional planning processes, from land use to infrastructure to emergency response are all effective practices for reducing risk. Every advance in mitigation reduces impact, decreasing the need for response and recovery and increasing resilience.

Table II-2. Authorities and Capabilities identifies by jurisdiction the types of authorities and capabilities available to the plan holder jurisdictions with which they may implement natural hazard mitigation goals, objectives, and actions.

Table II-2. Authorities and Capabilities

	Coos County	Bandon	Coos Bay	Coquille	Lakeside	Myrtle Point	North Bend	Powers	Port of Coos Bay	Port of Bandon	Bay Area Hospital	Southern Coos Hospital	Haynes Drainage District	Comments
Public notification, warning systems	X	X	X	X	X	X	X	X	X	X	X	X	X	Plan holder communication networks
Education and outreach	X	X	X	X	X	X	X	X	X	X	X	X	X	Internal/external information sharing
Public/ private coordination	X	X	X	X	X	X	X	X	X	X	X	X	X	For funding, staffing, etc.
Mutual aid agreements	X	X	X	X	X	X	X	X	X	X	X	X	X	For response and recovery
Comprehensive planning	X	X	X	X	X	X	X	X						Oregon land use process requirement
Development standards	X	X	X	X	X	X	X	X						Locally driven code based on comp plan
Building codes	X	X	X	X	X	X	X	X						Building codes of Oregon adopt the International Building Code 2021 (IBC 2021), IRC 2018, IEBC 2021, etc.
Equipment: debris mgmt., recovery	X	X	X	X	X	X	X	X	X	X	X	X	X	
Funding authority: Taxes	X	X	X	X	X	X	X	X	X	X	X	X	X	All plan holders have taxation authority.
Capital improvement funding	X	X	X	X	X	X	X	X	X	X	X	X	X	All plan holders have funding authority.
Transportation planning	X	X	X	X	X	X	X	X	X	X				Maritime, estuarine, and surface roads.
Zoning code	X	X	X	X	X	X	X	X						NFIP Flood code; floodplain mgmt.
Provision of services:														
Bridge, dock, levee maintenance	X	X	X	X	X	X	X	X	X	X			X	Includes dredging waterways
Debris & garbage management	X	X	X	X	X	X	X	X						
Drinking water		X	X	X	X	X	X	X						
Emergency response services	X	X	X	X	X	X	X	X						
Healthcare services	X										X	X		
Mooring, shipping, storage									X	X				
Permits & fees for development	X	X	X	X	X	X	X	X						
Wastewater		X	X	X	X	X	X	X						

D. Mitigation Action 2016 Status

The status of mitigation actions in the 2016 Coos County Multi-Jurisdictional Natural Hazard Mitigation Plan were reported on alongside their number from the last plan as seen in column two. Actions that were carried over into the 2023 Coos County MJ-NHMP are referenced in column three.

Table II-3. 2016 Mitigation Action Status Table

	2016 Action Item #/ Status	2023 Action Item #/ Status	Mitigation Action	Notes	Project Lead(s)	Partners/ Funding	Hazards addressed
Coos County	16-MH-01/ Complete	n/a	Participate in the FEMA Risk Map discovery, hazard study, and resilience meeting processes.	Coos County staff worked with state and federal partners to update their flood ordinance and maps in advance of the FEMA flood maps becoming effective in 2018.	Coos County Planning	Coos County Emergency Management, Public Works	Multi-Hazard
Coos County	16-MH-02/ Complete	n/a	Utilize the final multi-hazard risk report and assessment currently being developed through FEMA's RiskMap program to update the Coos County Hazard Analysis.	The 2018 DOGAMI Natural Hazard Risk Report for Coos County was used to update the hazard analysis.	Coos County Emergency Management	Coos County Planning	Multi-Hazard

	2016 Action Item #/ Status	2023 Action Item #/ Status	Mitigation Action	Notes	Project Lead(s)	Partners/ Funding	Hazards address ed
Coos County	16-MH-03/ Complete	n/a	Utilize the final multi-hazard risk report and assessment currently being developed through FEMA's RiskMap program to update local risk assessment maps to show areas at risk for all hazards.	DOGAMI completed the Natural Hazard Risk Report for Coos County in 2018. This serves as the risk assessment for the 2023 Coos County NHMP update.	Coos County Planning	Planning Commission; Board of County Commissioner s; Economic Development; Coos Emergency Management	Multi-Hazard
Coos County	16-MH-04/ Started	22-MH-01/ Ongoing	Identify and disseminate information regarding alternate transportation routes.	22-MH-01: Revise to change word transportation to evacuation	Coos County Emergency Management		Multi-Hazard
Coos County	16-MH-05/ Started	22-MH-02/ Ongoing	Establish mutual aid agreements between government agencies and commercial businesses in the event of an emergency (e.g. fuel, heavy equipment, food, etc.)	22-MH-02: Access database developed; questionnaires about available supplies held by local businesses were sent out by CCEM in 2018. Have MOUs for shelters from 1990s-2000s that need to be revisited.	Coos County Emergency Management		Multi-Hazard

	2016 Action Item #/ Status	2023 Action Item #/ Status	Mitigation Action	Notes	Project Lead(s)	Partners/ Funding	Hazards addressed
Coos County	16-MH-06/ Started	22-MH-03/ Ongoing	Educate and encourage major businesses, service providers, schools, and governmental organizations to develop continuity of operations plans.	County, Cities, hospitals, and some schools have COOPs.	Coos County Emergency Management	Southwest Oregon Workforce Investment Board, Coos Curry Douglas Business Development Corp. OEM, Business Oregon,	Multi-Hazard
Coos County	16-FL-01/ Complete	n/a	Complete a risk analysis for the flood hazard using newly acquired Light Detection and Ranging (LIDAR) data.	Completed as a part of the FEMA flood map update.	Coos County Planning	Coos County Emergency Management	Flood
Coos County	16-CE-01/ Updated	22-CE-01/ Ongoing	Reduce risk of coastal erosion through hazard mapping and regulation.	Use of Coos County Beaches and Dunes Goal 18 Development suitability maps is ongoing. https://www.coastalatlas.net/coos-all-hazards/ Updates occur as data is improved.	Coos County Planning	Planning Commission; Board of County Commissioners; Coos Emergency Management	Coastal Erosion

	2016 Action Item #/ Status	2023 Action Item #/ Status	Mitigation Action	Notes	Project Lead(s)	Partners/ Funding	Hazards addressed
Coos County	10-WF-03/ 16-MH-06 Underway	22-MH-01/ Ongoing	Through multi-agency coordination, implement abatement efforts to control noxious weeds, specifically Gorse, Scotch Broom, and Butterfly Bush.	The Gorse Action Group is lead on fire-prone weed abatement. A wide array of control, monitoring, and coordination strategies are underway.	Gorse Action Group	Cities of Bandon, Lakeside and Powers; County Weed Board, CFPA.	Wildfire
Coos County	16-CE-02/ Updated	22-CE-01/ Ongoing	Monitor rates of coastal erosion in areas zoned for development and reassess development standards to prevent damage to future buildings and infrastructure.	This action item was written for external partners, it is being combined with Action 22-CE-01 for this plan update.	Coos County	DLCD, DOGAMI	Coastal Erosion
Coos County	16-EQ-01/ Not started	22-EQ-03/ Revised	Encourage residents and businesses to consider the purchase of earthquake insurance.	Revised into 22-EQ-03 for this plan update “Educate the community about the benefits of earthquake preparedness, including CERT and earthquake insurance.”	Coos County	OEM	Earthquake
Coos County	16-EQ-02/ Not started	22-EQ-03/ Revised	Conduct regular earthquake safety drills.	Revised as 22-EQ-02 for this plan update.	Coos County	OEM	Earthquake

	2016 Action Item #/ Status	2023 Action Item #/ Status	Mitigation Action	Notes	Project Lead(s)	Partners/ Funding	Hazards addressed
Coos County	16-EQ-03/ Started	22-MH-11	Have local emergency responders continue to take bridge assessment classes.	Revised as 22-MH-11 for this plan update to include other types of post-disaster damage assessment.	Coos County	ODOT, local EMS agencies	Earthquake
Coos County	16-EQ-04/ Started	22-EQ-01/ Ongoing	Retrofit schools, fire departments, and other critical facilities to withstand seismic activity.		Building/ Infrastructure owners	Local school districts, fire departments, and other agencies with critical facilities.	Earthquake
Coos County	16-FL-01/ Complete	n/a	Complete a risk analysis for the flood hazard using newly acquired Light Detection and Ranging (LIDAR) data.	This work was done as a part of the FEMA Flood Insurance Rate Map (FIRM) update that concluded in 2018 when flood maps became effective.	FEMA/ DOGAMI, Coos County Planning	FEMA/ DOGAMI	Flood
Coos County	16-FL-02/ Not started	n/a	Take steps for the county to qualify for participation in the National Flood Insurance Program's (NFIP) Community Rating System.	The Community Rating System requires a high level of staff capacity.	Coos County	DLCD, FEMA	Flood

	2016 Action Item #/ Status	2023 Action Item #/ Status	Mitigation Action	Notes	Project Lead(s)	Partners/ Funding	Hazards addressed
Coos County	16-FL-03/ Not started	n/a	Conduct an analysis of flooding issues in the Libby Drainage District and Englewood Drainage District and develop mitigation strategies to prevent future floods from damaging property in the area.		Coos County	Coos Watershed Association is a potential partner or lead for this project.	Flood
Coos County	16-FL-04/ Started	22-FL-01/ Ongoing	Consult with property owners and explore mitigation actions for repetitive flood loss properties in Coos County.		Coos County Planning	FMA, NFIP program, DLCD, FEMA	Flood
Coos County	16-LS-01/ Complete	n/a	Assess LIDAR maps to evaluate development in hazardous areas.	See Coos County Natural Hazard Risk Report, All Hazards Viewer https://www.coastalatlas.net/ , and SLIDO https://www.oregongeology.org/slido/	Coos County	DOGAMI, DLCD	Landslide
Coos County	16-LS-02/ Underway	22-LS-01	Continue to track landslide events along major roadways and develop appropriate mitigation measures.	22-LS-01: Adds mitigation implementation to action item	Coos County Road Dept.	ODOT, DOGAMI	Landslide

	2016 Action Item #/ Status	2023 Action Item #/ Status	Mitigation Action	Notes	Project Lead(s)	Partners/ Funding	Hazards addressed
Coos County	16-TS-01/	22-MH-04	Conduct regular tsunami evacuation drills.	Revised: Incorporated into 22-MH-04	Coos County		Tsunami
Coos County	16-WF-01/ Started	22-WF-02	Encourage new and existing developments in the WUI to incorporate wildfire mitigation measures and ensure adequate emergency access.	Revised:	Coos County Planning Dept.		
Coos County	16-WS-01/ Not started	22-MH-06	Educate the public about the dangers of downed power lines after a windstorm.	2010 action item by Coos Curry Electric Coop.	Coos County	Coos County Emergency Management, Coos County Planning, Sheriff, Cities, Rural Fire Departments	Windstorm
Coos County	16-WS-01/ Ongoing	22-WS-01/ Ongoing	Encourage all critical facilities to have backup power and/or emergency operations plans in place to deal with power outages.	Revised: two mitigation actions both moved into Multi-Hazard.	CCEM/ Infrastructure owner		

	2016 Action Item #/ Status	2023 Action Item #/ Status	Mitigation Action	Notes	Project Lead(s)	Partners/ Funding	Hazards addressed
Coos County	16-WS-02/ Reassign	n/a	Upgrade lines and poles to improve wind loading and underground critical power lines.	This is not a mitigation action that CC can implement.	Coos-Curry Electric Coop, others		Windstorm
City of Bandon	16-MH-01/ Complete	n/a	Participate in the FEMA Risk Map discovery, hazard study, and resilience meeting processes.	High priority action #1 from 2016. This FEMA process was completed when the new preliminary FIRM maps were released. City staff worked with state and federal partners to update their flood ordinance and maps in advance of the FEMA flood maps becoming effective in 2018.	City of Bandon Planning	DLCD, FEMA	Multi-Hazard
City of Bandon	16-MH-02/ Ongoing	22-MH-13	Utilize the final multi-hazard risk report and assessment developed by DOGAMI through FEMA's RiskMap program to update the Goal 7 section of the Bandon Comprehensive Plan.	This action item is ongoing but was partially completed in the 2020 adoption of the Hazards Overlay Zone.	City of Bandon	Coos County Planning	Multi-Hazard

	2016 Action Item #/ Status	2023 Action Item #/ Status	Mitigation Action	Notes	Project Lead(s)	Partners/ Funding	Hazards addressed
City of Bandon	16-MH-03/ Ongoing	22-MH-14/ Ongoing	Stock contains in city park with emergency response supplies.	The City plans to complete container repair, inventory, and local coordination for on-going maintenance and future improvements.	City of Bandon	Coos County Emergency Management	Multi-Hazard
City of Bandon	16-MH-04/ Ongoing	22-MH-09/ Ongoing	Continue to implement and enhance public education programs regarding earthquakes and tsunamis.	Increased Tsunami evacuation signage, participation in annual Shake Out day.	City of Bandon	Cities of Bandon, Lakeside and Powers; County Weed Board, CFPA.	Multi-Hazard
City of Bandon	16-MH-05/ Revised	22-MH-15/ Continued	Complete a disaster recovery plan for Bandon.	Continue as a countywide action item in 2023 plan.	City of Bandon	OEM, FEMA, Coos County Emergency Management	Multi-Hazard
City of Bandon	16-EQ-01/ Ongoing	n/a	Seek funding to study the seismic vulnerability of buildings and infrastructure in the City of Bandon and retrofit those that are vulnerable to seismic hazards.	GO Bond for seismic valve replacement Study @ water plant The City has obtained funding through bond sales and is completing seismic upgrades on the City's water supply tanks.	City of Bandon	Coos County Emergency Management	Earthquake

	2016 Action Item #/ Status	2023 Action Item #/ Status	Mitigation Action	Notes	Project Lead(s)	Partners/ Funding	Hazards addressed
City of Bandon	16-FL-01/ Ongoing	22-FL-01/ Continued	Identify the single listed Repetitive Loss building and periodically explore opportunities to complete a property buy-out in collaboration with state and federal partners.	Continued as repetitive loss qualifies the City for Flood Mitigation Assistance (FMA) funding.	City of Bandon	OEM, FEMA, Coos County Emergency Management	Flood
City of Bandon	16-LS-01/ Complete	n/a	Obtain lidar collection data from DOGAMI.	This process was completed with the 2020 adoption of a Hazards Overlay Zone, specific to landslide and liquefaction susceptibility.	City of Bandon	DLCD	Landslide
City of Bandon	16-TS-01/ Discontinued	n/a	Adopt a Tsunami Land Use Overlay Zone.	Old Town Bandon is in the floodplain already and tsunami regulations would be difficult to implement at this time.	City of Bandon	Coos County Planning	Tsunami

	2016 Action Item #/ Status	2023 Action Item #/ Status	Mitigation Action	Notes	Project Lead(s)	Partners/ Funding	Hazards address ed
City of Bandon	16-WF-01/ Ongoing	22-MH-05/ Ongoing	Through multi-agency coordination, implement abatement efforts to control noxious weeds, specifically Gorse, Scotch Broom, and Butterfly Bush, and reduce wildfire fuels.	A multi-district gorse abatement plan was created by the Gorse Action Group in 2019. The city hired a part time Vegetation Management Coordinator and Code Compliance Officer who are responsible for the plans ongoing implementation and enforcement. The City has obtained services from a gorse removal contactor and purchased equipment to abate noxious vegetation within public rights-of-ways and City owned property.	City of Bandon	Gorse Action Group	Wildfire

	2016 Action Item #/ Status	2023 Action Item #/ Status	Mitigation Action	Notes	Project Lead(s)	Partners/ Funding	Hazards addressed
City of Coquille	10-MH-01/ Complete	n/a	Participate in the FEMA Risk Map discovery, hazard study, and resilience meeting processes.	This FEMA process was completed when the new preliminary FIRM maps were released. City staff worked with state and federal partners to update their flood ordinance and maps in advance of the FEMA flood maps becoming effective in 2018.	City of Coquille	DLCD, FEMA	Multi-Hazard
City of Coquille	10-EQ-01/ Ongoing	22-MH-04/ Ongoing	Conduct regular earthquake safety drills.		City of Coquille		Earthquake
City of Coquille	10-WF-01/ Ongoing	22-MH-05/ Ongoing	Through multi-agency coordination, implement plan for control of Noxious Weeds, specifically Gorse, Scotch Broom, and Butterfly Brush.	Work is currently underway along the Coquille River Walk.	City of Coquille		Wildfire

	2016 Action Item #/ Status	2023 Action Item #/ Status	Mitigation Action	Notes	Project Lead(s)	Partners/ Funding	Hazards addressed
City of Coquille	10-MH-02/ Started	22-MH-13/ Started	Utilize the final multi-hazard risk report and assessment developed by DOGAMI and FEMA's RiskMap program to update the Goal 7 section of the Powers Comprehensive Plan.	Chief Ferren will meet with partners.	City of Coquille	DOGAMI, Coos County Emergency Management & Planning	Multi-Hazard
City of Coquille	10-MH-03/ Complete	n/a	Continue to review city comprehensive plan and zoning ordinance for the need to update hazard specific section to reflect the latest information on natural hazards.		City of Coquille		Multi-Hazard
City of Coquille	10-MH-03/ Ongoing	22-MH-09/ Ongoing	Continue to implement public education programs regarding natural hazards.		City of Coquille		Multi-Hazard
City of Coquille	10-EQ-01/ Started	22-EQ-01/ Started	Seek funding to retrofit buildings and/or infrastructure at risk of damage in a high magnitude earthquake.	Seeking funding for firehall seismic upgrades.	City of Coquille		Earthquake

	2016 Action Item #/ Status	2023 Action Item #/ Status	Mitigation Action	Notes	Project Lead(s)	Partners/ Funding	Hazards addressed
City of Coquille	10-FL-01/ Ongoing	22-FL-02/ Ongoing	Ensure continued compliance with the National Flood Insurance Program (NFIP) through enforcement of local floodplain ordinance.		City of Coquille	DLCD, FEMA	Flood
City of Coquille	10-LS-01/ Started	22-LS-01/ Started	Work with DOGAMI to identify and map high risk slide areas to create an accurate logistical assessment.	Chief Ferren will work with DOGAMI	City of Coquille	DOGAMI, ODOT	Landslide
City of Coquille	10-LS-02/ Started	22-LS-01/ Started	Evaluate current and high hazard slide areas for mitigation prioritization and explore mitigation possibilities.		City of Coquille	DOGAMI, ODOT	Landslide
City of Coquille	10-MH-04/ Ongoing	22-MH-04/ Ongoing	Identify and map all roads, private drives, logging trails to increase the ability of firefighters to locate and gain access to provide services and/or evacuations.	Fire Dept. is working with Public Works and the City of Coos Bay for mapping assistance.	City of Coquille	Coos County Emergency Management	Multi-Hazard

	2016 Action Item #/ Status	2023 Action Item #/ Status	Mitigation Action	Notes	Project Lead(s)	Partners/ Funding	Hazards addressed
City of Coquille	10-MH-05/ Ongoing	22-MH-10/ Ongoing	Educate and encourage major businesses, service providers, schools, and governmental organizations to develop continuity of operations plans.		City of Coquille	Coos County Emergency Management	Multi-Hazard
City of Coos Bay	16-MH-01/ Complete	n/a	Participate in the FEMA Risk Map discovery, hazard study, and resilience meeting processes.	High priority action #1 from 2016. This FEMA process was completed when the new preliminary FIRM maps were released. City staff worked with state and federal partners to update their flood ordinance and maps in advance of the FEMA flood maps becoming effective in 2018.	City of Coos Bay Planning Division	DLCD, FEMA	Multi-Hazard

	2016 Action Item #/ Status	2023 Action Item #/ Status	Mitigation Action	Notes	Project Lead(s)	Partners/ Funding	Hazards addressed
City of Coos Bay	16-MH-02/ Not started	22-MH-13/ Not started	Utilize the final multi-hazard risk report and assessment developed by DOGAMI and FEMA's RiskMap program to update the Goal 7 section of the Coos Bay Comprehensive Plan.	High priority action #2 from 2016.	City of Coos Bay Planning Division	DLCD, Coos County Planning	Multi-Hazard
City of Coos Bay	16-TS-01/ Discontinued	n/a	Adopt a Tsunami Land Use Overlay Zone.	High priority action #3 from 2016.	City of Coos Bay Planning Division	Coos County Planning	Tsunami
City of Coos Bay	16-FL-01/ Complete	22-FL-01/ Ongoing	Ensure continued compliance with the National Flood Insurance Program (NFIP) through enforcement of local floodplain ordinance.		City of Coos Bay Planning Division	DLCD, FEMA	Flood
City of Coos Bay	16-MH-03/ Started	22-MH-04/ Ongoing	Identify and map all roads, private drives, logging trails to increase the ability of firefighters to locate and gain access to provide services and/or evacuations.		City of Coos Bay	Coos County Emergency Management	Multi-Hazard

	2016 Action Item #/ Status	2023 Action Item #/ Status	Mitigation Action	Notes	Project Lead(s)	Partners/ Funding	Hazards addressed
City of Coos Bay	16-FL-02/ Completed	Discontinued	Explore alternative actions to mitigate flooding in Libby Drainage and Englewood Diking Districts.		City of Coos Bay		Flood
City of Coos Bay	16-MH-04/ Ongoing	22-MH-11/ Ongoing	Continue public education for earthquake and tsunami preparedness.		City of Coos Bay	Cities of Coos Bay, Lakeside and Powers; County Weed Board, CFPA.	Multi-Hazard
City of Coos Bay	16-EQ-01/ Started	22-EQ-02/ Ongoing	Promote CERT or other preparedness education.		City of Coos Bay		Multi-Hazard
City of Coos Bay	16-MH-05/ Started	22-MH-14/ Ongoing	Establish a cache of a disaster relief resources for displaced residents.	As of 7/1/2021, the city has resources in four locations to provide shelter, water, and food for 1600 people for two weeks.	City of Coos Bay	OEM, FEMA, Coos County Emergency Management	Multi-Hazard
City of Lakeside	n/a	New / 16-MH-05 added	Move wastewater facility out of the floodplain and build a resilient facility with emergency operations center capabilities.	Consider seismic upgrades-discuss with project engineer.	City of Lakeside	DEQ, FEMA	Multi-Hazard

	2016 Action Item #/ Status	2023 Action Item #/ Status	Mitigation Action	Notes	Project Lead(s)	Partners/ Funding	Hazards addressed
City of Lakeside	n/a	New	Improve coordination on local emergency management to ensure resilience after a CSZ event.	The topography of the Lakeside area poses an elevated risk for residents in the event of a catastrophic event.	City of Lakeside	Lakeside Fire Department, Coos County Emergency Management, Oregon Emergency Management.	Multi-Hazard
City of Lakeside	n/a	New	Develop a stormwater master plan.	It is a best practice to create foundational documents like Transportation Master Plans, system plans, and stormwater master and management plans so that evacuation and flood planning and construction work can be done using current information.	City of Lakeside		Multi-Hazard

	2016 Action Item #/ Status	2023 Action Item #/ Status	Mitigation Action	Notes	Project Lead(s)	Partners/ Funding	Hazards address ed
City of Lakeside	16-MH-01/ Complete	n/a	Participate in the FEMA Risk Map discovery, hazard study, and resilience meeting processes.	High priority action #1 from 2016. This FEMA process was completed when the new preliminary FIRM maps were released. City staff worked with state and federal partners to update their flood ordinance and maps in advance of the FEMA flood maps becoming effective in 2018.	City of Lakeside	DLCD, FEMA	Multi-Hazard

	2016 Action Item #/ Status	2023 Action Item #/ Status	Mitigation Action	Notes	Project Lead(s)	Partners/ Funding	Hazards addressed
City of Lakeside	16-MH-02/ Started	Ongoing	Utilize the final multi-hazard risk report and assessment developed by DOGAMI and FEMA's RiskMap program to update the Goal 7 section of the Lakeside Comprehensive Plan.	High priority action #2 from 2016. No hazard work done in the last period. Mayor Edwards just signed a letter for Ryn Lamb, FEMA for DOGAMI landslide mapping. Continue to review city comprehensive plan and zoning ordinance for the need to update hazard specific section to reflect the latest information on natural hazards	City of Lakeside	DLCD, Coos County Planning	Multi-Hazard
City of Lakeside	16-LS-01/ Started	Started	Evaluate current and high hazard slide areas for mitigation prioritization and explore mitigation possibilities.	High priority action #3 from 2016. Countywide evacuation planning with timber	City of Lakeside		Landslide

	2016 Action Item #/ Status	2023 Action Item #/ Status	Mitigation Action	Notes	Project Lead(s)	Partners/ Funding	Hazards address ed
City of Lakeside	16-WF-01/ Complete	Ongoing	Through multi-agency coordination, implement abatement efforts to control noxious weeds, specifically Gorse, Scotch Broom, and Butterfly Bush.	The Gorse Action Group helps coordinate weed abatement. A wide array of control, monitoring, and coordination strategies are underway. Unplanted logged hillside has resulted in a scotch broom overgrowth. City has an ordinance (April - Sept) residents are required to cut down weeds. City does outreach on this.	City of Lakeside	ODF/State Forestry, Lakeside Watershed Coordinator Mike Mader. Tenmile Creek is at the base of the scotch broom issue.	Wildfire
City of Lakeside	16-MH-03/ Complete	Revised, combined with 16-MH-02	Continue to review city comprehensive plan and zoning ordinance for the need to update hazard specific section to reflect the latest information on natural hazards.		City of Lakeside		Multi-Hazard

	2016 Action Item #/ Status	2023 Action Item #/ Status	Mitigation Action	Notes	Project Lead(s)	Partners/ Funding	Hazards addressed
City of Lakeside	16-MH-04/ Ongoing	Ongoing	Promote public education and outreach on hazards. Continue to implement public education programs regarding natural hazards.	**High Priority** Preparedness and homeowner actions for mitigation. Educate the public about how to prevent wildfire and evacuate in a wildfire event.	City of Lakeside		Multi-Hazard
City of Lakeside	16-MH-05/ Not Started	Revised, added to wastewater plant project	Build a community center/ evacuation center that can serve as a command center and kitchen.	Proposed in 2016 update, but without a tax base and having separate districts (water, fire, etc.)	City of Lakeside		Multi-Hazard
City of Lakeside	16-EQ-01/ Started	Not started	Seek funding to retrofit buildings and/or infrastructure at risk of damage in a high magnitude earthquake.		City of Lakeside		Earthquake
City of Lakeside	16-MH-06/ Ongoing	Ongoing	Ensure continued compliance in the National Flood Insurance Program (NFIP) through enforcement of local floodplain management ordinances.		City of Lakeside		Multi-Hazard

	2016 Action Item #/ Status	2023 Action Item #/ Status	Mitigation Action	Notes	Project Lead(s)	Partners/ Funding	Hazards addressed
City of Lakeside	16-MH-07/ Ongoing	Ongoing	Identify and map all roads, private drives, logging trails to increase the ability of firefighters to locate and gain access to provide services and/or evacuations.	Fire Department is lead.	City of Lakeside		Multi-Hazard
City of Lakeside	16-MH-08/ Started	Ongoing	Enhance strategies for debris management relating to severe wind and winter storm events.	Central Lincoln PUD does the bulk of this; in coordination with Fire Dept. and PW.	City of Lakeside		Multi-Hazard
City of Myrtle Point	10-MH-01/ Complete	n/a	Participate in the FEMA Risk Map discovery, hazard study, and resilience meeting processes.	This FEMA process was completed when the new preliminary FIRM maps were released. City staff worked with state and federal partners to update their flood ordinance and maps in advance of the FEMA flood maps becoming effective in 2018.	City of Myrtle Point	DLCD, FEMA	Multi-Hazard

	2016 Action Item #/ Status	2023 Action Item #/ Status	Mitigation Action	Notes	Project Lead(s)	Partners/ Funding	Hazards address ed
City of Myrtle Point	10-MH-02/ Started	22-MH-13/ Started	Utilize the final multi-hazard risk report and assessment developed by DOGAMI and FEMA's RiskMap program to update the Goal 7 section of the Myrtle Point Comprehensive Plan.		City of Myrtle Point	DLCD, Coos County Planning	Multi-Hazard
City of Myrtle Point	10-MH-03/ Complete	Complete	Continue to review city comprehensive plan and zoning ordinance for the need to update hazard specific section to reflect the latest information on natural hazards.		City of Myrtle Point		Multi-Hazard
City of Myrtle Point	10-MH-04/ Ongoing	22-MH-09/ Ongoing	Continue to implement public education programs regarding natural hazards.	Development within Hazards Overlay Zone subject to specific development requirements.	City of Myrtle Point		Multi-Hazard
City of Myrtle Point	10-MH-05/ Ongoing	22-MH-04/ Ongoing	Identify and map all roads, private drives, logging trails to increase the ability of firefighters to locate and gain access to provide services and/or evacuations.		City of Myrtle Point	Coos County Emergency Management	Multi-Hazard

	2016 Action Item #/ Status	2023 Action Item #/ Status	Mitigation Action	Notes	Project Lead(s)	Partners/ Funding	Hazards address ed
City of Myrtle Point	10-MH-06/ Ongoing	22-MH-10/ Ongoing	Educate and encourage major businesses, service providers, schools, and governmental organizations to develop continuity of operations plans.		City of Myrtle Point	Coos County Emergency Management	Multi-Hazard
City of Myrtle Point	10-EQ-01/ Ongoing	22-MH-06/ Ongoing	Conduct regular earthquake safety drills.	City staff conducts annual earthquake drill. Need to add post-earthquake operational scenario.	City of Myrtle Point		Earthqu ake
City of Myrtle Point	10-EQ-02/ Ongoing	22-EQ-01/ Ongoing	Seek funding to retrofit buildings and/or infrastructure at risk of damage in a high magnitude earthquake.	City received $1.1 Million Seismic Rehab grant for Fire & Ambulance Station. Design in progress.	City of Myrtle Point		Earthqu ake
City of Myrtle Point	10-FL-01/ Ongoing	22-FL-02/ Ongoing	Ensure continued compliance with the National Flood Insurance Program (NFIP) through enforcement of local floodplain ordinance.	Floodplain development permits required for construction within floodplain.	City of Myrtle Point	DLCD, FEMA	Flood

	2016 Action Item #/ Status	2023 Action Item #/ Status	Mitigation Action	Notes	Project Lead(s)	Partners/ Funding	Hazards address ed
City of Myrtle Point	10-LS-01/ Not Started	22-LS-01/ Not Started	Work with DOGAMI to identify and map high risk slide areas to create an accurate logistical assessment.		City of Myrtle Point	DOGAMI, ODOT	Landslid e
City of Myrtle Point	10-LS-02/ Not Started	22-LS-01/ Not Started	Evaluate current and high hazard slide areas for mitigation prioritization and explore mitigation possibilities.		City of Myrtle Point		Landslid e
City of Myrtle Point	10-WF-01/ Ongoing	22-MH-05/ Ongoing	Through multi-agency coordination, implement plan for control of Noxious Weeds, specifically Scotch Broom.	Noxious vegetation is regularly addressed through code enforcement.	City of Myrtle Point		Wildfire
City of North Bend	16-MH-01/ Complete	n/a	Participate in the FEMA Risk Map discovery, hazard study, and resilience meeting processes.	High priority action #1 from 2016. This FEMA process was completed when the new preliminary FIRM maps were released. City staff worked with state and federal partners to update their flood ordinance and maps in advance of the FEMA flood maps becoming effective in 2018.	City of North Bend Planning Department	DLCD, FEMA	Multi-Hazard

	2016 Action Item #/ Status	2023 Action Item #/ Status	Mitigation Action	Notes	Project Lead(s)	Partners/ Funding	Hazards addressed
City of North Bend	16-MH-02/ Complete	n/a	Utilize the final multi-hazard risk report and assessment developed by DOGAMI and FEMA's RiskMap program to update the Goal 7 section of the North Bend Comprehensive Plan.	High priority action #2 from 2016.	City of North Bend Planning Department	DLCD, Coos County Planning	Multi-Hazard
City of North Bend	16-MH-03/ Ongoing	22-MH-13/ Ongoing	Continue to review city comprehensive plan and zoning ordinance for the need to update hazard specific section to reflect the latest information on natural hazards.		City of North Bend Planning Department		Multi-Hazard
City of North Bend	16-MH-04/ Ongoing	22-MH-09/ Ongoing	Continue to implement public education programs regarding natural hazards.		City of North Bend		Multi-Hazard
City of North Bend	16-MH-05/ Complete	n/a	Identify and map all roads, private drives, logging trails to increase the ability of firefighters to locate and gain access to provide services and/or evacuations.		City of North Bend	Coos County Emergency Management	Multi-Hazard

	2016 Action Item #/ Status	2023 Action Item #/ Status	Mitigation Action	Notes	Project Lead(s)	Partners/ Funding	Hazards addressed
City of North Bend	16-MH-06/ Not Started	22-WS-01/ Not Started	Enhance strategies for debris management relating to severe wind and winter storm events.		City of North Bend		Multi-Hazard
City of North Bend	n/a	North Bend 22-MH-01	Develop a risk assessment for sea level rise and tsunami risk for industrial lands. Consider a feasibility study for expanding the UGB to include North Spit lands for annexation to replace existing industrial zoned lands.		City of North Bend	Port of Coos Bay, Coos County / DLCD, FEMA, NOAA	Multi-Hazard
City of North Bend	16-EQ-01/ Ongoing	22-EQ-01/ Ongoing	Seek funding to retrofit buildings and/or infrastructure at risk of damage in a high magnitude earthquake.	The city is exploring funding for seismic retrofits via Business Oregon.	City of North Bend		Earthquake
City of North Bend	16-FL-01/ Ongoing	22-FL-02/ Ongoing	Ensure continued compliance with the National Flood Insurance Program (NFIP) through enforcement of local floodplain ordinance.		City of North Bend Planning Department	DLCD, FEMA	Flood
City of North Bend	16-FL-02/ Not Started	22-FL-03/ Ongoing	Review current stormwater capabilities to determine necessity for new or additional mitigation actions.		City of North Bend Public Works		Flood

	2016 Action Item #/ Status	2023 Action Item #/ Status	Mitigation Action	Notes	Project Lead(s)	Partners/ Funding	Hazards addressed
City of North Bend	16-LS-01/ Not Started	22-LS-01/ Not started	Work with DOGAMI to identify and map high risk slide areas to create an accurate logistical assessment.	22-LS-01: Continue to track and mitigate landslide events along major roadways by developing data, designs, funding requests, and appropriate mitigation measures for implementation.	City of North Bend Public Works	DOGAMI, ODOT	Landslide
City of North Bend	16-LS-02/ Not Started	22-LS-01/ Not started	Evaluate current and high hazard slide areas for mitigation prioritization and explore mitigation possibilities.		City of North Bend Public Works		Landslide
City of North Bend	16-TS-01/ Complete	n/a	Adopt a Tsunami Land Use Overlay Zone.	North Bend code references ASCE-7-16 as the tsunami design standard.	City of North Bend Planning Department	DLCD, DOGAMI, Coos County Planning	Tsunami
City of North Bend	16-WF-01/ Ongoing	22-MH-05/ Ongoing	Through multi-agency coordination, implement plan for control of Noxious Weeds, specifically Gorse, Scotch Broom, and Butterfly Brush.		City of North Bend		Wildfire

	2016 Action Item #/ Status	2023 Action Item #/ Status	Mitigation Action	Notes	Project Lead(s)	Partners/ Funding	Hazards addressed
City of Powers	16-MH-01/ Complete	n/a	Participate in the FEMA Risk Map discovery, hazard study, and resilience meeting processes.	High priority action #1 from 2016. This FEMA process was completed when the new preliminary FIRM maps were released. City staff worked with state and federal partners to update their flood ordinance and maps in advance of the FEMA flood maps becoming effective in 2018.	City of Powers	DLCD, FEMA	Multi-Hazard
City of Powers	16-MH-02/ Started	22-MH-13/ Not started	Utilize the final multi-hazard risk report and assessment developed by DOGAMI and FEMA's RiskMap program to update the Goal 7 section of the Powers Comprehensive Plan.	High priority action #3 from 2016. City applied for grant funding from DLCD in 2021 to update the comp plan. This item may be included in that update if funding is awarded.	City of Powers	DLCD, Coos County Planning	Multi-Hazard

	2016 Action Item #/ Status	2023 Action Item #/ Status	Mitigation Action	Notes	Project Lead(s)	Partners/ Funding	Hazards addressed
City of Powers	16-MH-03/ Complete	n/a	Continue to review city comprehensive plan and zoning ordinance for the need to update hazard specific section to reflect the latest information on natural hazards.	PC and staff review completed approximately 2018. No significant updates noted.	City of Powers		Multi-Hazard
City of Powers	16-MH-04/ Ongoing	22-MH-09/ Ongoing	Continue to implement public education programs regarding natural hazards.	**22-WF-01** City regularly posts FEMA educational flyers and posters in high-traffic public areas.	City of Powers		Multi-Hazard
City of Powers	16-MH-05/ Ongoing	22-MH-04/ Not started	Identify and map all roads, private drives, logging trails to increase the ability of firefighters to locate and gain access to provide services and/or evacuations.	Areas to be mapped are outside of city's jurisdiction. Local group, VFW, volunteered to take on the project and coordinate with County/USFS.	City of Powers	Coos County Emergency Management	Multi-Hazard
City of Powers	16-MH-06/ Started	22-WS-01/ Ongoing	Enhance strategies for debris management relating to severe wind and winter storm events.	Public works crew coordinates with fire dept. to ensure debris is cleared from city streets year round.	City of Powers		Multi-Hazard

	2016 Action Item #/ Status	2023 Action Item #/ Status	Mitigation Action	Notes	Project Lead(s)	Partners/ Funding	Hazards addressed
City of Powers	16-EQ-01/ Started	22-EQ-01/ Started	Seek funding to retrofit buildings and/or infrastructure at risk of damage in a high magnitude earthquake.	In 2022 the City initiated design of a new civic center to replace the city admin, police, fire, ambulance, and library building. Final construction pending funding.	City of Powers		Earthquake
City of Powers	16-FL-01/ Complete	n/a	Ensure continued compliance with the National Flood Insurance Program (NFIP) through enforcement of local floodplain ordinance.	Permit forms drafted.	City of Powers	DLCD, FEMA	Flood
City of Powers	16-LS-01/ Ongoing	22-LS-01/ Not started	Work with DOGAMI to identify and map high risk slide areas to create an accurate logistical assessment.	No contact with DOGAMI/ODOT on this project. Slide areas appear to be primarily outside city jurisdiction.	City of Powers	DOGAMI, ODOT	Landslide
City of Powers	16-LS-02/ Complete	n/a	Evaluate current and high hazard slide areas for mitigation prioritization and explore mitigation possibilities.	Evaluation of slide areas appear to be primarily outside of city's jurisdiction.	City of Powers		Landslide
City of Powers							

	2016 Action Item #/ Status	2023 Action Item #/ Status	Mitigation Action	Notes	Project Lead(s)	Partners/ Funding	Hazards address ed
City of Powers	16-WF-01/ Ongoing	22-MH-05/ Ongoing	Through multi-agency coordination, implement plan for control of Noxious Weeds, specifically Gorse, Scotch Broom, and Butterfly Brush.	City currently enforces noxious weeds ordinance within city limits during summer months (June 30-Sept 1).	City of Powers		Wildfire
City of Powers	16-WF-02/ Ongoing	22-WF-02/ Not started	Implement wildfire actions identified in the Coos County Community Wildfire Protection Plan.	High priority action #2 from 2016.			Wildfire

III. PLANNING PROCESS

A. Plan Maintenance

The Plan Maintenance section details the formal process that will ensure that the Natural Hazard Mitigation Plan (NHMP) remains an active and relevant document. The plan maintenance program includes the responsibilities of the convener and steering committee, a meeting schedule and plan review checklist, a table for tracking changes, guidance for resuming the five-year update process, and best practices for public participation.

The Steering Committee and local staff are responsible for implementing this process, which includes maintaining and updating the Plan through a series of meetings outlined in the maintenance schedule below.

Convener

The Coos County Emergency Manager takes responsibility for county plan maintenance as Convener. In this role, the Coos County Emergency Manager will facilitate the Coos County Hazard Mitigation Steering Committee meetings and foster communication with the rest of the members of the Steering Committee. Each of the participating cities will also identify local conveners to oversee city specific mitigation activities. Participating cities will coordinate with the county where appropriate. Plan implementation and evaluation will be a shared responsibility among all the assigned Hazard Mitigation Steering Committee members.

Convener responsibilities include:

- Scheduling meetings of the Coos County Hazard Mitigation Steering Committee and inviting key stakeholders to regular NHMP implementation meetings.
- Organizing Steering Committee meeting dates, times, locations, agendas, and member notification.
- Documenting the discussions and outcomes of committee meetings.
- Coordinating with elected officials on necessary risk-reduction policies.
- Coordinating with fellow department heads (e.g., planning, economic development, public works, etc.) on necessary risk-reduction implementation activities.
- Serving as a communication conduit between the Steering Committee and the public/stakeholders.
- Identifying emergency management-related funding sources for natural hazard mitigation projects; and,
- Utilizing the Risk Assessment as a tool for prioritizing proposed natural hazard risk reduction projects.

Steering Committee

The Coos County Convener will engage the Coos County Hazard Mitigation Steering Committee to maintain, implement and update the NHMP. The Steering Committee responsibilities include:

- Attending NHMP maintenance, update and implementation meetings (or designating a representative to serve in place of the designated person).
- Serving as the local evaluation committee for FEMA funding programs such as the Hazard Mitigation Grant Program funds, Flood Mitigation Assistance, or Building Resilient Infrastructure and Communities (BRIC) program funds;

- Prioritizing and recommending funding for natural hazard risk reduction projects.
- Evaluating and updating the NHMP in accordance with the prescribed maintenance schedule.
- Developing and coordinating ad hoc and/or standing subcommittees as needed; and,
- Coordinating public involvement activities.

Meeting Schedule

The Steering Committee will meet on a **semi-annual basis** (twice per year) to complete the following tasks. During the first meeting, prior to the wildfire/irrigation season, the Steering Committee will:

- Review existing action items to determine appropriateness for funding.
- Educate and train new members on the Plan and in general.
- Identify issues that may not have been identified when the plan was developed; and,
- Prioritize potential mitigation projects using the methodology described below.

The second meeting of the year will take place in early fall, following the wildfire/irrigation season. During the second meeting the Steering Committee will:

- Review existing and new risk assessment data.
- Discuss methods for continued public involvement; and,
- Document successes and lessons learned during the year.

These meetings are an opportunity for the cities to report back to the county on progress that has been made towards their components of the NHMP. The Steering Committee may revise the above schedule as resources and events shift.

The Convener will be responsible for documenting the outcome of the semi-annual meetings. The process the Steering Committee will use to prioritize mitigation projects is detailed in the section below. The Plan's format allows the County and participating jurisdictions to review and update sections when new data becomes available. New data can be easily incorporated, resulting in a NHMP that remains current and relevant to the participating jurisdictions.

Five-Year Review of Plan

This plan will be updated every five years in accordance with the update schedule outlined in the Disaster Mitigation Act of 2000. **The Coos County NHMP is due to by updated by March 15, 2028.** The convener will be responsible for organizing the committee to address plan update needs. The steering committee will be responsible for updating any deficiencies found in the plan, and for ultimately meeting the plan update requirements.

The following checklist can assist the convener in determining which plan update activities can be discussed during regularly scheduled plan maintenance meetings, which activities require additional meeting time and/or the formation of sub-committees, and which should be part of the five-year plan update review.

Update Checklist

Table III-1. Natural Hazards Mitigation Plan Maintenance Checklist

Question	Yes	No	Plan Update Action
Is the planning process description still relevant?			Modify this section to include a description of the plan update process. Document how the planning team reviewed and analyzed each section of the plan, and whether each section was revised as part of the update process. (This toolkit will help you do that).
Do you have a public involvement strategy for the plan update process?			Decide how the public will be involved in the plan update process. Allow the public an opportunity to comment on the plan process and prior to plan approval.
Have public involvement activities taken place since the plan was adopted?			Document activities in the "planning process" section of the plan update
Are there new hazards that should be addressed?			Add new hazards to the risk assessment section
Have there been hazard events in the community since the plan was adopted?			Document hazard history in the risk assessment section
Have new studies or previous events identified changes in any hazard's location or extent?			Document changes in location and extent in the risk assessment section
Has vulnerability to any hazard changed?			Document changes in vulnerability in the risk assessment section
Have development patterns changed? Is there more development in hazard prone areas?			Document changes in vulnerability in the risk assessment section
Do future annexations include hazard prone areas?			Document changes in vulnerability in the risk assessment section
Are there new high risk populations?			Document changes in vulnerability in the risk assessment section
Are there completed mitigation actions that have decreased overall vulnerability?			Document changes in vulnerability in the risk assessment section
Did the plan document and/or address National Flood Insurance Program repetitive flood loss properties?			Document any changes to flood loss property status
Did the plan identify the number and type of existing and future buildings, infrastructure, and critical facilities in hazards areas?			1) Update existing data in risk assessment section, or 2) determine whether adequate data exists. If so, add information to plan. If not, describe why this could not be done at the time of the plan update
Did the plan identify data limitations?			If yes, the plan update must address them: either state how deficiencies were overcome or why they couldn't be addressed
Did the plan identify potential dollar losses for vulnerable structures?			1) Update existing data in risk assessment section, or 2) determine whether adequate data exists. If so, add information to plan. If not, describe why this could not be done at the time of the plan update
Are the plan goals still relevant?			Document any updates in the plan goal section
What is the status of each mitigation action?			Document whether each action is completed or pending. For those that remain pending explain why. For completed actions, provide a 'success' story.
Are there new actions that should be added?			Add new actions to the plan. Make sure that the mitigation plan includes actions that reduce the effects of hazards on both new and existing buildings.
Is there an action dealing with continued compliance with the National Flood Insurance Program?			If not, add this action to meet minimum NFIP planning requirements
Are changes to the action item prioritization, implementation, and/or administration processes needed?			Document these changes in the plan implementation and maintenance section
Do you need to make any changes to the plan maintenance schedule?			Document these changes in the plan implementation and maintenance section
Is mitigation being implemented through existing planning mechanisms (such as comprehensive plans, or capital improvement plans)?			If the community has not made progress on process of implementing mitigation into existing mechanisms, further refine the process and document in the plan.

Source: Oregon Partnership for Disaster Resilience.

Plan Adoption

The Coos County NHMP is developed and implemented through a collaborative process. After the Plan is locally reviewed and deemed complete, the Coos County Emergency Manager submits it to the State Hazard Mitigation Officer (SHMO) at the Oregon Department of Emergency Management (OEM). OEM submits the plan to FEMA- Region X for review. This review addresses the federal criteria outlined in the FEMA Interim Final Rule 44 CFR Part 201. Upon acceptance by FEMA, the County and participating cities will adopt the plan via resolution. Once the plan is formally adopted at the local level and formally approved by FEMA, the County and participating cities will retain eligibility for the Building Resilient Infrastructure & Communities (BRIC) Grant Program, the Hazard Mitigation Grant Program (HMGP) funds, and Flood Mitigation Assistance (FMA) program funds.

Plan Maintenance: Record of Revisions Form

During semi-annual Steering Committee meetings, document plan progress by adding information to this table. This could include Mitigation Action progress or success, disaster event updates to the relevant hazard chapter, or ideas for new Special Districts to join the next update.

Table III-2. Record of Revisions

Date	Jurisdiction(s)	Revision
Example:	Coos County	Impacts from xx/xx/20xx flood event in X, Y, Z areas submitted for disaster declaration request.
XX/XX/2023		
XX/XX/2023		
XX/XX/2023		
XX/XX/2023		
XX/XX/2024		
XX/XX/2024		
XX/XX/2025		
XX/XX/2025		

Steering Committee Operating Protocol

Coos County Multi-Jurisdictional Natural Hazard Mitigation Plan Steering Committee Operating Protocol

Basic Requirements:

- One representative from each jurisdiction will attend each full Steering Committee meeting. This representative will sign in and provide cost share documentation for their meeting attendance and preparation.
- Each jurisdiction will facilitate an internal planning process and engage the public/ their constituents. All meetings and public engagement efforts will be documented to the best of the ability of the participants.
- Each jurisdiction agrees to adopt the final plan.
- Completing the basic FEMA requirements is the responsibility of each jurisdiction.

Overall Process:

- Plan on meeting approximately quarterly.
- Ask questions or ask for help if needed.
- Participate and share, helping to formulate a joint vision. Engage this opportunity for collaboration.

Decision-making Process: *Proposal—Discussion—Decision*

- Decisions will be associated primarily with written proposals, shared in advance, or with enough substantive presentation at the meeting that the proposal is clear, and the group can adequately discuss it prior to a decision. Many concepts and ideas will be discussed that will not require formal decisions, however, there will be specific proposals for how the plan is outlined, etc.
- We will strive for consensus but use a voting process to make decisions. **Each jurisdiction formally participating in the plan will receive one vote (yes or no)**. The primary representative or the person in attendance will be the voting representative for the jurisdiction and is expected to wield voting authority. However, if the person wants to register their vote either as a ‘stand-aside’ due to a moral quandary or an ‘abstention’ due a lack of understanding of the question being called, that is acceptable.

Plan Update History

2010 Coos County Natural Hazard Mitigation Plan

The first Coos County Multi-Jurisdictional NHMP was approved by FEMA in 2010. In 2008, the Oregon Partnership for Disaster Resilience (OPDR/The Partnership) at the University of Oregon's Community Service Center partnered with the Oregon Department of Emergency Management (OEM) and Coos County to develop a Pre-Disaster Mitigation Planning Grant proposal. Once the Partnership, OEM, and the participating communities were awarded the grant, local planning efforts in this region began in 2009.

The following jurisdictions, agencies, and/or organizations were represented and served on the Steering Committee during the development of the 2010 Coos County NHMP:

- Coos County Planning Department
- Coos County Emergency Management
- City of Bandon
- City of Coos Bay
- City of Lakeside
- City of North Bend
- City of Powers
- Coos County Road Department
- Coos Health and Wellness
- Oregon Parks and Recreation Department
- Coquille Indian Tribe
- Coos-Curry Electric Cooperative
- Southwestern Oregon Public Safety Association

2016 Coos County Natural Hazard Mitigation Plan

The following jurisdictions, agencies, and/or organizations were represented and served on the Steering Committee during the development of the 2016 Coos County NHMP:

- Coos County Planning Department
- Coos County Emergency Management
- City of Bandon
- City of Coos Bay
- City of Lakeside
- City of North Bend
- City of Powers
- Coos County Road Department
- Coos Health and Wellness
- Oregon Dept. of Land Conservation & Development
- Oregon Parks and Recreation Department
- Coquille Indian Tribe
- Coos-Curry Electric Cooperative
- Southwestern Oregon Public Safety Association

B. 2023 Plan Update

Pre-Award

Coos County sent a letter of interest for a Pre-Disaster Mitigation (PDM) grant application the Oregon Department of Land Conservation and Development (DLCD) made to FEMA in 2018 to update the Coos County Multi-Jurisdictional Natural Hazards Mitigation Plan (Coos MJ-NHMP). Pre-award coordination between DLCD and Coos County Emergency Management began in January 2019 with a review of the proposed Intergovernmental Agreement (IGA) and the associated Scope of Work for the Coos County multi-jurisdictional process. A robust Steering Committee recruitment process was also conducted that included updating the contact information for local partners.

Pre-award meetings provided two overview presentations of the technical parts of the NHMP update process, a joint Steering Committee invitation/ DLCD consultation letter to three Tribes, and an introduction to cost share tracking. An array of interested parties joined the process, including Sumner Fire District, Coos Bay School District, and CERT volunteers. In addition, the Steering Committee outlined a solid public engagement plan. The plan update process saw an Emergency Manager transition, the COVID-19 pandemic, and a delay in FEMA funding by approximately a year. During the long delays, DLCD began project planning. A Memorandum of Agreement with a Scope of Work was developed and signed by the County, seven cities, and three special districts. Two special districts joined the planning process after pre-award was complete—a second hospital and a drainage district.

The following jurisdictions, agencies, and/or organizations were represented and served on the Steering Committee during the development of the 2023 Coos County NHMP (for a list of individuals, see the Acknowledgements section of this NHMP):

- Coos County
- City of Bandon
- City of Coos Bay
- City of Coquille
- City of Lakeside
- City of Myrtle Point
- City of North Bend
- City of Powers
- International Port of Coos Bay
- Port of Bandon
- Southern Coos Hospital District & Health Center
- Bay Area Hospital
- Haynes Drainage District
- Coquille Indian Tribe
- Confederated Tribes of the Coos, Lower Umpqua, and Siuslaw Indians
- Coos County CERT
- Coos Curry Douglas Business Development Corporation
- Coos Curry Electric
- Cow Creek Band of Umpqua Tribe of Indians
- Coos Bay School District
- Sumner Rural Fire Protection District
- Oregon Business Development Dept.
- Oregon Dept. of Land Conservation & Development
- Oregon Health Authority
- Oregon Parks & Recreation Dept.

Plan Update Priorities

At the March 4, 2021, Steering Committee meeting, the following plan update priorities were proposed and affirmed:

- Retain an integrated, succinct approach to the plan organization; improve plan logic and continuity.
- Update existing plan with risk assessment data from DOGAMI Risk Report, OCCRI report, other new data.
- Add new plan content for the new jurisdictions.
- Improve the capability assessment.
- Update/ expand mitigation actions.

Pre-Award: Steering Committee Recruitment

For the 2023 Plan Update, extensive outreach and engagement of special districts was conducted by Coos County Emergency Management as plan convener which expanded the multi-jurisdictional partnership from six to thirteen jurisdictions.

Figure III-1. Pre-Award Steering Committee Roster

Coos County Natural Hazard Mitigation Plan
2020 Update Steering Committee Recruitment

November 5, 2019
INVITEES/Proposed Steering Committee Members

1. **Mike Murphy**, Coos County Emergency Manager, Coos County Sheriff's Office
2. **Jill Rolfe**, Director, Coos County Planning
3. John Rowe, Director Coos County Public Works/ Roadmaster
4. John Sweet, Coos County Commissioner
5. Melissa Cribbins, Coos County Commissioner
6. Bob Main, Coos County Commissioner
7. City Manager, City of Bandon
8. Charli Davis, City Planner, City of Bandon
9. Rodger Craddock, City Manager, City of Coos Bay
10. Jim Hossley, Director, Coos Bay Public Works
11. Roberta Vanderwall, Interim City Manager, City of Coquille
12. Julie Rowe, Finance Director, City of Coquille
13. Andrew Carlstrom, City Manager, City of Lakeside
14. Bill Schaefer, Mayor, City of Myrtle Point
15. Darin Nicholson, City Manager, City of Myrtle Point
16. Terrence E. O'Connor, City Administrator, City of North Bend
17. Robert Kohn, Mayor, City of Powers
18. Stephanie Patterson, City Recorder, City of Powers
19. Lanny Boston, Coos Fire Defense Board/Bandon Fire District
20. Mike Gibbs, Bridge Fire District
21. Mick Sneddon, Fire Chief, Charleston Fire Department
22. Mark Anderson, Fire Chief, Coos Bay Fire Department
23. Dave Waddington, Coquille Fire Department
24. Bill Nelson, Fairview Fire District
25. Sam Mason, Millington Fire
26. Jerry Wharton, Fire Chief, Hauser Fire District
27. Jim Aldrich, Fire Chief, North Bay Fire District
28. Brian Waddington, North Bend Fire Department
29. Caley Sowers, District Manager, Coos Soil & Water Conservation District
30. Tenneal Wetherell, South Coast Education Service District
31. Doug Ardiana, Bandon School District
32. Bob Yester, North Bend School District
33. Bryan Trendell, Coos Bay School District
34. Candace McGowne, Coos Bay School District
35. Rick Roberts, Coos Bay School District
36. Tim Sweeney, Coquille School District
37. Dan Hinrichs, Bunker Hill School District
38. M. Shorb, Powers School District

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39. Patrick Kerr, International Port of Coos Bay
40. Jeff Griffin, Port Manager, Port of Bandon
41. Joshua Adamson, Project Manager, Port of Bandon
42. Bob Cook, Coos County Airport District/ Southwest Oregon Regional Airport
43. Coquille Indian Tribe representative(s)
44. Confederated Tribes of the Coos, Umpqua, and Siuslaw Indians representative(s)
45. Coos-Curry Electric Cooperative, Inc. representative(s)
46. Todd Sherwood, Douglas Electric Coop
47. Oregon Parks and Recreation Department representative(s)
48. Dave Hudson, Southwestern Oregon Public Safety Association
49. Mike Robison, Oregon Department of Forestry/ Coos Forest Patrol
50. Carey Palm, Tribal Liaison & GIS Analyst, Oregon Health Authority, Health Security, Preparedness and Response
51. Edwin Flick, Healthcare Preparedness Program (HPP) Regional Liaison/Coordinator, Oregon Health Authority
52. Hui Rodomsky, South Coast Regional Representative, Oregon Dept. of Land Conservation & Development (DLCD)
53. Meg Reed, Coastal Shores Specialist, Oregon Dept. of Land Conservation & Development (DLCD)
54. Althea Rizzo, Geological Hazards Program Coordinator, Oregon Emergency Management (OEM)
55. Nick Schoeppner, Park Manager, Bullards Beach Management Unit, Oregon Parks and Recreation Department
56. Larry Becker, South Coast District Manager, Oregon Parks and Recreation Department

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Project Schedule

The pre-award time period for the 2023 Coos MJ-NHMP extended nearly a year longer than originally anticipated by DLCD. The original start date anticipated for post-award work was October 2019 and the actual post-award date was October 2020.

Table III-3. Project Schedule

	COOS COUNTY MJNHMP Project Timeline *Update 3/4/21*													Plan Expires						
		Sep '20	Oct '20	Nov '20	Dec '20	Jan '21	Feb '21	Mar '21	Apr '21	May '21	Jun '21	Jul '21	Aug '21	Sep '21	Oct '21	Nov '21	Dec '21	Jan '22	Feb '22	Mar '22
	Months to FOP end	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
	PHASE I: PRE-AWARD ORGANIZATION																			
6.0	Develop Scope of Work																			
	Execute IGA and Scope of Work																			
	PHASE 2: PLAN UPDATE																			
7.0	Review and Update the Risk Assessment							X		X										
8.0	Public Review of the Risk Assessment																			
9.0	Review and Update the Mitigation Strategy											X								
10.0	Review and Update the Plan Maintenance Process													X						
11.0	Public Review of the Mitigation Strategy and Plan Maintenance Process																			
12.0	Document the Planning Process																			
13.0	Review and Update Remaining Chapters																			
14.0	Finalize Draft MJNHMP for State and Federal Review																			
	PHASE 3: REVIEW AND APPROVAL PROCESS																			
15.0	Submit Draft MJNHMP for State and Federal Review																			
16.0	Adopt Final Draft MJNHMP																			
	Receive Final FEMA Approval																			
	Receive Finalized FEMA-Approved Plan																			
	Key to Plan Tasks:	*Proposed SC Meetings*			X		*Proposed Public Meetings:*				X									

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C. Public Participation

The Steering Committee guides the plan updates, so their activities, since they are all public, provide the core of the public participation activities. The Steering Committee meetings held during the plan update were open to the public, advertised via public notice, and usually had good participation from an array of community organizations with interest or capabilities associated with hazard mitigation. Notice of these meetings, other public outreach, other public meetings, the plan update survey with comment sections, and specific plan input solicited from community organizations are the other primary components of outreach. Generally, the following best practices encourage public input.

- Post copies of the plan on corresponding websites.
- Place articles in the local newspaper directing the public where to view and provide feedback.
- Use existing avenues such as school newsletters and utility bills to inform the public where to view and provide feedback.
- Present new and relevant information at community events such as the Preparedness Fair.
- Announce upcoming meetings through press releases in the newspaper and on the local radio station.

In addition to the involvement activities listed above, Coos County will ensure continued public involvement by posting the Coos County NHMP on the County's website (http://www.co.Coos.or.us/). The Plan will also be archived and posted on the University of Oregon Libraries' Scholar's Bank Digital Archive (http://scholarsbank.uoregon.edu).

Meetings: Steering Committee

November 5, 2019

The November 5, 2019 meeting started the plan update process with the first of two in-person meetings. Twenty-seven attendees representing seven plan holder jurisdictions, four interested parties and four state agencies attended. Meeting #1 occurred in person at 201 N. Adams, Coquille, OR 47423 from 1:00 PM to 3:00 PM. Emergency Manager Mike Murphy, co-convener with DLCD, invited the interested parties and potential Steering Committee members who were in attendance. The group reviewed the IGA and scope of work, shared their mitigation priorities, and discussed potential outreach and community engagement strategies. In addition, Ed Flick, the Oregon Health Authority Regional Liaison, gave a presentation entitled, Coastal Hospital Resilience.

Attendees:

Melissa Cribbins, Coos County Commissioner
Bob Main, Coos County Commissioner
Mike Murphy, Coos County Emergency Manager
Kathleen Olson-Gray, Coos County Emergency Project Coordinator
Jill Rolfe, Coos County Planning Director
John Rowe, Coos County Public Works Director
Sonny Meyers, Coos County CERT/Eastside
Beverly Meyers, Coos County CERT/Eastside
Kathi Simonetti, City of Coquille Mayor
Ann Parker, City of Coquille City Councilor
Scott Sanders, City of Coquille Police Chief
Justin Ferren, City of Coquille Fire Chief
Mark Anderson, City of Coos Bay Fire Chief/Emergency Manager
Darin Nicholson, City of Myrtle Point City Manager
Jeff Griffin, Port of Bandon Port Manager
Thomas Durand, Port of Coos Bay/Coos Bay Rail Line Maritime Operations Manager
Rick Roberts, Coos Bay School District Facilities Manager (via phone)
Edie Jurgenson, RN, Southern Coos Hospital & Health Center Emergency Preparedness (Bandon)
Dennis Jurgenson, Southern Coos Hospital & Health Center Emergency Preparedness Manager (Bandon)
Armando Martinez, Confederated Tribes of the Coos, Lower Umpqua, and Siuslaw Indians Community Health Aide
Brian Cassoday, Coos Curry Electric Controller
Nick Schoeppner, Oregon Parks and Recreation Department, Bullards Beach Mgmt. Unit Park Manager
Tracy Loomis, Coos Curry Douglas Business Development Corporation Community Development Director
Sean Stevens, Business Oregon Regional Development Officer
Edwin Flick, Oregon Health Authority Healthcare Preparedness Program Regional Liaison
Hui Rodomsky, DLCD South Coast Regional Representative (via phone)
Pamela Reber, DLCD Natural Hazard Planner/ Coos County NHMP Update Project Manager

March 3, 2020

Twenty people, representing nine plan holder jurisdictions and three interested parties, attended the second Steering Committee meeting/second pre-award meeting. Meeting #2 occurred in person at 201 N. Adams, Coquille, OR 47423 from 1:00 PM to 3:00 PM. As Mike Murphy recently retired, the Coos County Sheriff's Office (Gabriel Fabrizio and Kathleen Olson-Gray) shared their current staffing and plans to recruit a new Emergency Manager. DLCD project manager Pam Reber presented the elements of the overall planning project and led the group to develop a decision-making process and a public-engagement plan; to affirm the IGA and participation of eleven jurisdictions; and to approve the meeting notes from Nov. 5th, 2019.

Attendees:

Bob Main, Coos County Commissioner
John Sweet, Coos County Commissioner
Gabriel Fabrizio, Coos County Sheriff's Dept. Captain/Administrator
Kathleen Olson-Gray, Coos County Emergency Project Coordinator
Jill Rolfe, Coos County Planning Director
John Rowe, Coos County Public Works Director
Sonny Meyers, Coos County CERT/Eastside
Beverly Meyers, Coos County CERT/Eastside
Dennis Lewis, City of Bandon City Manager
Sam Baugh, City of Coquille City Manager
Mark Anderson, City of Coos Bay Fire Chief/Emergency Manager
Andrew Carlstrom, City of Lakeside City Manager
Darin Nicholson, City of Myrtle Point City Manager
Chelsea Schnabel, City of North Bend Planner
Josh Adamson, Port of Bandon Project Manager
Edie Jurgenson, RN, Southern Coos Hospital & Health Center Emergency Preparedness (Bandon)
Dennis Jurgenson, Southern Coos Hospital & Health Center Emergency Preparedness Manager (Bandon)
Tracy Loomis, Coos Curry Douglas Business Development Corporation Community Development Director
Rob Aton, Sumner Rural Fire Protection District Fire Chief
Aaron Reisenbigler, Sumner Rural Fire Protection District Training Officer
Hui Rodomsky, DLCD South Coast Regional Representative
Pamela Reber, DLCD Natural Hazard Planner/ Coos County NHMP Update Project Manager

May 5, 2020

The May 5, 2020, online meeting was attended by 16 people representing eight plan holder jurisdictions, one interested party, and two state agencies. Meeting #3 occurred online via Zoom from 1:00 PM to 3:30 PM. The Steering Committee reviewed and approved the March 3rd, 2020, minutes and a joint DLCD/Steering Committee consultation letter to the three Tribal Nations with interest in Coos County. The group discussed technology access and logistics of conducting business remotely during the COVID-19 pandemic. The group also provided updates on the status of IGA adoption and discussed how to view hazard data via map viewers for the risk assessment. The project continued to be restricted to pre-award business and was impacted by the resignation of the long-time emergency manager.

Attendees:

Gabriel Fabrizio, Coos County Sheriff's Dept. Captain/Emergency Manager
Kathleen Olson-Gray, Coos County Emergency Project Coordinator
Jill Rolfe, Coos County Planning Director
Armando Martinez, Confederated Tribes of the Coos, Lower Umpqua, and Siuslaw Indians
Megan Lawrence, City of Bandon City Planner
Mark Anderson, City of Coos Bay Fire Chief
Sam Baugh, City of Coquille City Manager
Mark Anderson, City of Coos Bay Fire Chief/Emergency Manager
Darin Nicholson, City of Myrtle Point City Manager
Chelsea Schnabel, City of North Bend Planner
Jeff Griffin, Port of Bandon Port Manager
Edie Jurgenson, RN, Southern Coos Hospital & Health Center Emergency Preparedness (Bandon)
Dennis Jurgenson, Southern Coos Hospital & Health Center Emergency Preparedness Manager (Bandon)
Jevra Brown, Department of State Lands, Aquatic Resource Planner
Hui Rodomsky, DLCD South Coast Regional Representative
Pamela Reber, DLCD Natural Hazard Planner/ Coos County NHMP Update Project Manager

March 4, 2021

The March 4, 2021 online meeting was attended by 23 people representing nine plan holder jurisdictions, three local interested parties, and four state agencies. Meeting #4 occurred online via Zoom Webinar from 2:00 PM to 4:00 PM. The meeting featured introductions, a new plan update website announcement, and the beginning of the risk assessment after nearly a one-year funding delay of the project start. The Steering Committee reviewed and approved the May 5th, 2020 notes and the use of a memo format for tracking the plan update. The group discussed technical aspects of the risk assessment, including loss exposure, loss estimation, and the OEM Hazard Vulnerability Analysis methodology. The group also reviewed the plan hazards, hazard events, and whether to include infectious disease as a hazard. The group affirmed the proposed plan update priorities and signaled interest in securing plan comments via a community survey.

Attendees:

Gabriel Fabrizio, Coos County Co-convener
Jill Rolfe, Coos County
John Rowe, Coos County
Philip Nel, Coos Health and Wellness
Kathleen Olson-Gray, Coos County
Debbie Mueller, Coos County volunteer
Megan Lawrence, City of Bandon
Scott Sanders, City of Coquille
Mark Anderson, City of Coos Bay
Darin Nicholson, City of Myrtle Point
Chelsea Schnabel, City of North Bend
Jeff Griffin, Port of Bandon
Mike Dunning, Port of Coos Bay
Victoria McNeely, Southern Coos Hospital
Jason Cook, Southern Coos Hospital
Jeff Stump, Confederated Tribes
Tracy Loomis, CCD Business Dev. Corp.
Jessica McCormick, Oregon Health Authority
Ericka Mason, Oregon Health Authority
Sean Stevens, Business Oregon
Jevra Brown, Department of State Lands
Pamela Reber, DLCD Project Manager
Ingrid Caudel, DLCD Staff

April 22, 2021

The April 22, 2021, online meeting was attended by 16 people representing 9 plan holder jurisdictions and 2 state agencies. Meeting #5 occurred online via Zoom Webinar from 10:00 AM to 12:00 PM. The meeting featured a review of the draft Hazard and Planning Process chapters, an introduction to conducting the Hazard Vulnerability Assessment (HVA), and a review of the proposed Coos County Community Hazard Survey. The committee welcomed the Haynes Drainage District to the plan update. Participants gave input about where and how hazards affect their community and how their jurisdictions address them. The Steering Committee reviewed and approved the March 4th, 2021, meeting notes and the issuance of the community hazard survey with edits.

Attendees:

Kathleen Olson-Gray, Coos County
Debbie Mueller, Coos County volunteer
Jeff Griffin, Port of Bandon
Mark Anderson, City of Coos Bay
Jason Cook, Southern Coos Hospital
Victoria McNeely, Southern Coos Hospital
Darin Nicholson, City of Myrtle Point
Chelsea Schnabel, City of North Bend
Hui Rodomsky, DLCD S. Coast Regional Rep.
Hailey Sheldon, City of Coquille
Megan Lawrence, City of Bandon
Scott Sanders, City of Coquille
Greg Stone, Haynes Drainage District
Ericka Mason, Oregon Health Authority
Jessica McCormick, Oregon Health Authority
Pamela Reber, DLCD Project Manager

October 21, 2021

The October 21, 2021 online meeting was attended by fifteen people representing eight plan holder jurisdictions, one interested party, and two state agencies. Meeting #6 occurred online via Zoom Webinar from 1:00 PM to 2:30 PM. The meeting featured a presentation on developing problem statements, mitigation action development, and a review of windstorm and wildfire hazards. The group affirmed the accuracy of the April 22, 2021 meeting notes.

Attendees:

Chip Delyria, Coos County Emergency Services Manager
Debbie Mueller, Coos County Emergency Management
Jeff Griffin, Port of Bandon
Mark Anderson, City of Coos Bay
Rob Aton, Sumner Fire
Jill Rolfe, Coos County Planning
Mike Dunning, Port of Coos Bay
Brandon Collura, Port of Coos Bay
Jason Cook, Southern Coos Hospital
Chelsea Schnabel, City of North Bend
Jeremy Pitts, Bay Area Hospital
Hui Rodomsky, DLCD South Coast Regional Rep.
Scott Sanders, City of Coquille
Ericka Mason, Oregon Health Authority
Pamela Reber, DLCD Project Manager

November 3, 2022

The November 3, 2022 online meeting was attended by eleven people representing five plan holder jurisdictions, one interested party, and one state agencies. Meeting #7 occurred online via Zoom meeting from 3:30 PM to 5:30 PM. The meeting featured a presentation on the Oregon Climate Change Research Institute's Future Projections Report for Coos County.

Attendees: Chip Delyria, Debbie Mueller, Jill Rolfe, Chris MacWhorter, Mike Dunning, Jeremy Pittz, Mark Anderson, Melissa Cribbins, Erica Fleishman, Dominque Bachelet, Pam Reber.

January 18, 2023

The January 18, 2023 online meeting was attended by thirteen people representing eight plan holder jurisdictions, and one state agency. Meeting #8 occurred online via Zoom meeting from 9:00 AM to 10:30 AM. The meeting featured a review of the final plan components. The group affirmed the draft plan for submission to OEM and FEMA for review.

Attendees: Chip Delyria, Debbie Mueller, Jill Rolfe, Margaret Barber, Mike Dunning, Jeremy Pittz, Mark Anderson, Jason Cook, Jeff Griffin, Joshua Adamson, Stephanie Patterson, Melissa Bethel, Pam Reber.

Meetings: Regional

Regions 3 & 5 Healthcare Coalition Meeting

The May 5, 2021, online meeting of the Oregon Health Authority Hospital Preparedness Healthcare Coalition for Regions 3 & 5 featured a presentation about the Coos County 2021 MJNHMP update by Pam Reber, DLCD Project Manager and Gabe Fabrizio, Coos County Emergency Manager & Plan Convener. The presentation featured a review of the plan update process, participating jurisdictions, and hazards facing Coos County. Soon after the meeting, the Bay Area Hospital in Coos Bay joined the multi-jurisdictional process.

D. Community Hazard Survey

Coos County and plan holder jurisdictions conducted robust outreach during the plan update process despite being impacted by the first year of the COVID-19 pandemic. See the full survey report for the extensive comments and feedback provided by over 300 community members.

Introduction

The Coos County Community Hazard Survey was conducted as a part of the 2023 Coos County Multi-Jurisdictional Natural Hazard Mitigation Plan (MJNHMP) update. The thirteen jurisdictions participating in the plan update distributed the survey starting May 12th and made it available electronically through June 2021, securing 390 responses from across the county.

The Coos County Community Hazard Survey asked the public's opinion about the natural hazards most likely to impact the area, personal concerns about those hazard impacts, desired government response to the threat of natural hazards, and personal preparedness. The results of the survey are useful in providing public input and local knowledge necessary to update both the risk assessment and the mitigation strategy components of the plan update.

Methodology

The survey was comprised of twenty-nine questions of which twenty-one had yes-no-unsure responses including nine about the plan hazards in general. Two questions asked respondents to rank mitigation activities (1-10). Five of the nine general plan hazard questions had follow-on questions triggered by a yes or unsure response about hazard concern. Four multiple-choice follow-on questions asked about government response to earthquake, flood, tsunami, and wildfire—and these also had an open-ended "other" response. The final three questions were: an open-ended general comment, an opportunity for the commenter's name to appear with their comment, and an opportunity to provide an email address to receive additional information. The survey questions were developed in a collaboration between the DLCD Project Manager and the Coos County MJNHMP Steering Committee, in particular Coos County Emergency Management. The final questions were entered into Survey Monkey electronic survey tool by DLCD administrative staff and after review by the Coos County MJNHP Steering Committee, the electronic survey link was distributed publicly via press releases and local websites. All survey responses were garnered using this electronic format during the period May 12 to June 30, 2021.

Results

For documentation purposes, the twenty-nine questions asked are shown in these survey results. In addition, all public comments are shown in full text except those that used inappropriate language had those words removed. These comments and the overall findings were summarized into sections for use by local jurisdictions in their assessment of risk and development of mitigation actions.

Ranked Government Disaster Priorities

1. Ensure that lifeline infrastructures such as bridges, roads, water supply, communications, electricity, and fuel supply are built to endure most hazard events with minimal damage, interruptions, or secondary disasters.
2. Retrofit and improve critical facilities such as police, fire, emergency medical services, hospitals, schools, etc. to ensure they endure most hazard events with minimal damage.

3. Ensure that hospitals have uninterrupted power and water in all disaster scenarios.

Ranked Infrastructure Protection/ Resilience Priorities

1. Communications
2. Domestic water supply
3. Fire/ Police/ EMS
4. Emergency Operations Center/ Government operations
5. Bridges
6. Hospital/Other inpatient facility

Key Takeaways: Earthquake, Flood, Tsunami, and Wildfire

- Earthquake mitigation findings:
    - More than 75% of respondents support strengthening of critical facilities and utilities to withstand earthquake shaking.
    - Funding for home seismic retrofits was the most popular unsolicited need identified as ten respondents stated this unsolicited response in the comments.
- Flood mitigation findings:
    - 49% of respondents support improving flood response capabilities for public works.
    - 44% support limiting the types of land uses allowed in the floodplain.
    - 31% support a buyout program for homes subject to flooding
    - 25% of open-ended comments support flood improvements that secure infrastructure and critical facilities.
- Tsunami mitigation findings:
    - 86%of respondents support the improvement of streets, bridges, and trails that will serve as evacuation routes.
    - 65% support limiting the types of land uses allowed in the tsunami inundation areas (e.g., prohibit high density accommodations, schools, hospitals, etc.)
    - 35% of open-ended comments support the installation/ improvement of tsunami evacuation signage and infrastructure (and includes two mentions of tsunami evacuation towers).
- Wildfire mitigation findings:
    - Mitigating fire risk by greatly reducing Gorse infestations is the highest priority wildfire mitigation action in the county.
    - Beyond gorse, a high level of wildfire resilience was indicated which could be read as clear public support for closing the following gaps as mitigation actions:
        - 17% of respondents said their home address is NOT well-signed and clearly visible from the street (reflective numbers visible at night, without vegetation impeding visibility, etc.)
        - 27% said they did NOT have a wildfire evacuation plan in place.
        - 26% have retrofit their home to withstand natural hazards; 55% have created firebreaks around their homes; 45% have prepared an alternate water and/or power supply for use in a disaster.

Public Comment Summaries

The following sections are summaries drawn directly from public comments designed to support use of the public sentiment in hazard mitigation planning.

Personal Mitigation Actions Being Taken by Community Members

The survey found that Coos County residents/respondents had a high level of awareness of preparedness overall, but open-ended comments identified a need to support home retrofits for earthquake and wildfire mitigation. In fact, 72% of respondents have homes built before seismic standards were in place and 22% have considered seismic retrofits for their homes. One respondent had even installed a hydrant supplied by 5000 gal. tank, firehose and pump, indicating a high level of concern likely resulting from education and outreach efforts by mitigation partners but possibly a lack of infrastructure or government services in some parts of the county. Other Home/Business Renovations that mitigate hazards that respondents noted having done included:

- Adding a metal roof (wildfire)
- Gorse removal & creation of fire breaks (wildfire)
- Smoke detectors & fire extinguishers available and functioning (wildfire)
- Developing a tsunami evacuation plan (tsunami)
- Adding shear walls to some rooms in the house (earthquake).
- Adding seismic straps to the water heater (earthquake).
- Installing a French drain under the house to provide better drainage (flood).

Suggested Mitigation Actions

The comment sections of the survey garnered a wide array of suggestions for mitigation actions. They are captured here for use in mitigation planning by the participating jurisdictions.

- Partner with OSU Extension to provide trainings on preparedness and hazard mitigation measures for homeowners.
- Strengthen critical facilities and utilities to withstand earthquake shaking.
- Consider incentives, grant funding, or tax breaks to encourage seismic retrofits by local homeowners, property managers, senior housing, and mobile home parks.
- Provide workshops for homeowners about seismic risks to residential structures and recommend retrofits for common structure types or how to select a qualified contractor.
- Protect highways and other lifelines in the event of a major disaster.
- Develop informational materials that explain the importance of hazard-specific insurance, the availability of flood insurance to cover tsunami losses, and the need to seismically retrofit buildings for them to be insurable for earthquake.
- Eradicate gorse from open space as well as private property, especially on properties in the Rosa Road vicinity of Bandon.
- Include information on fire prevention earthquake education.
- Prevent critical infrastructure, hazardous facilities, public buildings from being built in the tsunami inundation zones.
- Make sure tsunami areas are clearly identified so you know you are in a tsunami area
- Build or require tsunami vertical evacuation towers in areas with high population density and where it is impossible to evacuate on foot out of the tsunami inundation zone in a timely manner.

- Require new or renovated high-density housing and schools in tsunami inundation zone to have vertical evacuation towers.
- Install tsunami signs and evacuation routes for Front Street in Coos Bay.
- Look into tsunami reduction modifications in the bay.
- Install/improve tsunami evacuation signage and infrastructure: Develop evacuation plans and educate the community about evacuation routes and practices.
- Develop specific evacuation plans and training/exercises for mobile home parks.
- Ensure that community drinking water storage tanks have an auto shut off valve that can function in case of an earthquake, so this potable water is available for disaster recovery instead of draining out through broken water lines; Replace or retrofit concrete water cistern with a seismically sound option.
- Rebuild Myrtle Point High School.
- Retrofit Myrtle Crest Elementary School.
- Retrofit the Myrtle Point Community Center (old middle school).
- Consider re-establishing rail transportation links to serve the community and local industry if the highway is closed for an extended period of time.
- Form a Rural Fire Protection District for the Allegany area so renters can secure fire insurance; require the formation of fire districts where there are homes.
- Project future risks in planning given rising sea level and increased storms.
- Restore marsh lands and remove dikes that limit the flood plain.
- Make sure homes downstream from the dam know about their risk of flood in the event of a dam failure; allow first responders with heavy equipment access to Water Board land to shut things down quickly in the event of an earthquake or flood.
- Address flooding on county roads in Allegany and on East Bay Drive.
- Mitigate future flooding by using dikes, reservoirs, retention ponds. See how the Dutch deal with their water problems - hydraulic dikes, etc.
- Regulate or prohibit RVs in the floodplain. Regulation of hazard areas and enforcement of existing regulations.
- Subsidize flood insurance for those that can't afford it.
- Repair dated or failed flood gates to address flooding—specifically the Haynes Inlet.
- Address the island created by the loss of the Crown Point bridge in a disaster scenario.

Populations with Additional Risk

- Veterans and low-income people will be unable to improve their homes and properties without financial assistance.
- Mobile homes and mobile home parks have structures at greater risk of hazard impact and likely fewer resources with which to prepare.
- People who are delinquent on property taxes probably do not carry home insurance.
- Backup power for medical equipment that requires electricity like nebulizers for COPD, etc.
- People who live rurally, are isolated, or don’t reach out are likely unaware of their hazard risks.

Suggested Preparedness Actions

The comment sections of the survey garnered a wide array of suggestions for preparedness actions.

- Focus tsunami education in low areas near water throughout the county.
- Educate about shelter in place, preparations to help neighbors, alternate means of communications and other self-reliance tools need to become standard in the disaster education curriculum.
- Preposition more supplies on high ground in all communities: stockpile water and basics at high ground locations; plan for toilet facilities at points where people will gather; Stage satellite phones and solar panels to charge them at these locations.
- Coordinate with school districts on communication to the public about disaster plans.
- Map where necessities can be replenished such as water, basic medical needs etc.
- Communicate with the community about the risk associated with bridges and other lifeline interruption in an earthquake (power, water, communications, etc.), response plans, and how to prepare.
- Educate the community about the Emergency Operations Plan.
- Make sure tsunami areas are clearly identified so you know you are in a tsunami area.
- Have a call feature practice drill to survey and coach—real practice drills, not just maps and brochures.
- Create an informational calendar with preparedness activities.
- Secure emergency desalination equipment.

Completed Mitigation Actions

- Recent Public Works shop renovation in Coquille included seismic upgrades.
- Communication structure and policies between county, cities and emergency services such as mutual aid agreements.

Survey Questions

Hazard Concerns

- Earthquake, Drought, and Wildfire, followed by Tsunami, Wind Storm, and Winter Storm are the hazards of greatest community concern for impacts to home, family, or livelihood.

Results in Ranked Order

Hazard	*Concern of hazard affecting home, family, or livelihood?*			Total Rank
	Yes	No	Unsure	
Earthquake	292	69	29	1
Drought	219	140	31	2
Wildfire	210	121	23	3
Tsunami	192	130	33	4
Wind Storm	169	198	34	5
Winter Storm	142	137	22	6
Coastal Erosion	117	215	58	7
Landslide	101	232	22	8
Flood	98	254	24	9

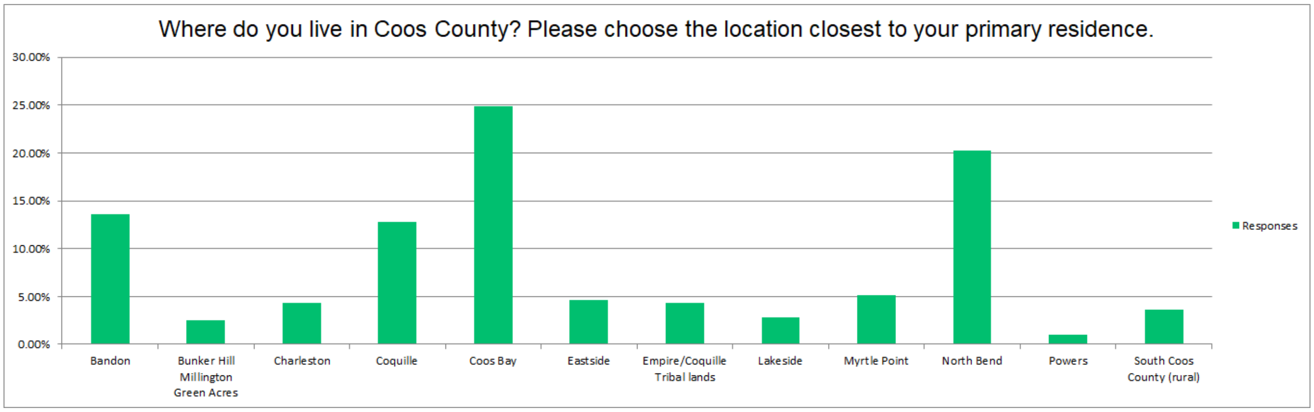
Results in Order Presented

Hazard	*Concern of hazard affecting home, family, or livelihood?*			Total Responses
	Yes	No	Unsure	
Coastal Erosion	30.00%	55.13%	14.87%	390
Drought	56.15%	35.90%	7.95%	390
Earthquake	74.87%	17.69%	7.44%	390
Flood	26.06%	67.55%	6.83%	376
Landslide	28.45%	65.35%	6.20%	355
Tsunami	54.08%	36.62%	9.30%	355
Wildfire	59.32%	34.18%	6.59%	354
Wind Storm	56.15%	32.56%	11.30%	301
Winter Storm	47.18%	45.51%	7.31%	301

Respondent Characteristics

Nearly half (45%) of survey respondents live in the Coos Bay-North Bend urban area (176). Bandon and Coquille responses comprised 26% (103) of the total whereas nearly 9% (35) respondents were from Lakeside, Myrtle Point, and Powers. The unincorporated communities of Charleston, Eastside, Bunker Hill/ Millington/ Green Acres, or Empire/Coquille Tribal lands provided the balance of the survey responses—nearly 16% (62).

Question 1: Where do you live in Coos County? Please choose the location closest to your primary residence.

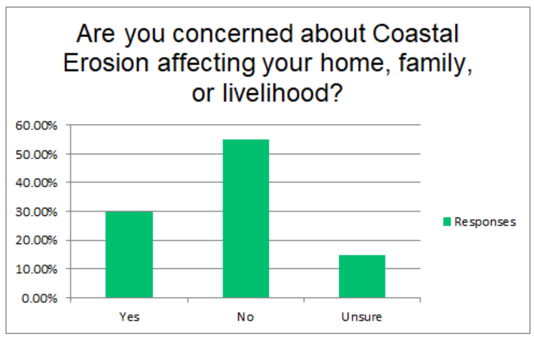


Question 1: Location		
Answer Choices	*Responses*	
Bandon	13.59%	53
Bunker Hill/Millington/Green Acres	2.56%	10
Charleston	4.36%	17
Coquille	12.82%	50
Coos Bay	24.87%	97
Eastside	4.62%	18
Empire/Coquille Tribal lands	4.36%	17
Lakeside	2.82%	11
Myrtle Point	5.13%	20
North Bend	20.26%	79
Powers	1.03%	4
South Coos County (rural)	3.59%	14

Question 1: Location		
Answer Choices	*Responses*	
	Answered	390
	Skipped	0

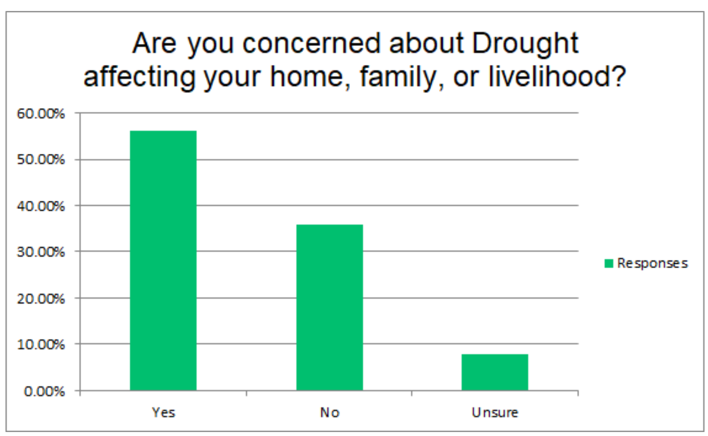
Question 2: Are you concerned about Coastal Erosion affecting your home, family, or livelihood?

Question 2: Coastal Erosion Concerns		
Answer Choices	*Responses*	
Yes	30.00%	117
No	55.13%	215
Unsure	14.87%	58
	Answered	390
	Skipped	0



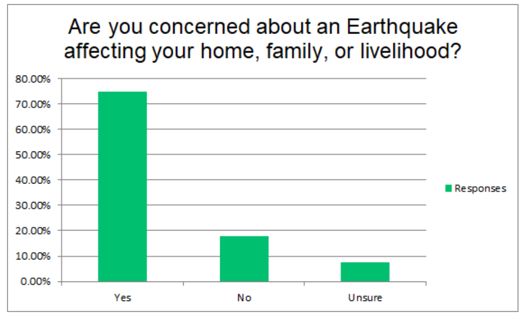
Question 3: Are you concerned about Drought affecting your home, family, or livelihood?

Question 3: Drought Concerns		
Answer Choices	*Responses*	
Yes	56.15%	219
No	35.90%	140
Unsure	7.95%	31
	Answered	390
	Skipped	0



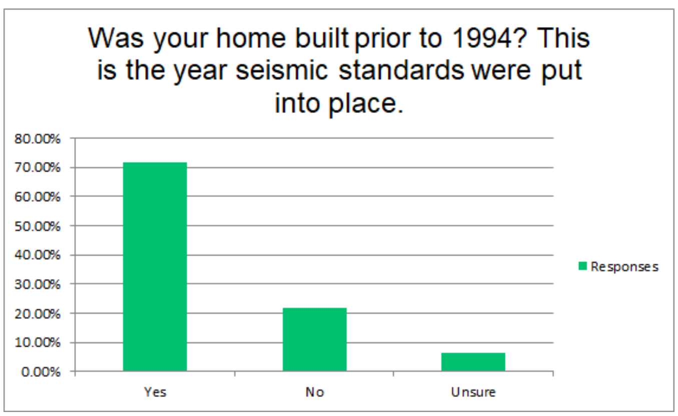
Question 4: Are you concerned about an Earthquake affecting your home, family, or livelihood?

Question 4: Earthquake Concerns		
Answer Choices	*Responses*	
Yes	74.87%	292
No	17.69%	69
Unsure	7.44%	29
	Answered	390
	Skipped	0



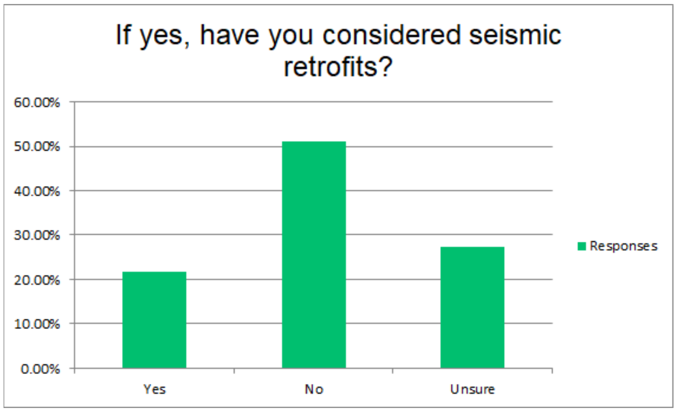
Earthquake: Follow-on Questions

Question 5: Was your home built prior to 1994? This is the year seismic standards were put into place.



Question 5: Earthquake Year Built Pre-1994		
Answer Choices	*Responses*	
Yes	71.70%	228
No	22.01%	70
Unsure	6.29%	20
	Answered	318
	Skipped	72

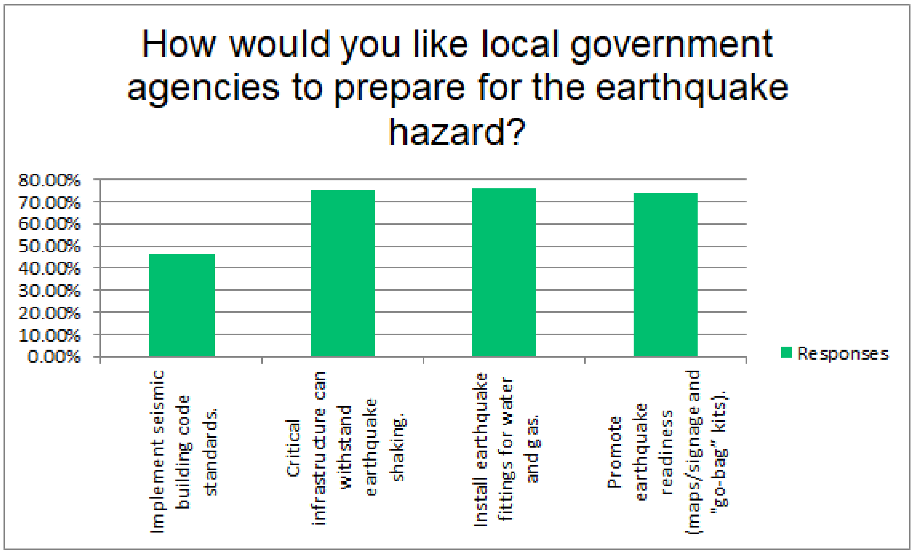
Question 6: Have you considered seismic retrofits?



Question 6: Earthquake Retrofits		
Answer Choices	*Responses*	
Yes	21.76%	52
No	51.05%	122
Unsure	27.20%	65
	Answered	239
	Skipped	151

Earthquake: Follow-on Questions

Question 7: How would you like local government agencies to prepare for the earthquake hazard?



Question 7: Government Preparations for Earthquake		
Answer Choices	*Responses*	
Implement seismic building code standards.	46.60%	137
Strengthen and/or rebuild critical infrastructure to withstand earthquake shaking.	75.17%	221
Install earthquake fittings for water and gas (sensors, flexible connectors, shut off valves).	76.19%	224
Promote readiness through education, evacuation maps, signage and street markers, and guidance for how to make "go-bag" kits.	74.15%	218
Other	-	45
	Answered	294
	Skipped	96

Other/ Comments: 44 comments were received reflecting the following priorities.

- Funding for home retrofits: 10
- Secure infrastructure and retrofit critical facilities: 7
- Education: 6
- Preparedness: 7
- Regulate development in hazard zones: 4
- Community resilience: 4
- All of the above: 2
- Mitigate fire after earthquake (fuel/gas storage/lines/tanks): 2
- Train first responders: 1
- Evacuation routes, signage, infrastructure needed: 1

Earthquake Open-Ended Responses

Earthquake Open-Ended Response Comments How would you like local government agencies to prepare for the earthquake hazard?			
#	Commenter	Comment	Response
1	Avery Horton, Bandon	Let citizens know not to expect help from the government and they will be on their own for a long time and to have months' worth of supplies. For those who live near the water, make sure they understand they will most likely lose everything.	Thank you for sharing your perspective—personal preparedness is very important. See this link for more information: www.ready.gov/kit
2	Anonymous, Bandon	All of the above and help veterans and low income with their homes.	Thank you for sharing your perspective.
3	Anonymous, Bandon	Make Earthquake retrofit, for homes before 1994, affordable by grants or some kind of financial assistance! Keep us safe!	Thank you. This suggestion is being considered as a mitigation action.
4	Anonymous, Bandon	Funding for retro fitting	Thank you. This suggestion is being considered as a mitigation action.
5	Anonymous, Bandon	Help older home owners in older dwellings to access resources for retrofitting earthquake hazards	Thank you. This suggestion is being considered as a mitigation action.
6	Anonymous, Bandon	Earthquakes often trigger fires due to downed power lines, ruptured gas lines, etc. part of earthquake education should focus on fire prevention.	Thank you. Please see the Coos County Emergency Management webpage for a PDF with considerations: https://www.co.coos.or.us/sites/default/files/fileattachments/sheriff039s_office/page/13791/home_fire_preparedness_and_considerations.pdf
7	Anonymous, Bandon	Advice on upgrading my residence to better withstand an earthquake.	Thank you. Here are two seismic retrofit guides: Earthquake Preparedness in the Northwest: a Homeowner Guide https://enhabit.org/documents/Enhabit-Seismic-Homeowner-Guide_4-1-16.pdf Earthquake Retrofitting: House Bolting, Foundation Bolting & Cripple Wall Bracing https://www.earthquakesafety.com/earthquake-retrofitting.html
8	Anonymous, Bandon	Find money to help homeowners do seismic retro fitting	Thank you. This suggestion is being considered as a mitigation action.
9	Anonymous, Bunker Hill/ Millington/ Green Acres	First responders train more for event.	Thank you. The preparedness and response training of first responders does include all potential emergencies.

Earthquake Open-Ended Response Comments How would you like local government agencies to prepare for the earthquake hazard?			
#	Commenter	Comment	Response
10	Kathleen Hornstuen, Charleston	go-bag booklet on what to do in case of a disaster event of any kind. Including pandemic and computer hacking of critical services.	Thank you. This suggestion is an ongoing preparedness action—Coos County Emergency Management distributes a booklet entitled “Are you Ready? Preparing for Disasters and Terrorism in Coos County.”: https://www.co.coos.or.us/sheriff/page/are-you-ready-booklet
11	Jan Hodder, Charleston	Prevent critical infrastructure, hazardous facilities, public buildings being built in the tsunami inundation zones.	Thank you. This suggestion is being considered as a mitigation action.
12	Anonymous, Charleston	Promote building away from dangerous zones	Thank you. This suggestion is being considered as a mitigation action.
13	Kathleen Hornstuen, Charleston	Include tsunami education in low areas near water throughout the county	Thank you. This suggestion is being considered as a preparedness action.
14	Anonymous, Charleston	One of the biggest problems is that people in general think that they can just leave the area. Education about shelter in place, prepare to help neighbors, alternate means of communications and other self-reliance tools need to become standard in the disaster education curriculum.	Thank you for sharing your perspective—personal preparedness is very important. See this link for more information: www.ready.gov/kit
15	James M Behrends, Coos Bay	more prepositioned supplies in all communities	Thank you. This suggestion is underway as a mitigation action.
16	Barb Shamet, Allegany, Or	Make all homes decentralized energy, each one producing its own power, rooftop wind tulips and solar cells	Thank you. This is an individual preparedness action dependent upon municipal ordinance.
17	Anonymous, Coos Bay	Making parents of students in Schools in Eastside comfortable in case of natural disasters.	Thank you. Your concern will be shared with Coos Bay School District.
18	Anonymous, Coos Bay	Set moratorium on siting hazardous facilities in tsunami zones or close to urban areas.	Thank you. This suggestion is being considered as a mitigation action.
19	Anonymous, Coos Bay	Obtain seismic upgrade grants for existing infrastructure and trickle that down to homeowners. Most cannot afford upgrades of their current living conditions.	Thank you. This suggestion is being considered as a mitigation action.
20	Anonymous, Coos Bay	Map where necessities can be replenished such as water, basic medical needs etc.	Thank you. This suggestion is being considered as a mitigation action. More information is available on DOGAMI evacuation maps (subject to change) or http://nvs.nanoos.org/TsunamiEvac

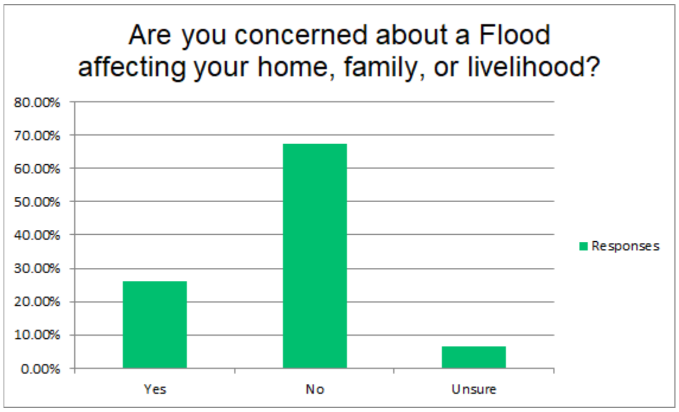
Earthquake Open-Ended Response Comments How would you like local government agencies to prepare for the earthquake hazard?			
#	Commenter	Comment	Response
21	Anonymous, Coos Bay	Education specifically for how homeowners can upgrade their older homes in an economical way.	Thank you. This suggestion is being considered as a mitigation action.
22	Anonymous, Coos Bay	Subsidize retrofits for homeowners, they are too expensive for my family to obtain	Thank you. This suggestion is being considered as a mitigation action.
23	Anonymous, Coos Bay	A Plan on how getting supplies to our community quickly when bridges and roads are out. Especially water, fuel, and food within 48 hours	Thank you for sharing your perspective—personal preparedness is very important because it may take more like 2 weeks or more to be able to reach everyone. See this link for more information: www.ready.gov/kit This is an ongoing concern with planning and considerations.
24	Anonymous, Coos Bay	Secure one armored route to I-5	Thank you for your input.
25	Harper Thompson, Coos Bay	All the above	Thank you for your input.
26	James Fox, Coquille	I only know one way from the highway to my home and I don't know how to escape if fire or earthquake prevents using that route. How can I get attention to this problem for me and my many neighbors in the Shelley Lane area?	Thank you. Please visit this link or the Coos County Emergency Management website to sign up for the Coos County Emergency Mass Notification System (Everbridge): https://member.everbridge.net/892807736724057/login to receive text alerts about evacuation. Coos Emergency Management will also send out press releases, Facebook notices, and specific evacuations (wildfire), will include door-to-door evacuation notices. However, evacuation routes are important research for residents to conduct on their own.

Earthquake Open-Ended Response Comments How would you like local government agencies to prepare for the earthquake hazard?			
#	Commenter	Comment	Response
27	Anonymous, Coquille	1. Provide workshops for homeowners that (1) illustrate examples of seismic risks to be aware of and maybe (2) examples of how to fix or the (3) type of contractor to trust to fix correctly or (4) how to evaluate if the cost of fixing is logical based on the value of the home. MAYBE the county should partner with OSU-extension to provide such service. 2. In the event of a quake many city water lines will break and quickly drain water in storage. The big tanks that hold community drinking water should have an auto shut off so there is a safe option to collect potable water at least for a few days. 3. Readiness education as described above.	Thank you. This suggestion is being considered as a mitigation action. For more information Earthquake Preparedness in the Northwest: A Homeowner Guide https://enhabit.org/documents/Enhabit-Seismic-Homeowner-Guide_4-1-16.pdf
28	Anonymous, Coquille	A new fire hall in Coquille financed via Urban Renewal funds	Thank you for your input. Planning is underway for future expansion.
29	Anonymous, Coquille	Recent shop that was built is retrofitted and there are already building code standards in place so there does not need to be more. They exist for all new building in Coos County already.	Thank you, this will be documented as a completed mitigation action. And you are correct, these standards do exist.
30	Anonymous, Eastside	Why bother... you let people burn trash. I can't open my windows 8 month out of the year. because of coos bay allowing TRASH BURNING!	These issues are beyond the scope of this plan and is a concern for the EPA.
31	Anonymous, Eastside	Do not approve any more Jordan Cove LNG permits! That's a danger to our safety especially if an earthquake was to happen!	Thank you for your input.
32	Anonymous, Empire/Coquille Tribal lands	Don't forget about those of us living in mobile homes and the specific dangers we face.	Thank you for sharing your perspective.
33	Anonymous, Empire/Coquille Tribal lands	County Board of Supervisors to take this a heck of a lot more seriously than they did COVID, and not cripple the people trying to help.	Thank you for your input.

Earthquake Open-Ended Response Comments How would you like local government agencies to prepare for the earthquake hazard?			
#	Commenter	Comment	Response
34	Anonymous, Empire/Coquille Tribal lands	Earthquakes may not damage much but can cause fires and explosions from existing fuel/gas storage/lines/tanks. Old coal mines can also catch fire like the one on the hillside by the old school building on Sherman in North Bend.	Thank you. This suggestion is being considered as a mitigation action. There are pre-planned emergency support functions or capabilities for each of these concerns.
35	Anonymous, Lakeside	all of the above	Thank you for your input.
36	Anonymous, Myrtle Point	We can't afford seismic retrofitting on our home. Please help with a grant program for older homes.	Thank you. This suggestion is being considered as a mitigation action.
37	Anonymous, Myrtle Point	Rebuild the high school, which has partially collapsed. Retrofit the elementary school. Retrofit the community center (old middle school). Consider re-establishing rail transportation links to serve the community and local industry in the event that the highway is closed for an extended period of time. Retrofit the water treatment facility. Replace the concrete water cistern with a seismically sound option. Inspect the bridges leading into town.	Thank you. These suggestions are being considered as mitigation actions. Infrastructure planning is ongoing and a concern of the current operations.
38	Anonymous, North Bend	Repair old tidegates.	Thank you. This suggestion is being considered as a mitigation action. Infrastructure planning is ongoing and a concern of the current operations.
39	Anonymous, North Bend	Stockpile water and basics at high ground locations. Plan for toilet facilities at points where people will gather. Satellite phones and solar panels to charge them are a must.	Thank you. This suggestion is being considered as a preparedness action.
40	Anonymous, North Bend	Certify local contractors to do needed strengthen and rebuild work.	Thank you. This suggestion is being considered as a mitigation action in coordination with state agencies.
41	Anonymous, North Bend	Very concerned about our bridge.	Thank you. Coordination with Oregon Department of Transportation is underway to address the seismic resilience of Coos County bridges.
42	Anonymous, North Bend	Education of citizens	Thank you for sharing your perspective—personal preparedness is very important because it may take more like 2 weeks or more to be able to reach each individual. See this link for more information: www.ready.gov/kit

Earthquake Open-Ended Response Comments How would you like local government agencies to prepare for the earthquake hazard?			
#	Commenter	Comment	Response
43	Anna Banana, North Bend	I'm no expert so I'd like them to confer with experts and do whatever is the right thing.	Thank you.
44	Anonymous, North Bend	When the bridge goes, what's the game plan for all of us that are north of it.	Thank you for highlighting the continued need for long-term preparedness. Additional mitigation actions are being considered such as coordination with Fire Districts, emergency communication systems in place, and supply caches in geographically displaced communities. See this link for more information for personal preparedness: www.ready.gov/kit
45	Julie, South Coos County (rural)	For those struggling need to secure home insurance and delinquency issues if delinquent on property tax they probably have no home insurance protection against any hazardous situations only thinking about the current problem.	Thank you for sharing your perspective.

Question 8: Are you concerned about a Flood affecting your home, family, or livelihood?

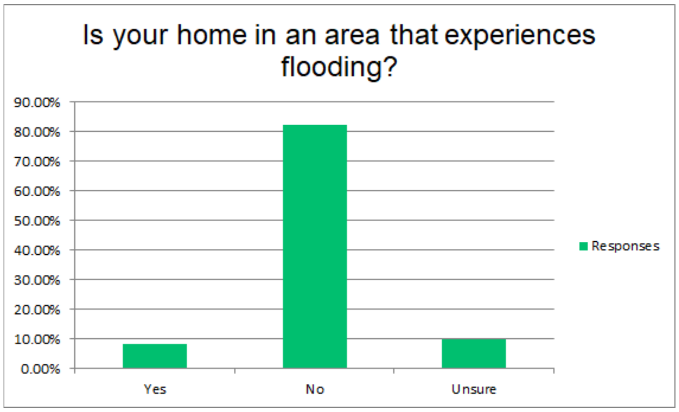


Question 8: Flood Concerns		
Answer Choices	*Responses*	
Yes	26.06%	98
No	67.55%	254
Unsure	6.83%	24
	Answered	376
	Skipped	14

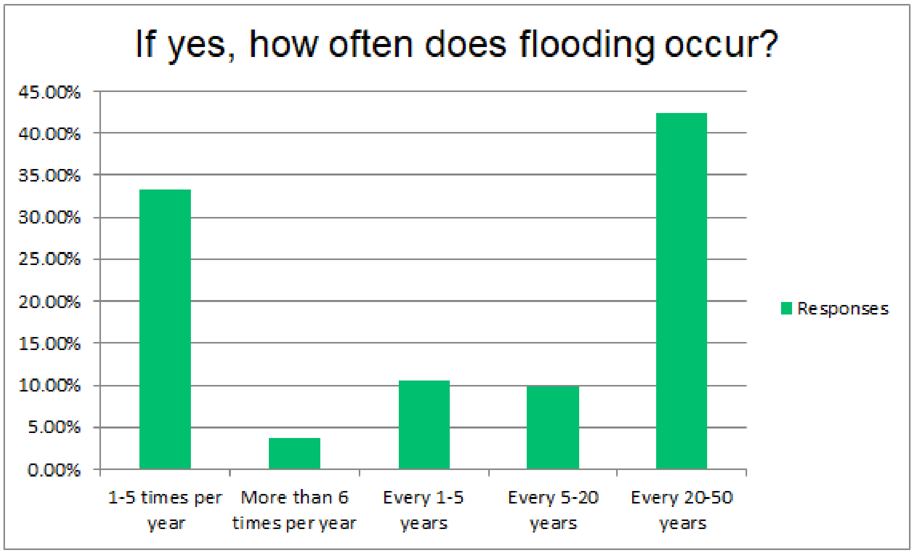
Flood: Follow-on Questions

Question 9: Is your home in an area that experiences flooding?

Question 9: Flooding Near Home		
Answer Choices	*Responses*	
Yes	8.27%	31
No	82.13%	308
Unsure	9.60%	36
	Answered	375
	Skipped	15



Question 10: How often does flooding occur?

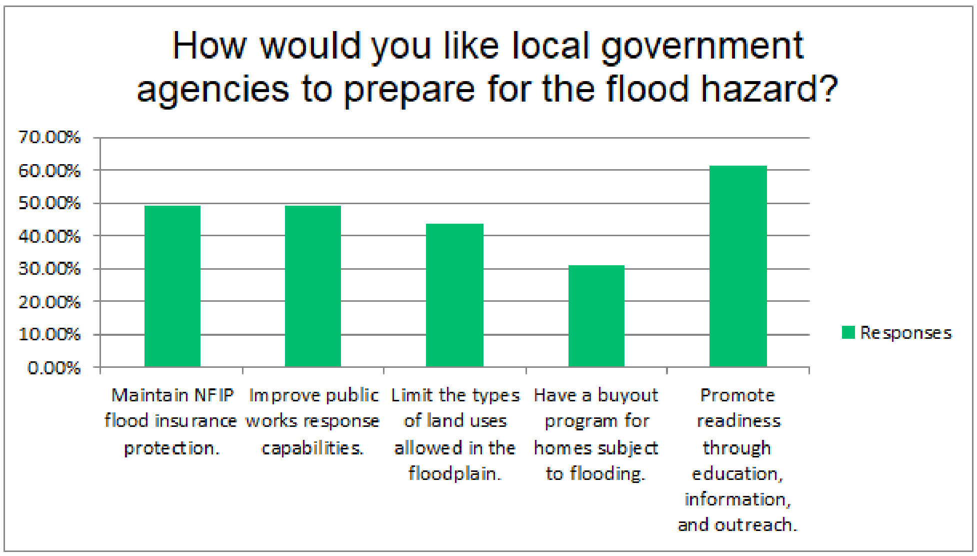


Question 10: Flood Frequency		
Answer Choices	*Responses*	
1-5 times per year	33.33%	44
More than 6 times per year	3.79%	5
Every 1-5 years	10.61%	14

Question 10: Flood Frequency		
Answer Choices	*Responses*	
Every 5-20 years	9.85%	13
Every 20-50 years	42.42%	56
	Answered	132
	Skipped	258

Flood: Follow-on Questions

Question 11: How would you like local government agencies to prepare for the flood hazard?



Question 11: Government Preparations for Flood		
Answer Choices	*Responses*	
Follow FEMA National Flood Insurance Program requirements to ensure the community maintains flood insurance protection.	49.30%	175
Improve public works response capabilities.	49.01%	174
Limit the types of land uses allowed in the floodplain.	43.66%	155
Have a buyout program for homes subject to flooding.	31.27%	111
Promote readiness through education, information, and outreach.	61.13%	217

Question 11: Government Preparations for Flood		
Answer Choices	*Responses*	
Other		32
	Answered	355
	Skipped	35

Other/ Comments: 30 comments were received reflecting the following priorities:

- Secure infrastructure and retrofit critical facilities: 7
- Protect natural infrastructure: 5
- Plan for evacuation: 4
- Regulate development in hazard zones: 3
- Prefer no government preparations: 2
- Address climate change: 1
- All of the above: 1
- Community resilience: 1
- Funding for homeowners (flood insurance): 1
- Preparedness: 1
- Protect private property rights: 1
- Train first responders: 1
- Other: 2

Flood Open-Ended Responses

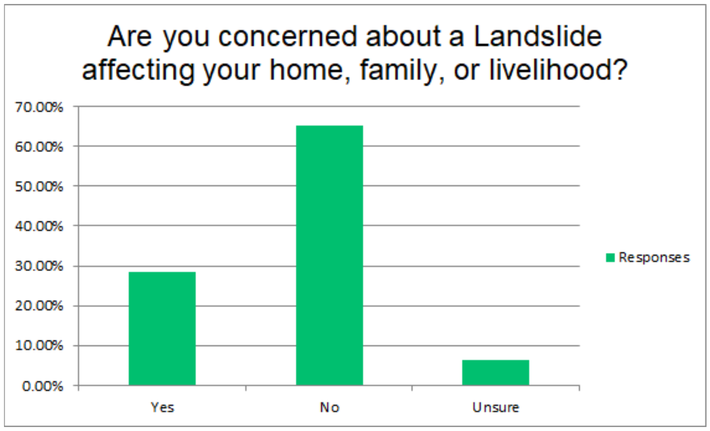
Flood Open-Ended Response Comments How would you like local government agencies to prepare for the flood hazard?			
#	Commenter	Comment	Response
1	Anonymous, Bandon	Also Stop hotels and all other businesses from building in them.	Thank you for your input.
2	Anonymous, Bandon	During a Tsunami, our house may be flooded, but it is not flooded by river or seasonal rain.	Thank you for sharing your perspective.
3	Anonymous, Bandon	Climate change, king tides, coastal erosion and rising ocean levels - how are these factors predicted to impact homes along smaller waterways like local creeks and lakes with tidal influence? I can find information for people living right on the beach but what about those of us a little further inland, should we be concerned?	The information you are interested in will likely be in the full final NHMP update. But you may be interested in these websites: the National Oceanic and Atmospheric Administration (NOAA). Sea Level Rise Viewer: https://www.coastalatlas.net/sealevelrise/ or the DLCD Oregon Coastal Management Program at https://www.oregon.gov/lcd/OCMP/Pages/index.aspx
4	Kathleen Hornstuen, Charleston	include information in a go-kit booklet on what to do for mitigation before and after a flood event to lessen impact.	Thank you. Please see www.ready.gov/kit for preparedness ideas. See the Coos County Emergency Management booklet entitled "Are you Ready? Preparing for Disasters and Terrorism in Coos County" available at: https://www.co.coos.or.us/sheriff/page/are-you-ready-booklet
5	Anonymous, Coos Bay	project future risks in planning given rising sea level and also increased storms	Thank you. This suggestion is being considered as a mitigation action.
6	Anonymous, Coos Bay	evaluate possible water evacuation systems and flow patterns in cases of flooding.	Thank you. This suggestion is being considered as a preparedness action.
7	James M Behrends, Coos Bay	restore marsh lands, remove dikes that limit the flood plain	Thank you. This suggestion is being considered as a mitigation action.
8	Barb Shamet, Allegany, Or	If the timber industry keeps clear cutting, devastating washouts from climate catastrophe will be irreparable, they need to thin only trees under age 65 years, the older trees are storing water and carbon, and they must be left intact to prevent disaster	Thank you for sharing your perspective. A climate report will inform this plan update.

Flood Open-Ended Response Comments How would you like local government agencies to prepare for the flood hazard?			
#	Commenter	Comment	Response
9	Anonymous, Coos Bay	Allow fire departments/first responders with heavy response equipment access to waterboard land to shut things down QUICKLY in the event of an earthquake/flood. Make sure homes downstream from the dam know the danger they are in so they can do what ever can be done to homes to prepare for instant catastrophic flood. Stop letting people build in that flood zone in the first place - the flood path is right through neighborhoods with families and the dam isn't getting any younger, but every day we're one day closer to the "big one" that at 9.8 could easily knock it down!	The waterboard has contingency plans in place and works with emergency responders for access to their lands. Floodplain regulations are in place and enforced by local planning departments in order to maintain compliance with the National Flood Insurance Program. The community is welcomed to and encouraged to have higher standards than minimum standards set for building.
10	Anonymous, Coos Bay	Protect major highways to escape hazards	Thank you. This suggestion is being considered as a mitigation action
11	Anonymous, Coos Bay	Stop breaking down the _ bay! Starbucks is going to be fun under water _!	Thank you for sharing your perspective.
12	Anonymous, Coquille	Maybe the government has a responsibility to identify areas subject to flooding and notify each property owner, but please minimize taking away the rights of the property owner to use the property as the owner sees fit. Instead let the insurance company charge the appropriate fees based on the flood risk.	Floodplain regulations are enforced by local planning departments in order to maintain compliance with the National Flood Insurance Program. The county has not modified or set new codes.
13	Anonymous, Eastside	No concern	
14	Anonymous, Eastside	The fire and police departments need NEW management and training. There responses to emergencies for me has been terrible!	Thank you for sharing your perspective.
15	Anonymous, Eastside	Work with restoration groups to see how we can utilize pur estuary and riverways to help elevate flooding	Thank you. This suggestion is being considered as a mitigation action
16	Anonymous, Eastside	Ensure county highways/roads are secure from lowland flooding, especially East Bay Drive.	Thank you. Infrastructure planning is ongoing and a concern of the current operations.
17	Anonymous, Empire/Coquille Tribal lands	Get rid of the "garbage" infesting our area and Discontinue the Endless violations of our Natural Rights.	Thank you for sharing your perspective.

Flood Open-Ended Response Comments How would you like local government agencies to prepare for the flood hazard?			
#	Commenter	Comment	Response
18	Anonymous, Empire/Coquille Tribal lands	Mitigate any possible problems like creating dikes, reservoirs, retention ponds. See how the Dutch deal with their water problems - hydraulic dikes, etc.	Infrastructure planning is ongoing and a concern of the current operations.
19	Anonymous, Lakeside	all of the above	Thank you for sharing your perspective.
20	Karen L Crouch, Lakeside	Our city allows RVS in the flood plain--violations like this risk lives	Thank you. This suggestion is being considered as a mitigation action.
21	Anonymous, Myrtle Point	Subsidized flood insurance for those that can't afford it	Floodplain regulations are enforced by local planning departments to maintain compliance with the National Flood Insurance Program. The community is welcomed to and encouraged to have higher standards than minimum standards set for building. Currently, the county can’t afford to subsidize personal insurance.
22	Anonymous, North Bend	Repair dated / failed flood gates. Specifically the Haynes Inlet. We above the tide gate are experiencing terrible flooding.	Infrastructure planning is ongoing and a concern of the current operations. This project is planned to be part of the mitigation actions.
23	Liz, North Bend	The less the government is involved in our business the better	Thank you for sharing your perspective.
24	Anonymous, North Bend	These are land use issues that need a County - wide / long term community development / population location non-political / highly technical academic approach to political zoning / earthquake / flood issues and challenges. The money now wasted in building the now abandoned "new" CB library is an example of the consequences to the public of past "market" and poorly regulated community expansion decisions.	Thank you for sharing your perspective.
25	Anonymous, North Bend	our flooding is due to a decrepit tide gate. The bridge that the tide gate is near is being compromised.	Thank you. Infrastructure planning is ongoing and a concern of the current operations.
26	Anonymous, North Bend	My home doesn't flood, per se, but we're close enough to the Bay that in event of a tsunami we're probably hoarked.	Thank you for sharing your perspective.

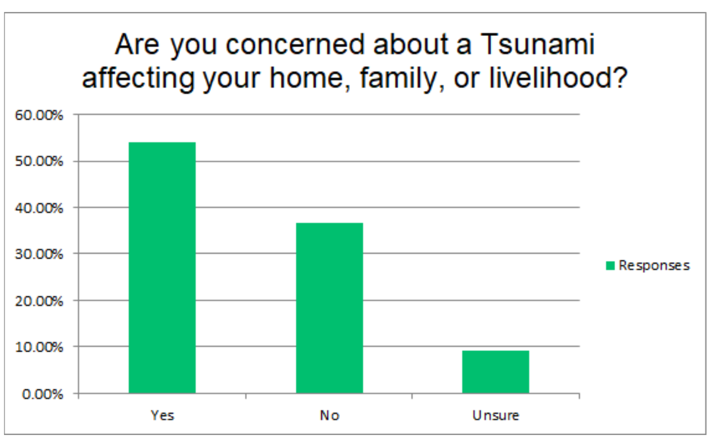
Flood Open-Ended Response Comments How would you like local government agencies to prepare for the flood hazard?			
#	Commenter	Comment	Response
27	Anonymous, North Bend	Help us to higher ground	Thank you. This suggestion could be considered as a mitigation action. Please contact please contact the City of North Bend at (541) 756-8535 or the DLCD Oregon Coastal Management Program at https://www.oregon.gov/lcd/OCMP/Pages/index.aspx Tsunami information is available on DOGAMI evacuation maps (subject to change) or http://nvs.nanoos.org/TsunamiEvac
28	Anonymous, South Coos County (rural)	I live in Allegany and our roads frequently flood nothing can be done to change a river	Thank you for sharing your perspective.
29	Anonymous, South Coos County (rural)	Maintaining ditches along roadways and culverts would help a lot to ensure we have a good road system.	Thank you. This suggestion is being considered as an ongoing mitigation action. Infrastructure planning is ongoing and a concern of the current operations.
30	Anonymous, South Coos County (rural)	Keep cotton picking government hands off my stuff and out of my life.	Thank you for sharing your perspective.

Question 12: Are you concerned about a Landslide affecting your home, family, or livelihood?



Question 12: Landslide Concerns		
Answer Choices	*Responses*	
Yes	28.45%	101
No	65.35%	232
Unsure	6.20%	22
	Answered	355
	Skipped	35

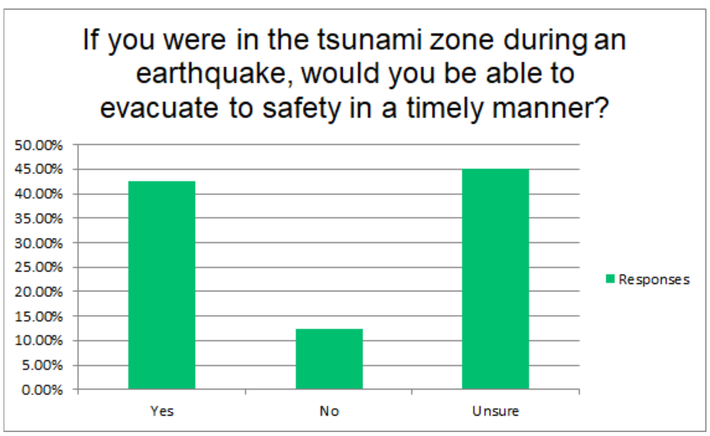
Question 13: Are you concerned about a Tsunami affecting your home, family, or livelihood?



Question 13: Tsunami Concerns		
Answer Choices	*Responses*	
Yes	54.08%	192
No	36.62%	130
Unsure	9.30%	33
	Answered	355
	Skipped	35

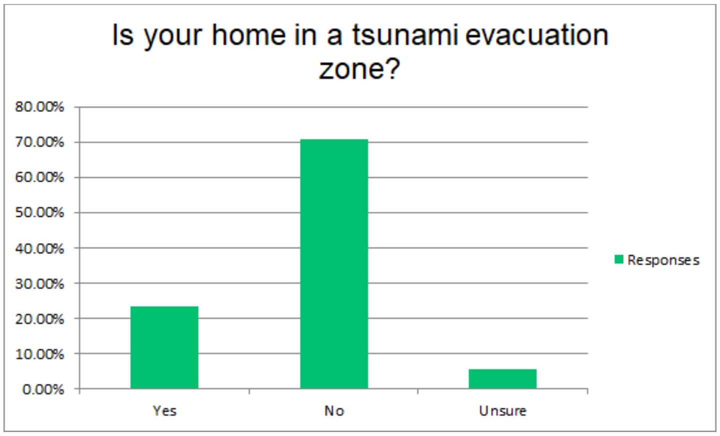
Tsunami: Follow-on Questions

Question 14: If you were in the tsunami zone during an earthquake, would you be able to evacuate to safety in a timely manner?



Question 14: Timely tsunami evacuation		
Answer Choices	*Responses*	
Yes	42.62%	52
No	12.30%	15
Unsure	45.08%	55
	Answered	122
	Skipped	268

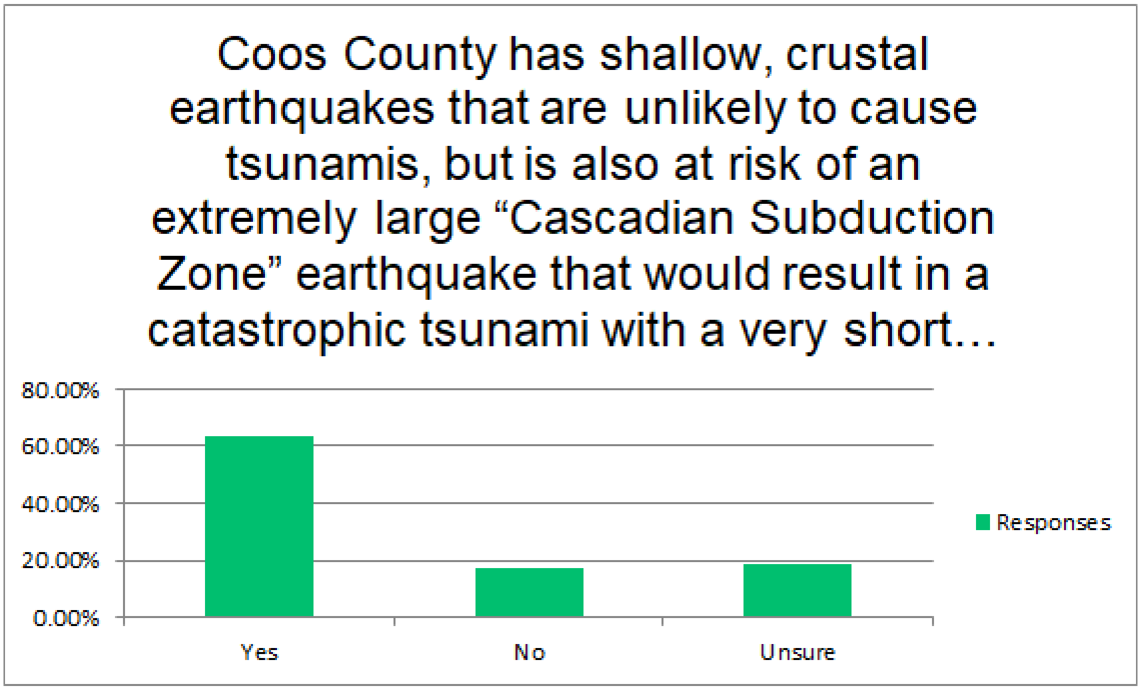
Question 15: Is your home in a tsunami evacuation zone?



Question 15: Home in tsunami zone		
Answer Choices	*Responses*	
Yes	23.58%	29
No	70.73%	87
Unsure	5.69%	7
	Answered	123
	Skipped	267

Tsunami: Follow-on Questions

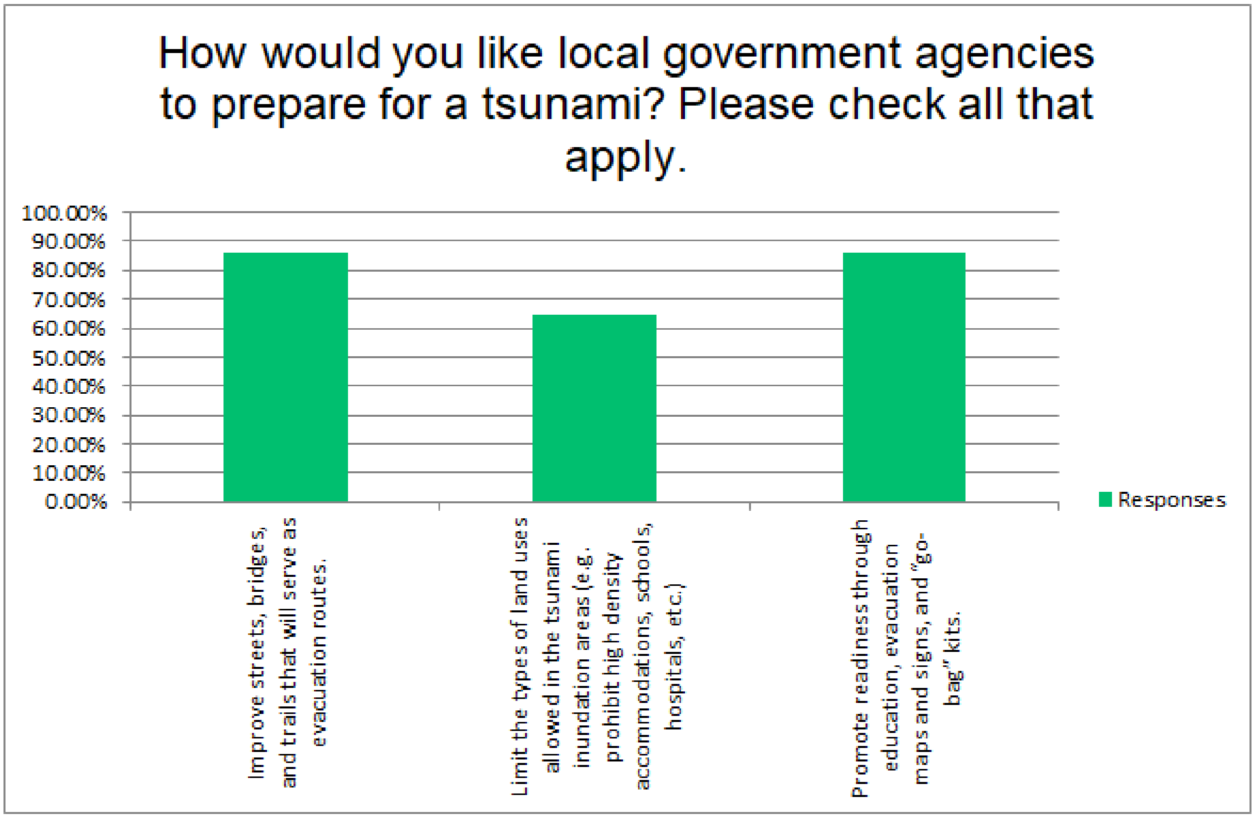
Question 16: Coos County has shallow, crustal earthquakes that are unlikely to cause tsunamis, but is also at risk of an extremely large "Cascadian Subduction Zone" earthquake that would result in a catastrophic tsunami with a very short evacuation timeline. If an earthquake occurred, would you know when and how to evacuate for a tsunami?



Question 16: Tsunami Evacuation: when/how?		
Answer Choices	*Responses*	
Yes	63.64%	77
No	17.36%	21
Unsure	19.01%	23
	Answered	121
	Skipped	269

Tsunami: Follow-on Questions

Question 17: How would you like local government agencies to prepare for a tsunami? Please check all that apply.



Question 17: Government Preparations for Tsunami

Answer Choices	*Responses*	
Improve streets, bridges, and trails that will serve as evacuation routes.	86.07%	105
Limit the types of land uses allowed in the tsunami inundation areas (e.g. prohibit high density accommodations, schools, hospitals, etc.)	64.75%	79
Promote readiness through education, evacuation maps and signs, and "go-bag" kits.	86.07%	105
Other		18
	Answered	122
	Skipped	268

Other/ Comments: 17 comments were received reflecting the following priorities:

- Install/improve tsunami evacuation signage and infrastructure:6
- Hazard regulations: 3
- Education: 2
- Home location/Cascadia event comment: 2
- Secure infrastructure and retrofit critical facilities: 2
- Community resilience: 1
- Preparedness: 1

Tsunami Open-Ended Responses

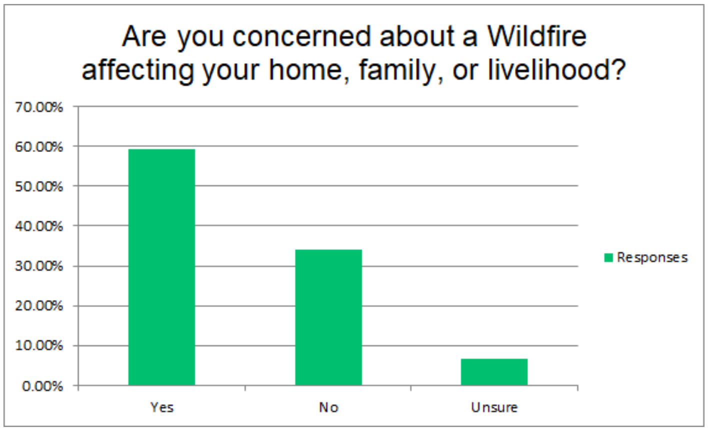
Tsunami Open-Ended Response Comments How would you like local government agencies to prepare for a tsunami?			
#	Commenter	Comment	Response
1	Anonymous, Bandon	Early warning system	Thank you. This is a mitigation action.
2	Anonymous, Bandon	Make sure tsunami areas are clearly identified so you know you are in a tsunami area	Thank you, tsunami evacuation planning is an ongoing mitigation action. Areas have been posted and include evacuation signage. Signs will be updated as necessary.
3	Anonymous, Bandon	We are not in the evacuation zone, but we are right across the street from the bluff overlooking the ocean. My concern is that such an earthquake as predicted for the Cascadian Subduction Zone would cause land to shift and serious damage to the houses on/in the bluff and possible flooding in Tupper Creek which runs behind our home. We feel fairly safe here, but unsure of what could happen to our specific property given its proximity to the coastal bluffs and the riparian water way that runs behind our home and out to the ocean via a culvert under Beach Loop Drive and through a creek in the bluff on down to the beach.	Please consult a licensed geotechnical engineer to determine your home's specific risk. You may find the Statewide Landslide Information Layer for Oregon to be useful.: https://www.oregongeology.org/slido/ It appears that regional scale data only is available, but it indicates widespread moderate risk and intermittent high risk to landslides in the Beach Loop Road vicinity. Consider seismic retrofits for your home.
4	Kathleen Hornstuen, Charleston	Include retrofit information in a go-kit booklet and what to put in the kit.	Thank you. This suggestion is being considered as a preparedness action, and you can visit this link for more information for personal preparedness: www.ready.gov/kit See the Coos County Emergency Management booklet entitled "Are you Ready? Preparing for Disasters and Terrorism in Coos County" available at: https://www.co.coos.or.us/sheriff/page/are-you-ready-booklet
5	James M Behrends, Coos Bay	prepositioned more supplies in more locations on high ground.	Thank you. This suggestion is being considered as a preparedness action.

Tsunami Open-Ended Response Comments How would you like local government agencies to prepare for a tsunami?			
#	Commenter	Comment	Response
6	Barb Shamet, Allegany, Or	Promote green infrastructure, micro grids for power, so when and if the big one hits, some p,aves will still be up and running, Decentralize the power grid	Thank you. This suggestion is being considered as a mitigation action.
7	Anonymous, Coos Bay	Follow through with punishing people who run straight to the beach to watch it when a possible tsunami is coming in so even if they don't take the danger seriously, it won't be worth the risk of the giant fine that comes from ignoring an evac/stay away order.	Thank you for sharing your perspective.
8	Anonymous, Coos Bay	Build or require vertical evacuation towers in areas where high population density and difficulty getting people out of inundation zone in a timely manner. And/or require any high-density housing and schools in tsunami inundation zone to have said towers.	Thank you. This suggestion is being considered as a mitigation action.
9	Anonymous, Coos Bay	Improve your infrastructure! Nobody can get out of downtown and now Front Street with traffic one way in and out it can't handle! No speed signs! People doing 40 on Front Street. You have way more to worry about!	Evacuation maps (subject to change) can be found on DOGAMI or http://nvs.nanoos.org/TsunamiEvac Infrastructure is an ongoing planning concern and considerations.

Tsunami Open-Ended Response Comments How would you like local government agencies to prepare for a tsunami?			
#	Commenter	Comment	Response
10	Anonymous, Eastside	Why make any changes? I have asthma and the trash burning and brush burning negatively impacts me more than half the year! It also affects home sales. My neighbor was trying to sell his house and there were multiple time buyers were annoyed and left because of the smoke that engulfs the area so frequently. But no one will help me. The fire department told me to sue my neighbor. Are you serious? New fire and police management are needed badly.	Thank you for sharing your perspective.
11	Anonymous, Eastside	Do not approve any more Jordan Cove LNG permits that would be a danger to our community if constructed	Thank you for sharing your perspective.
12	Karin Kenney, Empire/Coquille Tribal lands	Have call feature that can be used to have practice drills for tsunami. Employers should have to allow us to answer the call and see how we do getting out of the zone and into a safe area, either on foot or by car. We need real practice, not just maps and brochures.....I need to drive that route to safety from my home.....from my work.....from my moms house if I'm over there.....I need to know where to go and how!!	Evacuation maps (subject to change) can be found on DOGAMI or http://nvs.nanoos.org/TsunamiEvac Please visit this link or the Coos County Emergency Management website to sign up for the Coos County Emergency Mass Notification System (Everbridge): https://member.everbridge.net/892807736724057/login to receive text alerts about evacuation. Coos Emergency Management will also send out press releases, Facebook notices, and specific evacuations (wildfire), will include door-to-door evacuation notices. However, evacuation routes are important research for residents to conduct on their own.
13	Kat Burgess, MRC, CERT, Empire/Coquille Tribal lands	Look into tsunami reduction modifications in the bay AND erect some high platforms like they have in Japan.	Thank you. Infrastructure is an ongoing planning concern and considerations.
14	Anonymous, Myrtle Point	Make tsunami evacuation structures if possible	Thank you. This suggestion is being considered as a mitigation action.

Tsunami Open-Ended Response Comments How would you like local government agencies to prepare for a tsunami?			
#	Commenter	Comment	Response
15	Anonymous, North Bend	Some of the maps for evacuation and areas presumed to be safe surprise me. I would ask that local emergency folks actually drive and inspect each area; then use their expertise and common sense not the modeling. Make it hands-on and what is logical.	Thank you, tsunami evacuation planning is an ongoing mitigation action. County personnel regularly inspect tsunami signs and travel the routes and will conduct an analysis of route suitability.
16	Anonymous, North Bend	It is crazy to me that people use the McCullough Memorial Bridge into North Bend even though, to the best of my knowledge, it is not seismically sound. I wonder if people know how dangerous it is, or if people don't believe the danger, or if it's just not feasible to avoid the bridge in everyday travel due to a risk that may or may not be imminent.	Thank you for sharing your perspective. Bridges are identified as an ongoing mitigation action.
17	Anonymous, North Bend	Don't allow a LNG facility that could potentially be devastating to the area.	Thank you for sharing your perspective.
18	Anonymous, North Bend	We've been here 25yrs and I've never seen or heard the evacuation plan for N Bay Schools including school bussing	Thank you. Your concern will be shared with the North Bend School District.
19	Anonymous, South Coos County (rural)	Send poster flyer informational calendars yearly through mail people can put up around house that has all emergency info	Thank you. This suggestion is being considered as a preparedness action.

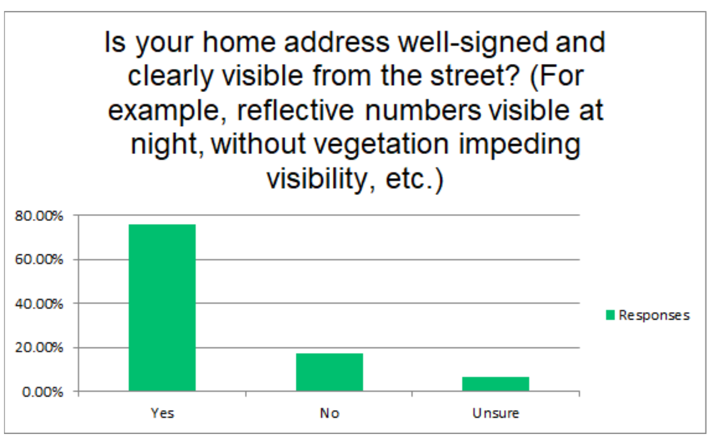
Question 18: Are you concerned about a Wildfire affecting your home, family, or livelihood?



Question 18: Wildfire Concerns		
Answer Choices	*Responses*	
Yes	59.32%	210
No	34.18%	121
Unsure	6.59%	23
	Answered	354
	Skipped	36

Wildfire: Follow-on Questions

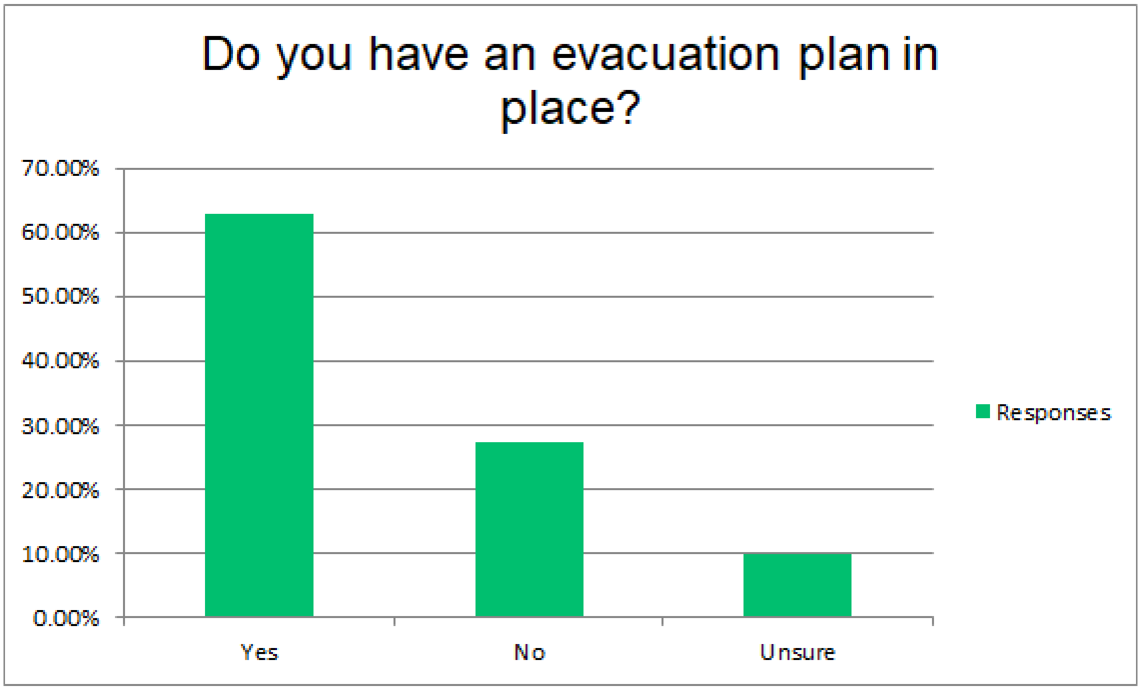
Question 19: Is your home address well-signed and clearly visible from the street? (For example, reflective numbers visible at night, without vegetation impeding visibility, etc.)



Question 19: Visible Home Address		
Answer Choices	*Responses*	
Yes	76.12%	153
No	17.41%	35
Unsure	6.47%	13
	Answered	201
	Skipped	189

Wildfire: Follow-on Questions

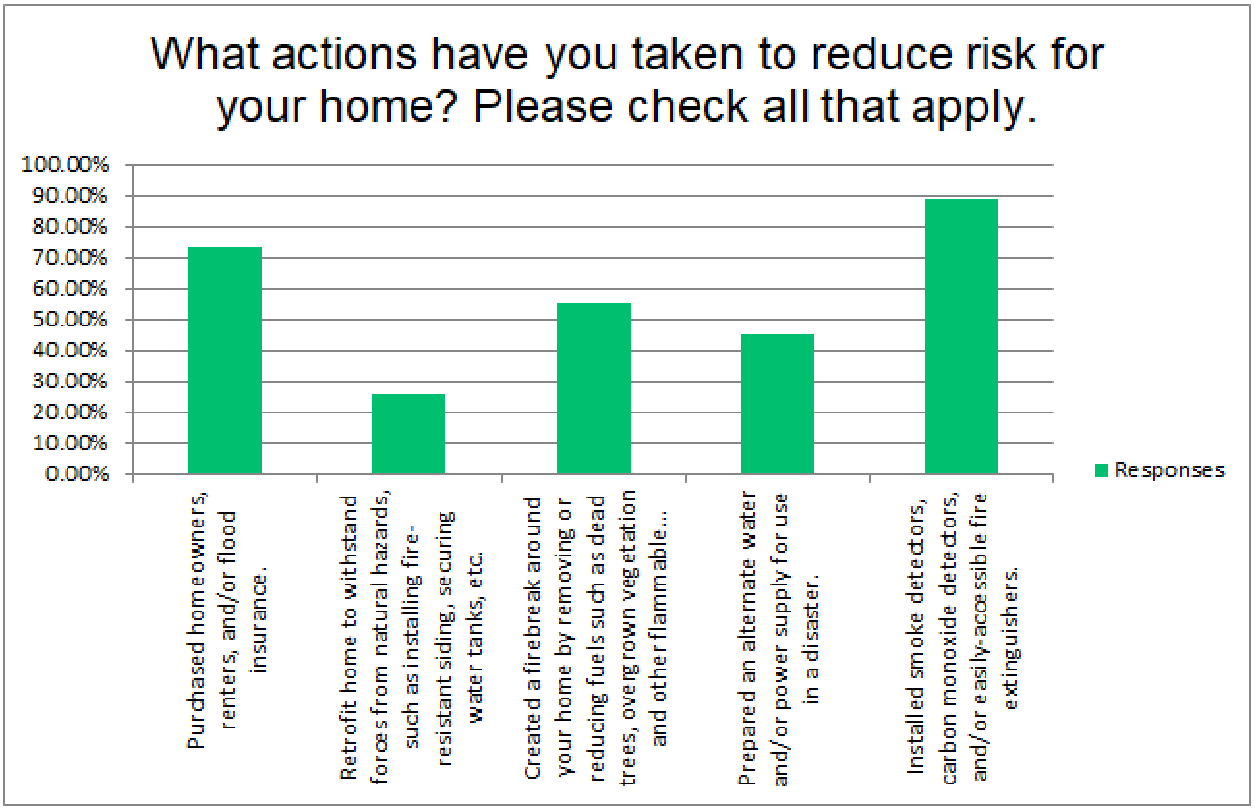
Question 20: Do you have an evacuation plan in place?



Question 20: Evacuation plan?		
Answer Choices	*Responses*	
Yes	62.69%	126
No	27.36%	55
Unsure	9.95%	20
	Answered	201
	Skipped	189

Wildfire: Follow-on Questions

Question 21: What actions have you taken to reduce risk for your home? Please check all that apply.



Question 21: Risk Reduction Actions?

Answer Choices	*Responses*	
Purchased homeowners, renters, and/or flood insurance.	73.43%	210
Retrofit home to withstand forces from natural hazards, such as installing fire-resistant siding, securing water tanks, etc.	25.52%	73
Created a firebreak around your home by removing or reducing fuels such as dead trees, overgrown vegetation, and other flammable materials; clean leaf and tree debris from gutters and roof.	55.24%	129
Prepared an alternate water and/or power supply for use in a disaster.	45.10%	254
Installed smoke detectors, carbon monoxide detectors, and/or easily-accessible fire extinguishers.	88.81%	254
Other		26

Question 21: Risk Reduction Actions?		
Answer Choices	*Responses*	
	Answered	286
	Skipped	104

Wildfire Open-Ended Responses

Other/ Comments: 34 comments were received reflecting the following priorities:

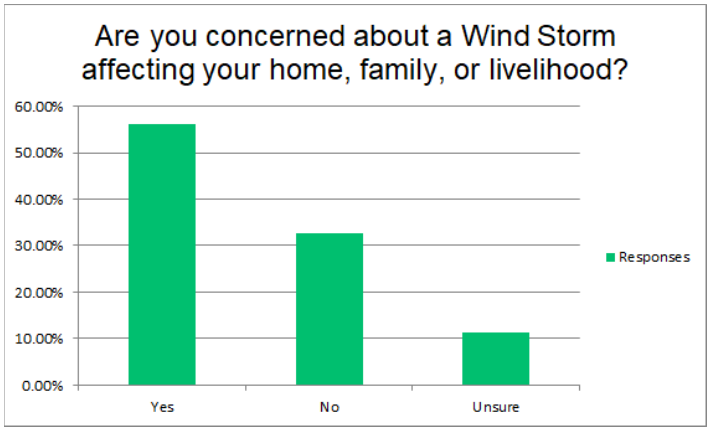
- Gorse/fire concern: 3
- Vegetation management for fire prevention: 3
- Firefighting equipment: 1
- Tsunami warning/evacuation: 5
- Barriers to insurance: 2
- Insurance: 2
- Preparedness: 4
- Home/ Business renovations: 5
- No risk reduction conducted: 6
- Other/Unrelated: 3

Wildfire Open-Ended Response Comments What actions have you taken to reduce risk for your home?			
#	Commenter	Comment	Response
1	Anonymous, Bandon	Can't afford to retrofit my home on a monthly disability income.	Thank you. Your situation has been described as a community need to be addressed as a mitigation action.
2	Anonymous, Bandon	The Bandon area has a serious problem with invasive, highly flammable vegetation. Even if I reduce fuels around my home if neighboring properties can't or won't do the same my property is a risk. How can the county help to build community engagement and assist low-income property owners to minimize fire danger?	Thank you. Gorse eradication and control is ongoing and is considered an invasive species of plant.
3	Anonymous, Bandon	Alternate food supply	Thank you for sharing your wildfire mitigation action.
4	Anonymous, Bunker Hill/ Millington/ Green Acres	Nothing	See this link for preparedness information: www.ready.gov/kit Please visit this link or the Coos County Emergency Management website to sign up for the Coos County Emergency Mass Notification System (Everbridge): https://member.everbridge.net/892807736724057/login to receive text alerts about evacuation. Coos Emergency Management will also send out press releases, Facebook notices, and specific evacuations (wildfire), will include door-to-door evacuation notices. However, evacuation routes are important research for residents to conduct on their own.
5	Kathleen Hornstuen, Charleston	My go kit is ready	Thank you for sharing your wildfire mitigation action.

Wildfire Open-Ended Response Comments What actions have you taken to reduce risk for your home?			
#	Commenter	Comment	Response
6	Jan Hodder, Charleston	Developed a tsunami evacuation plan. Added shear walls to some rooms in the house.	Thank you for sharing your tsunami mitigation actions.
7	Kathleen Hornstuen, Charleston	Checked for tsunami elevation	Thank you for sharing your tsunami mitigation action.
8	Anonymous, Coquille	We have metal roofs on our home and shop	Thank you for sharing your wildfire mitigation actions.
9	Anonymous, Eastside	Purchased earthquake insurance	Thank you for sharing your mitigation action.
10	Martin Heldt Eastside	Have emergency supplies	Thank you for sharing your mitigation action.
11	Anonymous, Eastside	I cannot leave my smoke detectors on because my house is regularly inundated with smoke from the neighbors that burn trash in their homes and yard	Thank you for sharing your concerns.
12	Kat Burgess, MRC, CERT, Empire/Coquille Tribal lands	Stocked food and supplies for emergencies.	Thank you for sharing your mitigation action.
13	Anonymous, Empire/Coquille Tribal lands	I live right next to tribal land and it is being unmanaged and somehow last year my neighbors have used bulldozers to move trees and brush into piles and now they are big piles of dry tinder, very near to the apt complex I rent. People frequently access the land via trails and some have built fires in the area, and I think their may be a homeless camp as I have seen smoke from the same area.	Thank you for sharing your concerns. Citizens are urged to contact tribal property with concerns about tribal lands. Fires built during fire season should be reported to local authorities or the Coos Forest Protective Association (CFPA).
14	Anonymous, Myrtle Point	Seismic straps for the water heater. French drain under the house to provide better drainage. New roof in 2015.	Thank you for sharing your mitigation actions.
15	Anonymous, North Bend	I pay extra for earthquake insurance.	Thank you for sharing your mitigation actions.

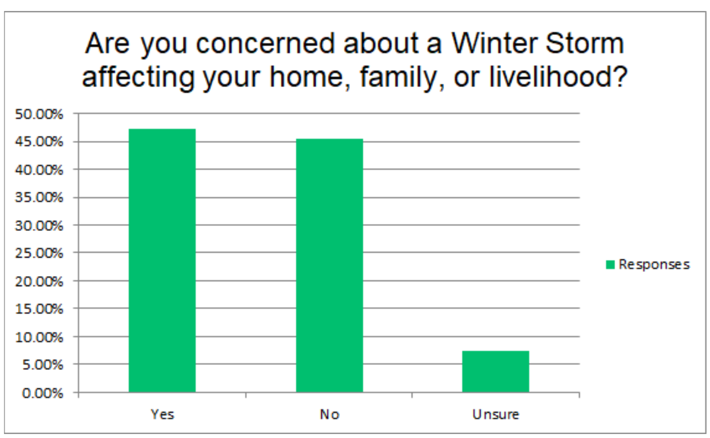
Wildfire Open-Ended Response Comments What actions have you taken to reduce risk for your home?			
#	Commenter	Comment	Response
16	Anonymous, North Bend	Still difficult to make a complete fire break around my home. Some retrofit to withstand forces from natural hazards, metal roof, wood stove, try to keep extra supplies on hand.	Thank you for sharing your wildfire mitigation actions and concerns.
17	Anonymous, North Bend	None	
18	Elaine, North Bend	Sorry I have a few smoke detectors but no fire extinguisher and no home owners insurance. I pay attention to harmful weather that might blow my roof off.	Thank you for sharing your wildfire mitigation actions. Fire preparedness is advised, please see this link for ideas: https://www.co.coos.or.us/sites/default/files/fileattachments/sheriff039s_office/page/13791/home_fire_preparedness_and_considerations.pdf
19	Anonymous, South Coos County (rural)	I live in Allegany and rent. we can cot get renters insurance as we do not have a fire district. the flood and home owners insurance is hard to find and expensive. It would be helpful for the county, state or us government mandate a rural fire department to help us be able to get lower insurance premimums.	Thank you. Your situation has been described as a community need to be addressed as a mitigation action.
20	Julie, South Coos County (rural)	Current delinquent and transfer issues have not been able to get any preparation or protections or insurance try save home from forclosure	Thank you for sharing your concerns.
21	Anonymous, South Coos County (rural)	Have hydrant supplied by 5000 gal. tank, firehose and pump.	Thank you for sharing your wildfire mitigation actions.
22	Anonymous, South Coos County (rural)	Gorse removal	Gorse eradication and control is ongoing and is considered an invasive species of plant.
23	Anonymous, South Coos County (rural)	Fenced the place securely so livestock are not on the road.	Thank you for sharing your mitigation action.

Question 22: Are you concerned about a Wind Storm affecting your home, family, or livelihood?



Question 22: Wind Storm Concerns		
Answer Choices	*Responses*	
Yes	56.15%	169
No	32.56%	98
Unsure	11.30%	34
	Answered	301
	Skipped	89

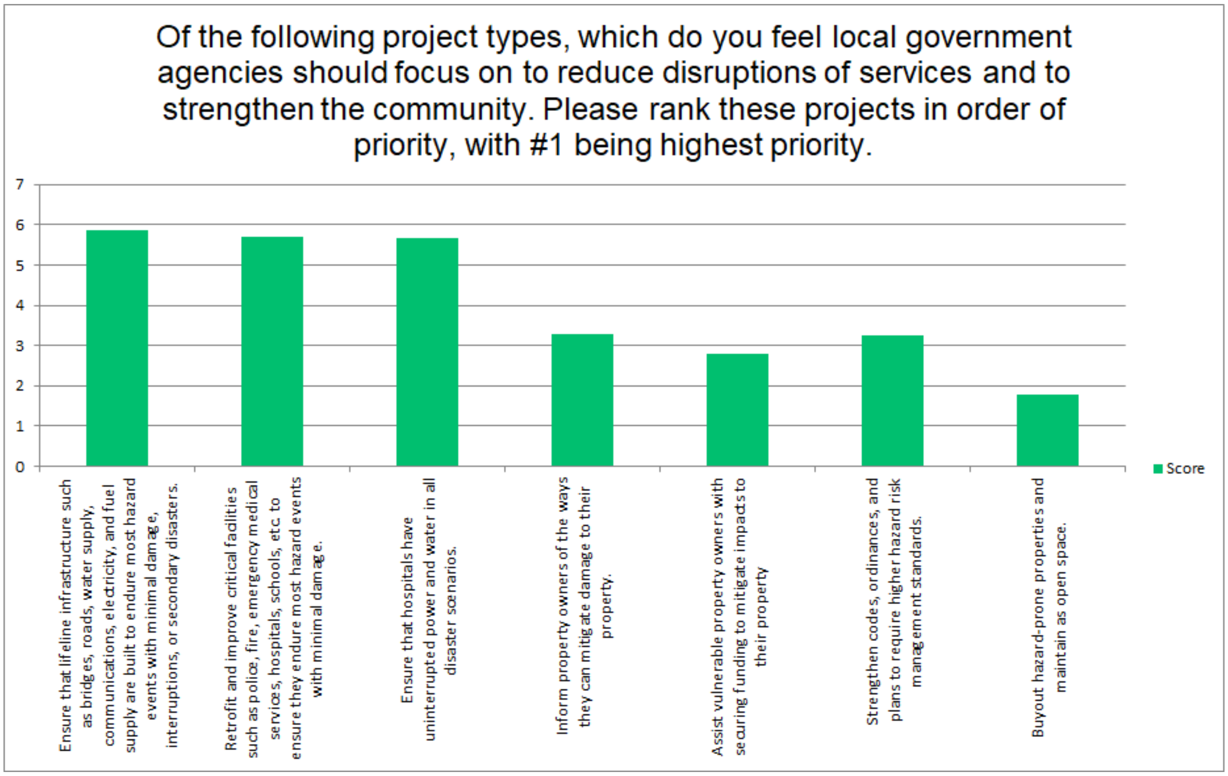
Question 23: Are you concerned about a Winter Storm affecting your home, family, or livelihood?



Question 23: Winter Storm Concerns		
Answer Choices	*Responses*	
Yes	47.18%	142

Question 23: Winter Storm Concerns		
Answer Choices	*Responses*	
No	45.51%	137
Unsure	7.31%	22
	Answered	301
	Skipped	89

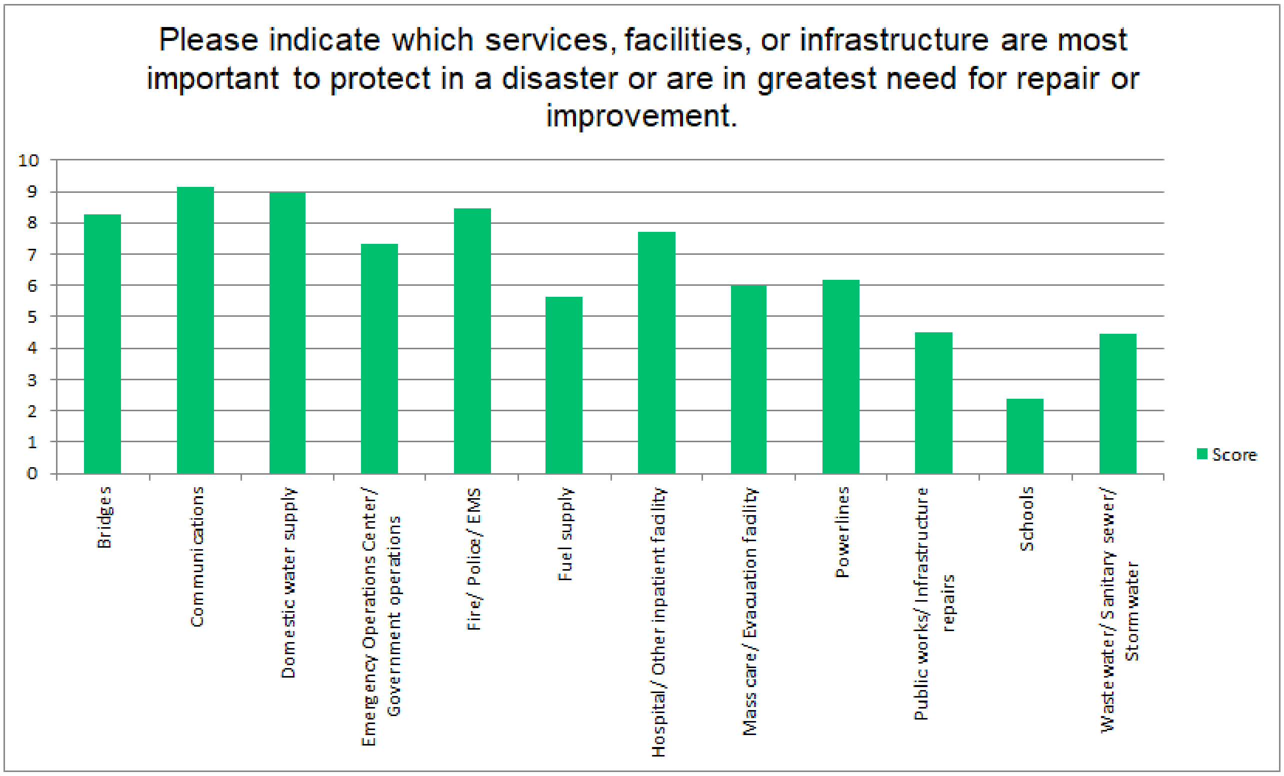
Question 24: Of the following project types, which do you feel local government agencies should focus on to reduce disruptions of services and to strengthen the community. Please rank these projects in order of priority, with #1 being highest priority.



Top Government Priority Projects:

4. Ensure that lifeline infrastructures such as bridges, roads, water supply, communications, electricity, and fuel supply are built to endure most hazard events with minimal damage, interruptions, or secondary disasters.
5. Retrofit and improve critical facilities such as police, fire, emergency medical services, hospitals, schools, etc. to ensure they endure most hazard events with minimal damage.
6. Ensure that hospitals have uninterrupted power and water in all disaster scenarios.

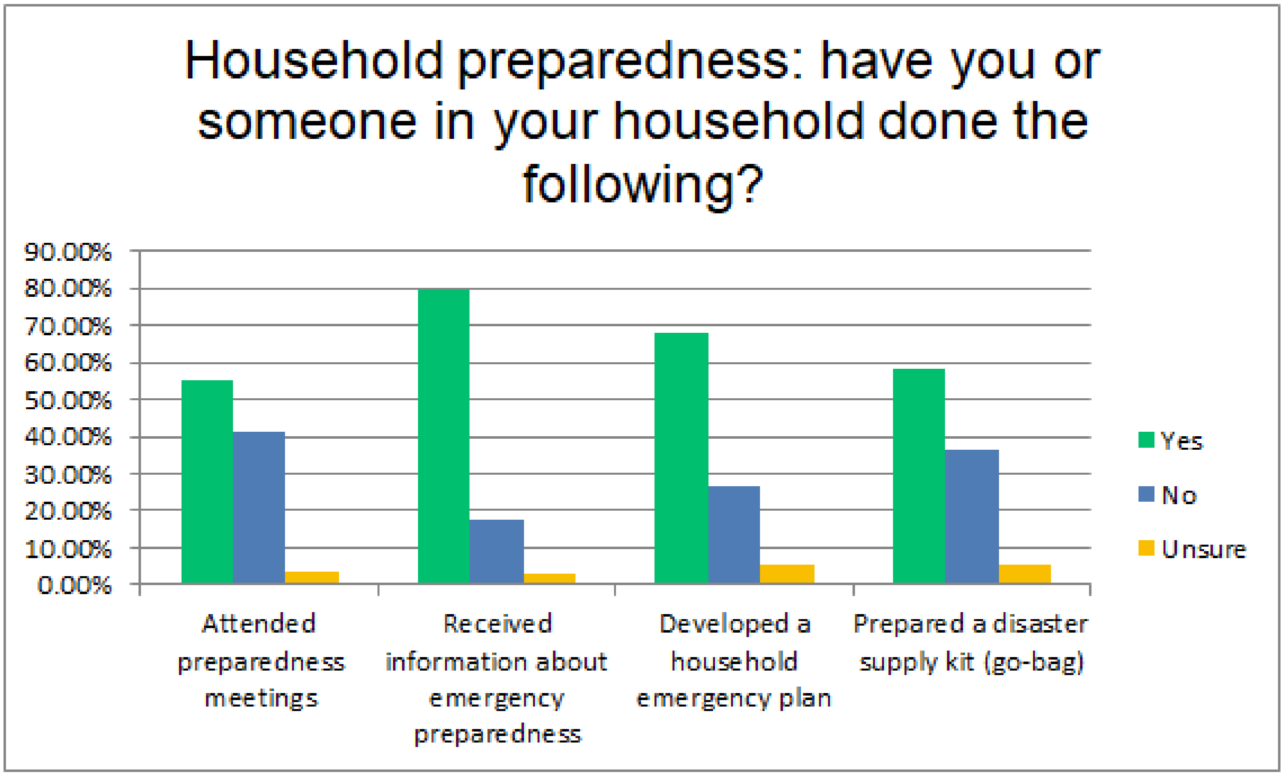
Question 25: Please indicate which services, facilities, or infrastructure are most important to protect in a disaster or are in greatest need for repair or improvement. The information you provide will help to shape plan priorities. Please rank these projects in order of priority, with #1 being highest priority.



Priority Infrastructure Protection/ Disaster Need:

7. Communications
8. Domestic water supply
9. Fire/ Police/ EMS
10. Emergency Operations Center/ Government operations
11. Bridges
12. Hospital/Other inpatient facility

Question 26: Household preparedness: have you or someone in your household done the following?



Question 26: Household Preparedness						
Answer Choices	*Yes*		*No*		*Unsure*	
Attended preparedness meetings	55.22%	164	41.08%	122	3.70%	11
Received information about emergency preparedness	79.46%	236	17.51%	52	3.03%	9
Developed a household emergency plan	67.80%	200	26.78%	79	5.42%	16
Prepared a disaster supply kit (go-bag)	58.45%	173	36.15%	107	5.41%	16
					Answered	297
					Skipped	93

Question 27: Do you have any additional concerns or comments about hazards in your community? Please share them in the space below.

General Open-Ended Responses

General Open-Ended Response Comments Do you have any additional concerns or comments about hazards in your community?			
#	Commenter	Comment	Response
1	Avery Horton, Bandon	Local officials are not prioritizing emergency preparedness.	Thank you for sharing your perspective.
2	Anonymous, Bandon	Gorse is highly flammable. It needs to be removed.	Absolutely, gorse is a priority. It is included in the Wildfire Hazard Chapter and the Mitigation Strategy.
3	Anonymous, Bandon	Evacuation issues w bridges out, flooding, isolated small oceanside towns like Bandon	Thank you. Your perspective provides helpful insight on the importance of evacuation planning for this plan update.
4	Anonymous, Bandon	Our outdoor public speakers for emergency are intelligible. The music is fine, the words are gibberish even standing near them.	Thank you. This suggestion is underway as a mitigation action.
5	Anonymous, Bandon	The spread of fires due to the ever increasing gorse growth that appears out of control in Bandon.	Absolutely, gorse is a priority. It is included in the Wildfire Hazard Chapter and the Mitigation Strategy.
6	Anonymous, Bandon	The homeless and drugs that have destroyed neighborhoods and families.	Thank you for sharing your perspective. These issues are beyond the scope of this natural hazard mitigation plan.
7	Anonymous, Bandon	Gorse and the fire danger it causes. Seems to be overtaking many areas around Bandon. A fire would be hotter and faster with so much of it	Absolutely, we agree that gorse is a priority. It is included in the Wildfire Hazard Chapter and the Mitigation Strategy.
8	Anonymous, Bandon	Thank you for this opportunity.	Thank you for sharing your perspective.
9	Anonymous, Bandon	Worried about explosions from propane tanks in the neighborhood. These could level the town and burn the remaining area	Absolutely, we agree that addressing fuel sources in advance of an earthquake is a priority. It is included in the Earthquake Hazard Chapter and the City of Bandon Mitigation Action Items.
10	Anonymous, Bandon	The threat of fire from the huge amount of gorse that is within and surrounding Bandon City and outlying neighborhoods poses a significant threat and is of real concern for us, given the town has burned down twice. More needs to be done to eradicate gorse from open space as well as private property, especially properties out off of Rosa Road and that general vicinity.	Absolutely, we agree that gorse is a priority. It is included in the Wildfire Hazard Chapter and the Mitigation Strategy. Fire preparedness is advised, please see this link for ideas: https://www.co.coos.or.us/sites/default/files/fileattachments/sheriff039s_office/page/13791/home_fire_preparedness_and_considerations.pdf

General Open-Ended Response Comments Do you have any additional concerns or comments about hazards in your community?			
#	Commenter	Comment	Response
11	Anonymous, Bandon	Drought conditions plus unchecked gorse infestation puts fire risk at the top of my list. Elderly, low income and other rural property owners need help to reduce fuel loads on the land, they don't need fines and penalties heaped on them for a problem which has arisen from circumstances beyond reasonable control.	Absolutely, gorse is a priority. It is included in the Wildfire Hazard Chapter and the Mitigation Strategy. Thank you for sharing your perspective on fines and penalties, your input helps us to prioritize supporting local homeowners in their gorse management in this plan update.
13	Anonymous, Bandon	During Cascadian My home may survive as not in Tsunami area. I am concerned how long I could be trapped here. Are we harnessing wind energy for emergencies	See this link for preparedness information: www.ready.gov/kit See the Coos County Emergency Management booklet entitled "Are you Ready? Preparing for Disasters and Terrorism in Coos County" available at: https://www.co.coos.or.us/sheriff/page/are-you-ready-booklet
14	Jacob Rosenberg, Bunker Hill/ Millington/ Green Acres	We need a diversified backup communications system in the County.	Thank you. Your perspective provides insight on emergency communications in this plan update. Coos County Amateur Radio (ARES) is an active component of emergency preparedness and a backup to existing capabilities.
15	Kathleen Hornstuen, Charleston	I like the idea of a full-time emergency coordinator in the sheriff's office who will have meetings with all parties that would be involved in a disaster on a regular basis so our county is prepared if and when it happens here.	Thank you for sharing your perspective.
16	Jan Hodder, Charleston	I am concerned about additional developments on the North Spit. This is an area that will be completely inundated in a Cascadia earthquake/tsunmai event. There is only one exit from the spit over a bridge that likely will be impassable. It will be impossible for any workers to evacuate the area. I am also concerned about our lack of planning for sea level rise. One only has to drive Hwy 101 during a storm high tide to see that the level of the bay is already higher than the road and railway.	Thank you for sharing your perspective. Your input helps to prioritize evacuation and sea level rise in this plan update.

General Open-Ended Response Comments Do you have any additional concerns or comments about hazards in your community?			
#	Commenter	Comment	Response
17	Mike Graybill, Charleston	I am concerned about government agencies such as the port recruiting businesses and industries that if sited in our communities will only make a disaster/emergency worse. The Japan Earthquake and Tsunami emergency was made even worse because a nuclear power plant was sited in a risk zone. The seismic incident resulted in a meltdown emergency at the power plant releasing radiation and requiring emergency personnel to orchestrate an evacuation of 80,000 people in addition to the search and rescue efforts necessitated by the earthquake and tsunami. In our community the port authority is recruiting and promoting industries like LNG and fuel tank farms that if constructed, will only intensify the risk to our local population posed by a seismic event.	Thank you for sharing your perspective.
18	Tina, Charleston	Escape routes out of Barview	Thank you. Tsunami information is available on DOGAMI evacuation maps or http://nvs.nanoos.org/TsunamiEvac
19	Bob Pedro, Charleston	The loss of the Crown Point Bridge will create an "Island" of people without emergency services available. Our fire station is usually staffed with an intern and the ONE and only fire hydrant on Crown Point Rd. is about 100 yards North from the station toward the bridge and perhaps 1/4 mi from the bridge. It's a long way to the end of Crown Point Rd.	Thank you. Your concern is being taken into consideration for its mitigation and preparation recommendations.

General Open-Ended Response Comments Do you have any additional concerns or comments about hazards in your community?			
#	Commenter	Comment	Response
20	Kathleen Hornstuen, Charleston	Offer low cost first aid classes to give people confidence in an emergency. A county wide disaster education booklet to keep with a go-kit.	Thank you for sharing your perspective—personal preparedness is very important. See this link for more information: www.ready.gov/kit See the Coos County Emergency Management booklet entitled "Are you Ready? Preparing for Disasters and Terrorism in Coos County" available at: https://www.co.coos.or.us/sheriff/page/are-you-ready-booklet
21	Anonymous, Charleston	People should be somewhat prepared for any disaster but not live in fear and not be relying on the government to save them.	Thank you for sharing your perspective—personal preparedness is very important. See this link for more information: www.ready.gov/kit
22	Anonymous, Charleston	Open fires on properties without homeowners insurance. Around me.	Thank you for sharing your perspective. During time of a fire ban, fires should be reported to authorities or to the Coos Forest Protective Association (CFPA).
23	Anonymous, Charleston	Lack of lighting in dark and rainy conditions impacting visibility of pedestrians who cross roads at places other than crosswalks creating hazards for drivers	Thank you for sharing your perspective.
24	Anonymous, Coos Bay	Clean water in the case of emergencies.	See this link for preparedness information: www.ready.gov/kit See the Coos County Emergency Management booklet entitled "Are you Ready? Preparing for Disasters and Terrorism in Coos County" available at: https://www.co.coos.or.us/sheriff/page/are-you-ready-booklet
25	Moffitt, Coos Bay	Difficult to prioritize these as they are all related. We need more infrastructure support for sure.	Thank you for sharing your perspective. Infrastructure concerns and planning are ongoing and prioritized.

General Open-Ended Response Comments Do you have any additional concerns or comments about hazards in your community?			
#	Commenter	Comment	Response
26	Anonymous, Coos Bay	We waste by looking at worst cases. Our down town has vacant upper floors of buildings, that with deterioration create a serious hazard. If allowed, they could have less of a risk, but are not economical to bring to highest disaster risk standards. Regulation-overly so is adding to evacuation and safety issues. Schools brought to higher level offer disaster centers for emergencies, and they should be looked at for such purposes. A reserve medical corps of retired medical and trained emergency people would be helpful if organized and trained to how to respond in emergencies. this would also be true for command centers.	Thank you for sharing your perspective. Please see the below link for information regarding the Medical Readiness Corps, which is a function of Coos Health and Wellness. https://www.phe.gov/mrc/Pages/default.aspx
27	Anonymous, Coos Bay	The greatest hazard to our community is homelessness and crime. Beyond that, the ability to effectively and safely evacuate during an emergency.	Thank you for your response. Tsunami information is available on DOGAMI evacuation maps or http://nvs.nanoos.org/TsunamiEvac
28	James M Behrends, Coos Bay	Police are under staffed both city and county	Thank you for sharing your perspective—personal preparedness is very important. See this link for more information: www.ready.gov/kit
29	Joseph Metzler, Coos Bay	Earthquake, tsunami, forest fire.	Thank you for sharing your perspective. Fire preparedness is advised, please see this link for ideas: https://www.co.coos.or.us/sites/default/files/fileattachments/sheriff039s_office/page/13791/home_fire_preparedness_and_considerations.pdf

General Open-Ended Response Comments Do you have any additional concerns or comments about hazards in your community?			
#	Commenter	Comment	Response
30	James Fritz, Coos Bay	Subsidence of the land. Seismic uplift has pushed us 6 feet higher than normal. When a subduction zone quake occurs. We will drop 6 feet or more. The new sea level will submerge roads, bridges and downtown Coos Bay at high tide. Daily. They didn't call it Marshfield for nothing.	Thank you for sharing your perspective.
30	Anonymous, Coos Bay	Comment about mutual aid, 911, and budgets. GOOD JOB! Not letting them take the Coast Guard Stations away along the coast so one unit spread too thin!	Thank you for sharing your perspective.
31	Anonymous, Coos Bay	The roads are a major hazard. Cars swerve into other lane to avoid tire damaging holes. Libby. Wilshire 4th. There are many more.	Thank you for sharing your perspective.
32	Anonymous, Coos Bay	We (Coos County) will not be a priority like the metropolitan areas with in this state.	Thank you for sharing your perspective.
33	Anonymous, Coos Bay	Protection from looting in a natural disaster if home has to be left for an extended time.	Thank you for sharing your perspective.
34	Donna, Coos Bay	Maybe more Community Info needed. I just moved here & was unaware there is a Tsunami danger!	Thank you for sharing your perspective. Tsunami information is available on DOGAMI evacuation maps (subject to change) or http://nvs.nanoos.org/TsunamiEvac Please see the Coos County Emergency Management booklet entitled "Are you Ready? Preparing for Disasters and Terrorism in Coos County" available at: https://www.co.coos.or.us/sheriff/page/are-you-ready-booklet
35	Anonymous, Coos Bay	Mainly fire	Thank you for sharing your perspective. Fire preparedness is advised, please see this link for ideas: https://www.co.coos.or.us/sites/default/files/fileattachments/sheriff039s_office/page/13791/home_fire_preparedness_and_considerations.pdf

General Open-Ended Response Comments Do you have any additional concerns or comments about hazards in your community?			
#	Commenter	Comment	Response
36	Anonymous, Coos Bay	clean water in the case of emergencies.	Thank you. This suggestion is being considered as a preparedness action.
37	James Fox, Coquille	Alternate evacuation routes. Places to assemble to deal with disaster.	Thank you. This suggestion is being considered as a preparedness action. Evacuation information is available on DOGAMI evacuation maps (subject to change) or http://nvs.nanoos.org/TsunamiEvac
38	Coos County CERT and SERV OR member, Coquille	People have no clue how bad it will really be in the Coos County area in the event of a mass disaster such as a quake caused by the subduction zone.	Thank you for sharing your perspective and your service.
39	Ken Smith, Coquille	Neighbors help each other as much as possible . . . deny the attitude, "Every man for himself"	Thank you for sharing your perspective.
40	Anonymous, Coquille	Communication and policies between county, cities and emergency services to be structured and more at the top of the list of priorities.	Thank you. This suggestion is underway/ ongoing as a mitigation action.
41	Anonymous, Coquille	Stabilization of emergency response team buildings should be priority as well as road systems to be able to help victims quickly.	Thank you for sharing your perspective.
42	Anonymous, Coquille	Landslides are a concern!	Thank you for sharing your perspective. You may find the Statewide Landslide Information Layer for Oregon to be useful.: https://www.oregongeology.org/slido/
43	Anonymous, Coquille	I work in Coos Bay so the bridges are very important in many ways for me, first to get home but for everyone else for food, water, other agencies help like more power workers etc to get in to Coos Bay to help with everything.	Thank you for sharing your perspective. Bridges are an ongoing mitigation effort.
44	Martin Heldt, Eastside	The housing shortage	Thank you for sharing your perspective.

General Open-Ended Response Comments Do you have any additional concerns or comments about hazards in your community?			
#	Commenter	Comment	Response
45	Anonymous, Eastside	The trash burning and the terrible response from local law enforcement have been enough to make me consider moving but I am handicap and it is not so easy for me to do so. Regular home owners are suffering everyday because of these stone age allowances. And the local police department... I have no faith in there ability to protect me. After a man drove into my home destroying my property and nearly hitting my son with his vehicle. The local PD did nothing. It took them 6 weeks to look at the vehicle that hit my home. I called the 13 times during that period. When I stepped up to speak to someone in charge the reposene I got was disgusting! I am now afraid to complain further as I am now concerned for my and my family safety.	Thank you for sharing your perspective.
46	Anonymous, Eastside	Landslides & Powerlines	Thank you for sharing your perspective. You may find the Statewide Landslide Information Layer for Oregon to be useful.: https://www.oregongeology.org/slido/
47	LB, Eastside	The services hierarchy difficult to rank	Thank you for sharing your perspective.
48	Anonymous, Eastside	do not approve any more Jordan Cove LNG permits	Thank you for sharing your perspective.
49	Rebecca Benson, Empire/Coquille Tribal lands	I don't feel that this community takes the Cascadia Subduction zone quake and tsunami seriously enough. It is going to happen and every day that goes by, it gets closer. How we fare as a community will depend on how well we prepare.	Thank you for sharing your perspective—personal preparedness is very important. See this link for more information: www.ready.gov/kit
50	Anonymous, Empire/Coquille Tribal lands	The Corrupt city counsel and mayor should Resign immediately in order that Further Infringements on Our Natural Rights do NOT continue.	Thank you for sharing your perspective.
51	Anonymous, Empire/Coquille Tribal lands	All the options in # 18 are equally important.	Thank you for sharing your perspective.

General Open-Ended Response Comments Do you have any additional concerns or comments about hazards in your community?			
#	Commenter	Comment	Response
52	Kristen Laird, Empire/Coquille Tribal lands	Need more public knowledge about when and where meetings are and how to become involved … Implement remote ways to be active and participate in preparation meetings	Thank you for sharing your perspective. One of the goals of the NHMP is to improve education and outreach. We will incorporate broader outreach to the community including these actions.
53	Karin Kenney, Empire/Coquille Tribal lands	I live in a mobile home park and it is circular. There is only one entrance/exit. I worry about any disaster striking (especially wildfires) and fear we wouldn't be able to get out.	Thank you for sharing your perspective.
54	Kat Burgess, MRC, CERT, Empire/Coquille Tribal lands	Get the evacuation map corrected! You show Wallace to Libby Road for people in my area. WALLACE DOES NOT GO THROUGH TO LIBBY! The road from Travis to Libby is IMPASSABLE! Your mistake will get people KILLED!	Thank you for sharing your perspective. The map has been updated. Please use the DOGAMI Nanoos website: http://nvs.nanoos.org/TsunamiEvac
55	Anonymous, Empire/Coquille Tribal lands	Fire hazards, especially on tribal lands and the coos watershed, and transient camps/activities.	Thank you for sharing your perspective.
56	Anonymous, Lakeside	because we do get a lot of rain, we let down our guard as it relates to "defendable space". There is a lot of old, dry vegetation everywhere.	Thank you for sharing your perspective.
57	Karen L Crouch, Lakeside	Lakeside has no ordinance enforcement allowing dangerous situations to persist.	Thank you for sharing your perspective.
58	Anonymous, Lakeside	Hazard codes in Lakeside are not enforced. This makes me feel unsafe	Thank you for sharing your perspective. Regulations are an area of mitigation action under consideration.
59	Anonymous, Lakeside	There needs to be more attention to this matter	Thank you for sharing your perspective.
60	Anonymous, Myrtle Point	Our biggest hazard is __ druggies who will rob the people who are prepared. Clean them out of our town.	Thank you for sharing your perspective.
61	Anonymous, Myrtle Point	I live in Bridge and we are pretty much on our own out here.	Thank you for sharing your perspective.
62	Jill Rolfe, Myrtle Point	Funding is needed to complete preparedness	Thank you for sharing your perspective.

General Open-Ended Response Comments Do you have any additional concerns or comments about hazards in your community?			
#	Commenter	Comment	Response
63	Donna, Myrtle Point	I'm just worried on the off chance of a disaster that I and my community will not be properly prepared.	Thank you for sharing your perspective. Coos County Emergency Management distributes this booklet: https://www.co.coos.or.us/sheriff/page/are-you-ready-booklet or see this link for more information: www.ready.gov/kit
64	Anonymous, Myrtle Point	The big earthquake and tsunami terrifies me, but the wildfires are even more likely and scary. I'd move if I could, but we really can't afford to. I just get ready to evacuate every fire season and spend weeks in the summer terrified and on edge. What can we do about the drought conditions turning us into a matchbox every summer?	See www.drought.gov for more information. Please see this Coos County Emergency Management booklet: https://www.co.coos.or.us/sheriff/page/are-you-ready-booklet or see this link for more information: www.ready.gov/kit
65	Anonymous, North Bend	so many parts of the community are isolated if bridges go down, or there is massive flooding	Thank you for sharing your perspective.
66	Anonymous, North Bend	flooding out Kentuck has been worse and worse over the last few years and other farm owners are adding dirt around the creek without permits or permission making it worse. There needs to be better regulation for what you can do to a creek like Kentuck and Metman and then better implementation of those regulations.	Thank you. Regulations are an area of mitigation action under consideration.
67	Anonymous, North Bend	…with all money going to just live many people cannot afford to maintain homes and property.	Thank you for sharing your perspective.
68	Anonymous, North Bend	The flooding in Haynes Inlet could cause road and driveway and bridge failures - endangering lives.	Thank you. This suggestion is being considered as a mitigation action.
69	Liz , North Bend	Infrastructure of roads	Thank you. This suggestion is being considered as a mitigation action.
70	Anonymous, North Bend	No LNG	Thank you for sharing your perspective.

General Open-Ended Response Comments Do you have any additional concerns or comments about hazards in your community?			
#	Commenter	Comment	Response
71	Matthew Hays	Liquefaction is a slight concern in case of a large earthquake, but nothing to be done.	Thank you for sharing your perspective.
72	Anonymous, North Bend	People not taking care of brush on their properties	Thank you for sharing your perspective.
73	Pam, North Bend	Traffic in and out of the city	Thank you for sharing your perspective. Evacuation planning is a mitigation action.
74	Steve Jansen, North Bend	Sadly, with a major (earthquake, flood, Tsunami, etc) when things go, they'll ALL go at once. With the NB bridge out, all the fuel inbound fuel, food supplies, medical care will not arrive. Anything strong enough to take out that single point of failure will certainly cause smaller structures and roadways to slide/wash out/fail. The same chain of failures will easily take out power and water distribution. Does PP&L and other power companies have a public plan for citizen review? Ditto for ODOT?	Thank you for sharing your perspective—personal preparedness is very important. See this link for more information: www.ready.gov/kit Coordination with state and regional agencies on seismic upgrades for roads is an ongoing mitigation action, and to a lesser degree power and water resilience is as well.

General Open-Ended Response Comments Do you have any additional concerns or comments about hazards in your community?			
#	Commenter	Comment	Response
75	Anonymous, North Bend	Today my biggest concerns are fire, future pandemics, drought, earthquake- we have done what we can at this point to prepare for earthquake, we did our best during the current pandemic to stay safe but felt our local medical support system (doctors, clinics, public health dept) was woefully ill-prepared and public communication was inadequate. We are most concerned, at this point, about our county and region going up in flames due to the extreme fire danger we are facing this summer, and throughout the West. We have seen little preparation for fire prevention in North Bend and there is throughout the city, overgrown brush, trees, and grasses, in fact, throughout the county. We have three exits out of North Bend, North 101, South 101, and Hwy 42 East. Where do we go and how do we escape a raging fire? These are concerns our state representatives, county commissioners, and local governments need to address quickly and get the information out there to the public, ASAP. Our neighbors escaped the fires in Vida by the skin of their teeth, and their home and belongings burned to the ground. My brother-in-law in Santa Rosa has been evacuated several times from his home in the last four years, and promptly damage around him has been severe. The Paradise Fire scenario is a nightmare event that could easily happen in our county, and citizens in our region need to know what to do, how to prepare, how to prevent (if possible), and how to live with the extreme fire dangers of our region.	Thank you for sharing your perspective—personal preparedness is very important. See this link for more information: www.ready.gov/kit Coos County Emergency Management distributes this booklet: https://www.co.coos.or.us/sheriff/page/are-you-ready-booklet

General Open-Ended Response Comments Do you have any additional concerns or comments about hazards in your community?			
#	Commenter	Comment	Response
76	Anonymous, North Bend	Emphasizing personal preparedness is essential, especially encouraging people to be armed. The government or agencies cannot possibly help everyone in a major emergency and should not be expected to. Neighbors should be expected to help each other.	Thank you for sharing your perspective—personal preparedness is very important. See this link for more information: www.ready.gov/kit Coos County Emergency Management distributes this booklet: https://www.co.coos.or.us/sheriff/page/are-you-ready-booklet
77	Anonymous, North Bend	I can be pretty self-sufficient if a incident happens when I'm home, it's a whole different scenario if I'm in town. So it's kind of hard to answer some of the questions, I would answer them differently in different location.	Thank you for sharing your perspective.
78	Anonymous, North Bend	need emergency desalination equipment.	Thank you. This suggestion is an ongoing preparedness action.
79	Anonymous, North Bend	Making sure that supplies and relief can come as for the most part we are surrounded by water and bridges that in most events will become at least structurally unsound in most events.	Thank you for sharing your perspective—personal preparedness is very important. See this link for more information: www.ready.gov/kit Coos County Emergency Management distributes this booklet: https://www.co.coos.or.us/sheriff/page/are-you-ready-booklet
80	Anonymous, North Bend	Instead of building and beautifying Front street we need better flooding management	Thank you for sharing your perspective.
81	Anna Banana, North Bend	Next time you do one of these polls separate police from other emergency workers!! If my house is on fire, I need a FIREMAN, not a cop.	Thank you for sharing your perspective.
82	Anonymous, North Bend	Spouse has COPD with great breathing difficulty. Need power source for nebulizer.	Thank you for sharing your perspective.
83	Elaine, North Bend	Hazards I worry about most are the speed limits in north bend keep going up and the roads suffer so much for the speeding and heavy trucks that cause my house to rattle and shake at all hours of the day and night,	These issues are beyond the scope of this plan.

General Open-Ended Response Comments Do you have any additional concerns or comments about hazards in your community?			
#	Commenter	Comment	Response
84	Anonymous, North Bend	power companies using the new electronic meters that are LESS reliable in an emergency but gets backing from all levels of government.	These concerns are beyond the scope of this plan.
85	Julie, South Coos County (rural)	Communication to those who don't reach out	Thank you for sharing your perspective.
86	Craig, South Coos County (rural)	Getting home safely after an event... flooding, ciaos, trees down, fire.	Thank you for sharing your perspective.
87	Anonymous, South Coos County (rural)	Owners with Gorse fields not doing anything to mitigate them	Thank you for sharing your perspective. Regulations are an area of mitigation action under consideration.

Question 28: Provide your name if you would like it to appear with your comment.

	Answered	74
	Skipped	316

Question 29: Please provide your email if you would like to learn about future opportunities regarding hazards in Coos County.

	Answered	81
	Skipped	309

E. Plan Outreach

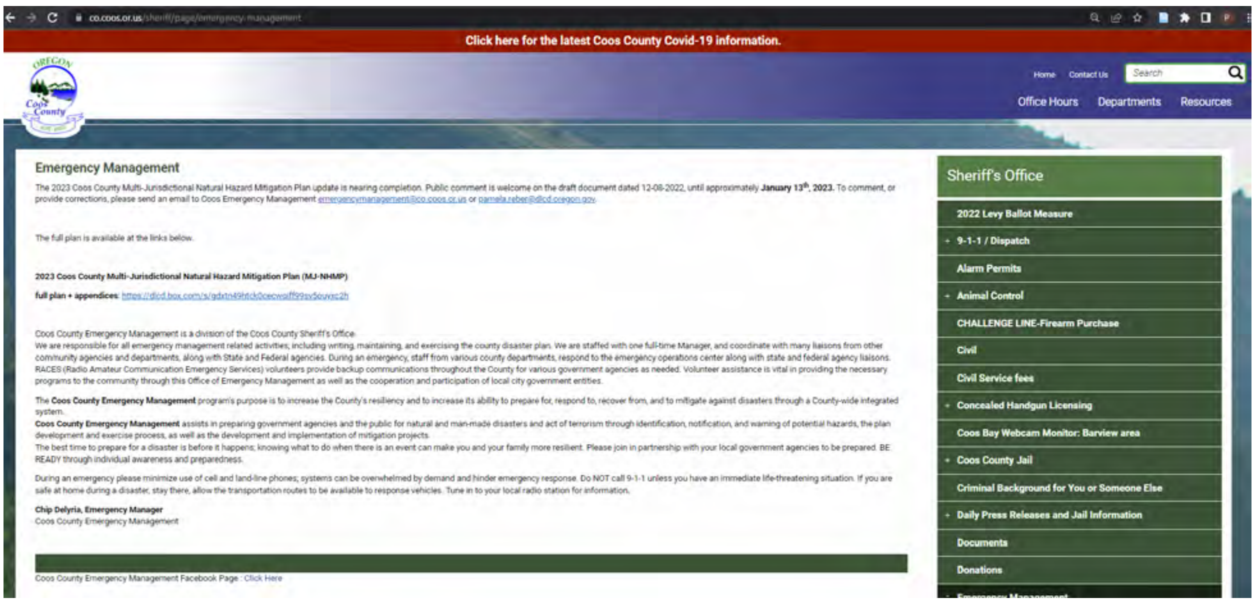
Project webpages, online and social media, public meetings, email lists, and outreach conducted for the Community Hazard Survey were the primary methods of outreach by Coos County, the seven cities, and the five special districts who joined the mitigation planning process. The pages that follow show examples and evidence of this outreach.

Project Webpage

The 2023 Coos County Multi-Jurisdictional Natural Hazard Mitigation Plan update webpage is available here:

https://www.co.coos.or.us/sheriff/page/natural-hazards-mitigation-plan

Figure III-2. Coos County NHMP Project Webpage 2022



Source: Coos County, 2022. Note: For the 2023 plan update, Coos County Emergency Management created a project webpage. The county has limited web management capacity, but several updates were made over the period of the project.

Figure III-3. Coos County Project Webpage 2021

Online & Social Media

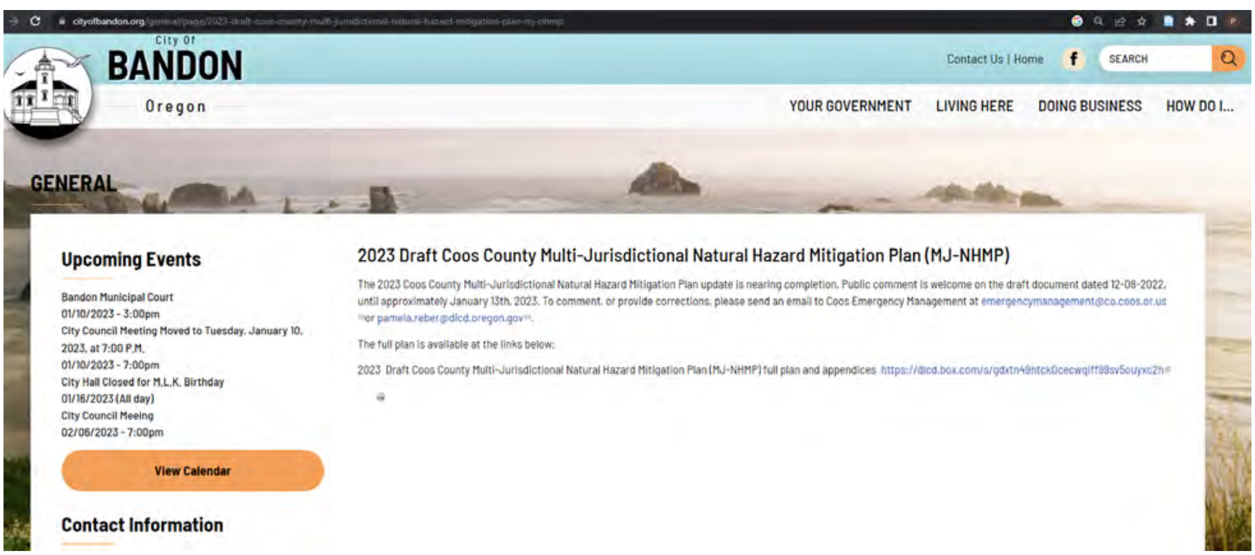
Figure III-4. Coos County Plan Review Outreach

Source: Coos County, 2022.

Figure III-5. Port of Bandon Plan Review Outreach

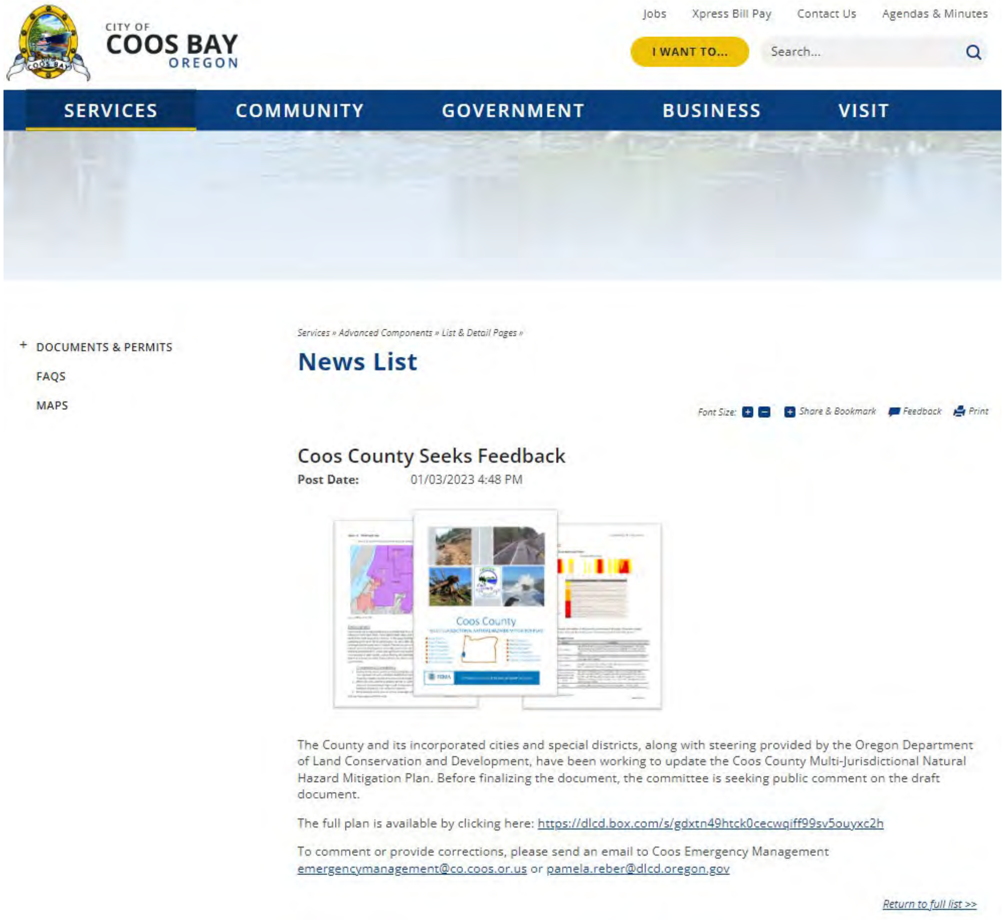
Source: Port of Bandon, 2022.

Figure III-6. Bandon Plan Review Outreach



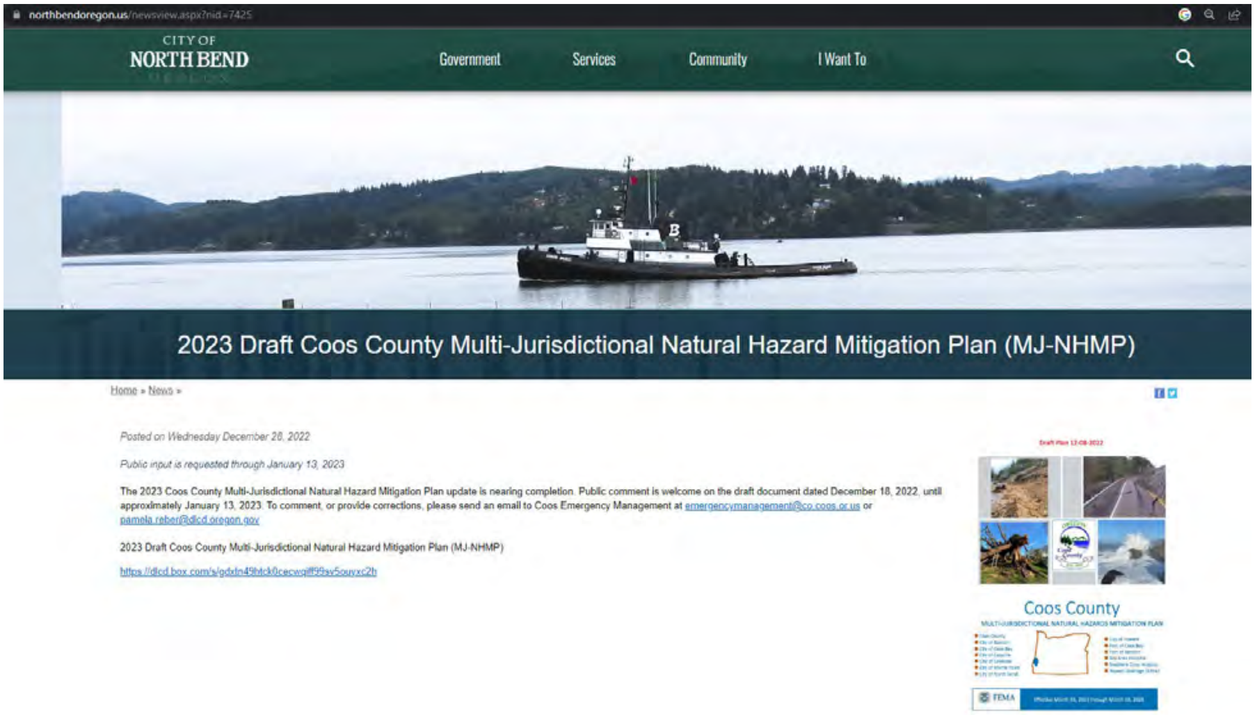
Source: City of Bandon, 2022.

Figure III-7. Coos Bay Plan Outreach



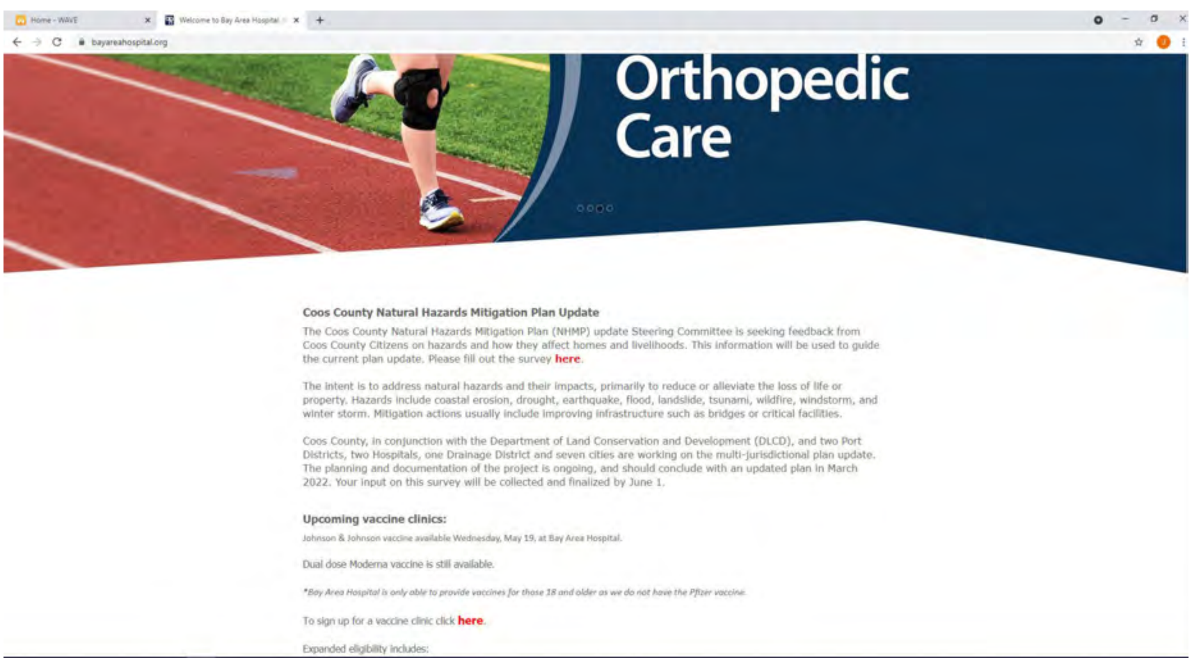
Source: City of Coos Bay, 2022.

Figure III-8. North Bend Plan Review Outreach



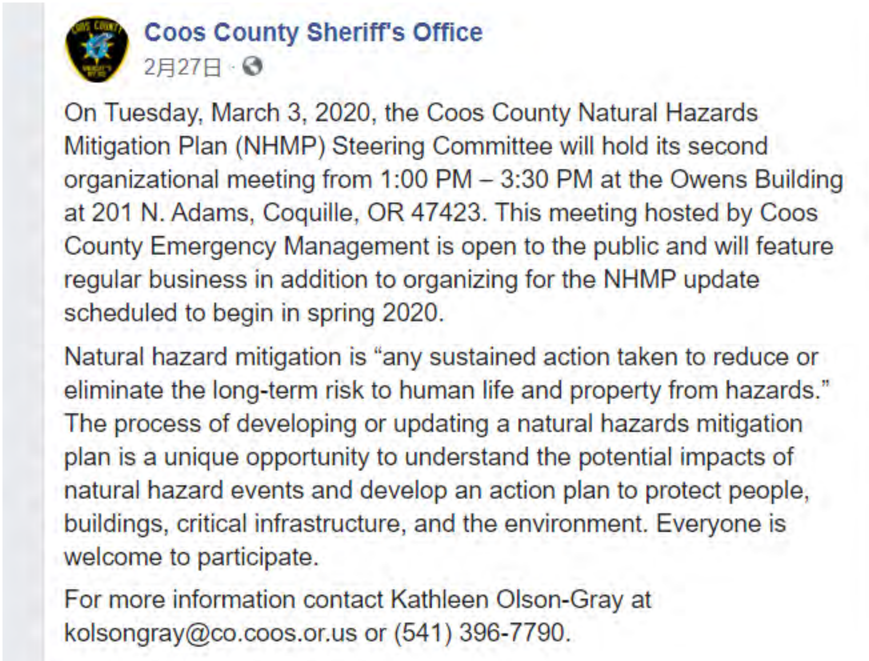
Source: City of North Bend, 2022.

Figure III-9. Bay Area Hospital NHMP webpage



Source: Bay Area Hospital, 2021.

Figure III-10. Public notice by Coos County for Steering Committee Meeting #2



Coos County Sheriff's Office

2月27日 ·

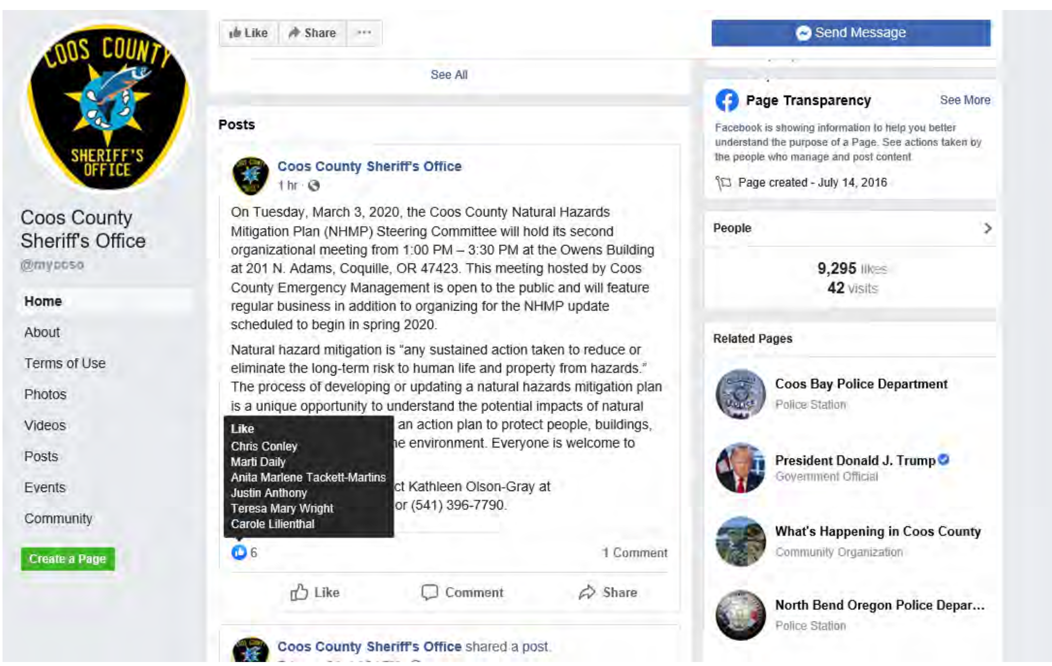
On Tuesday, March 3, 2020, the Coos County Natural Hazards Mitigation Plan (NHMP) Steering Committee will hold its second organizational meeting from 1:00 PM – 3:30 PM at the Owens Building at 201 N. Adams, Coquille, OR 47423. This meeting hosted by Coos County Emergency Management is open to the public and will feature regular business in addition to organizing for the NHMP update scheduled to begin in spring 2020.

Natural hazard mitigation is "any sustained action taken to reduce or eliminate the long-term risk to human life and property from hazards." The process of developing or updating a natural hazards mitigation plan is a unique opportunity to understand the potential impacts of natural hazard events and develop an action plan to protect people, buildings, critical infrastructure, and the environment. Everyone is welcome to participate.

For more information contact Kathleen Olson-Gray at kolsongray@co.coos.or.us or (541) 396-7790.

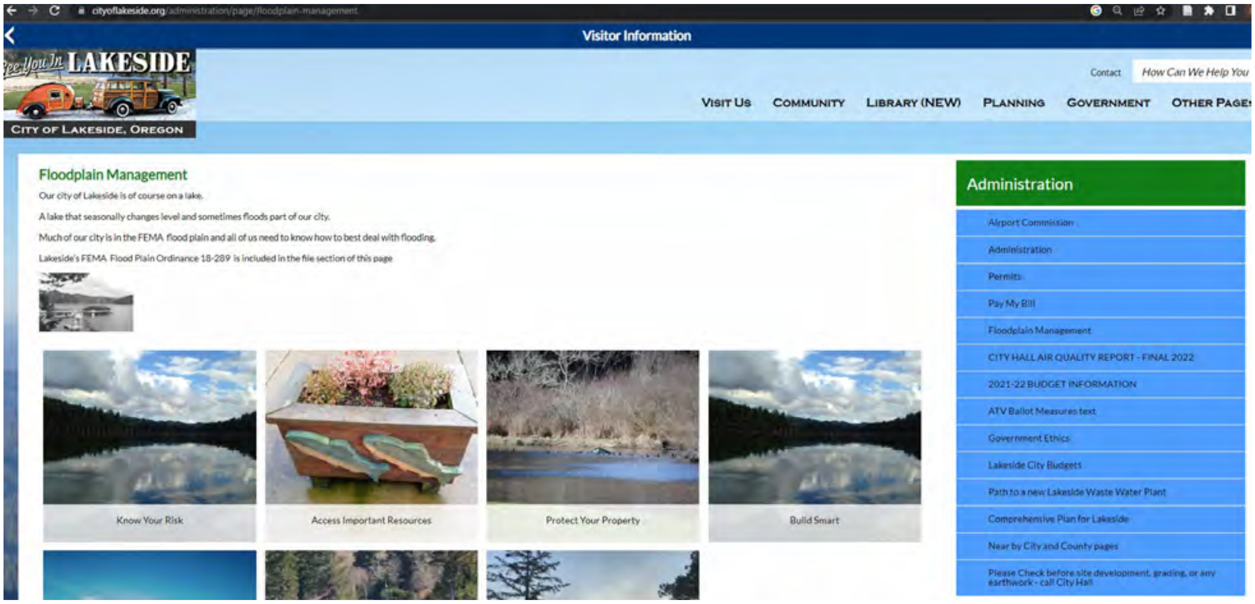
Source: Coos County, 2020.

Figure III-11. Social Media post by Coos County for Steering Committee Meeting #2



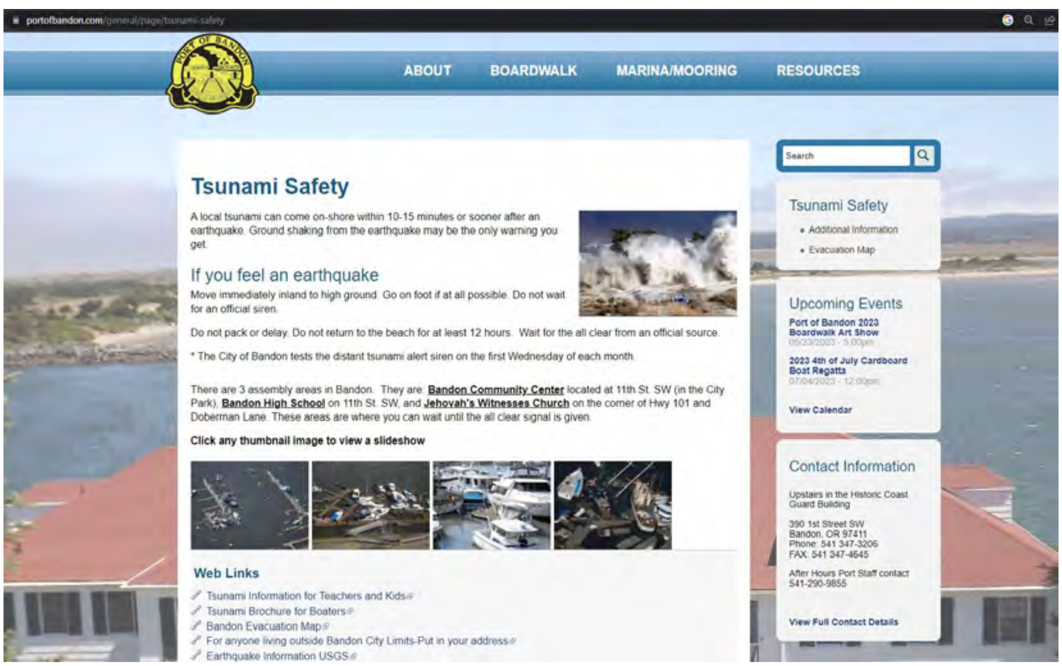
Source: Coos County, 2020

Figure III-12. City of Lakeside Floodplain Management Outreach



Source: City of Lakeside, 2022. https://www.cityoflakeside.org/administration/page/floodplain-management

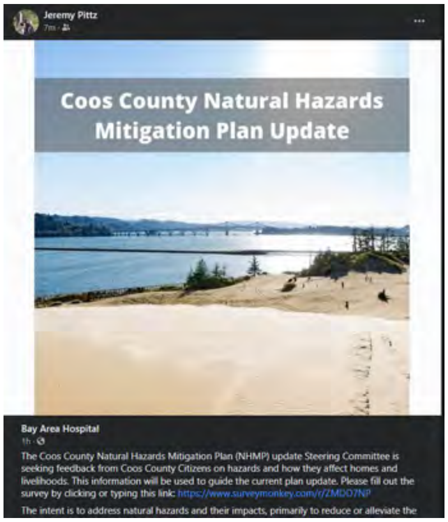
Figure III-13. Port of Bandon Tsunami Information



Source: Port of Bandon, 2022.

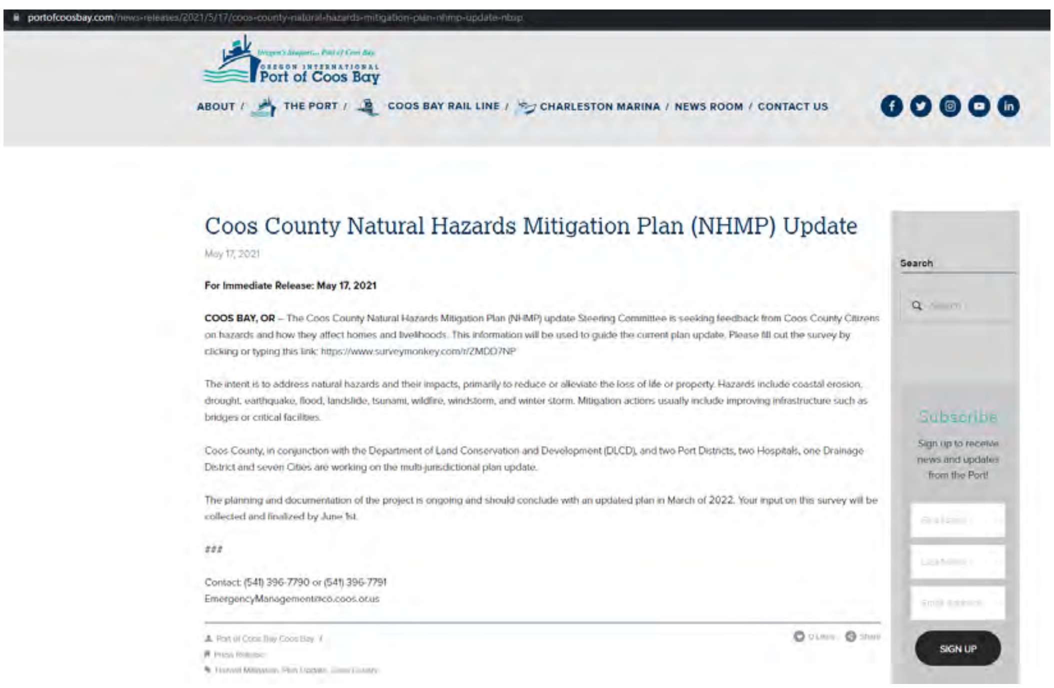
Survey Outreach

Figure III-14. Bay Area Hospital Social Media Post



Source: Bay Area Hospital, 2021

Figure III-15. Port of Coos Bay Survey Outreach



Source: Port of Coos Bay, 2021.

Figure III-16. City of Bandon Survey Outreach


Bandon Oregon

Search
Submit Search

Community | City Hall | Departments | Public Resources | Contact Us

Countywide Steering Committee requests your feedback through Community Hazards Survey!

Press Release Date:
Thursday, May 18, 2021

Coos County Natural Hazard Mitigation Plan

Coos County and the Cities of
Bandon, Coos Bay, Lakeside, North Bend and Powers

February, 2016 | Volume I: Basic Plan

PRESS RELEASE

Coos County Sheriff's Office

The Coos County Natural Hazards Mitigation Plan (NHMP) update Steering Committee is seeking feedback from Coos County Citizens on hazards and how they affect homes and livelihoods. This information will be used to guide the current plan update.

Please fill out the survey by clicking or typing this link:
https://www.surveymonkey.com/r/ZMDD7NP

The intent is to address natural hazards and their impacts, primarily to reduce or alleviate the loss of life or property. Hazards include coastal erosion, drought, earthquake, flood, landslide, tsunami, wildfire, windstorm, and winter storm. Mitigation actions usually include improving infrastructure such as bridges or critical facilities.

Coos County, in conjunction with the Department of Land Conservation and Development (DLCD), and two Port Districts, two Hospitals, one Drainage District and seven Cities are working on the multi-jurisdictional plan update. The planning and documentation of the project is ongoing, and should conclude with an updated plan in March of 2022. Your input on this survey will be collected and finalized by June 1st.

For more information about the current 2016 Coos County Natural Hazards Mitigation Plan and Bandon's involvement with this project please contact City Planner, Megan Lawrence in the Bandon Planning Department.

Supporting Documents

Press Release (48 KB)

Web Links

Hazard Survey

Directions

555 HWY 101
Bandon, OR 97411
See map: Google Maps

UPCOMING EVENTS

Planning Commission
05/27/2021 - 7:00pm
Holiday - Offices Closed
05/31/2021 (All day)
City Park Clean-up Day - Friday, June 4, 2021
06/04/2021 - 9:00am
City Council
06/07/2021 - 7:00pm

View Calendar

CONTACT INFORMATION

City Hall
Located South and up the Hill from Old Town
555 Highway 101
Bandon, OR 97411

Mailing address:
P.O. Box 67
Bandon, OR 97411

Office Hours:
Monday - Thursday
7:30 AM to 5 PM

Starting July 20, 2020, Office Hours:
Monday - Thursday
7:30 AM to 5 PM

View Full Contact Details

RESOURCE CENTER

Forms | Documents | News

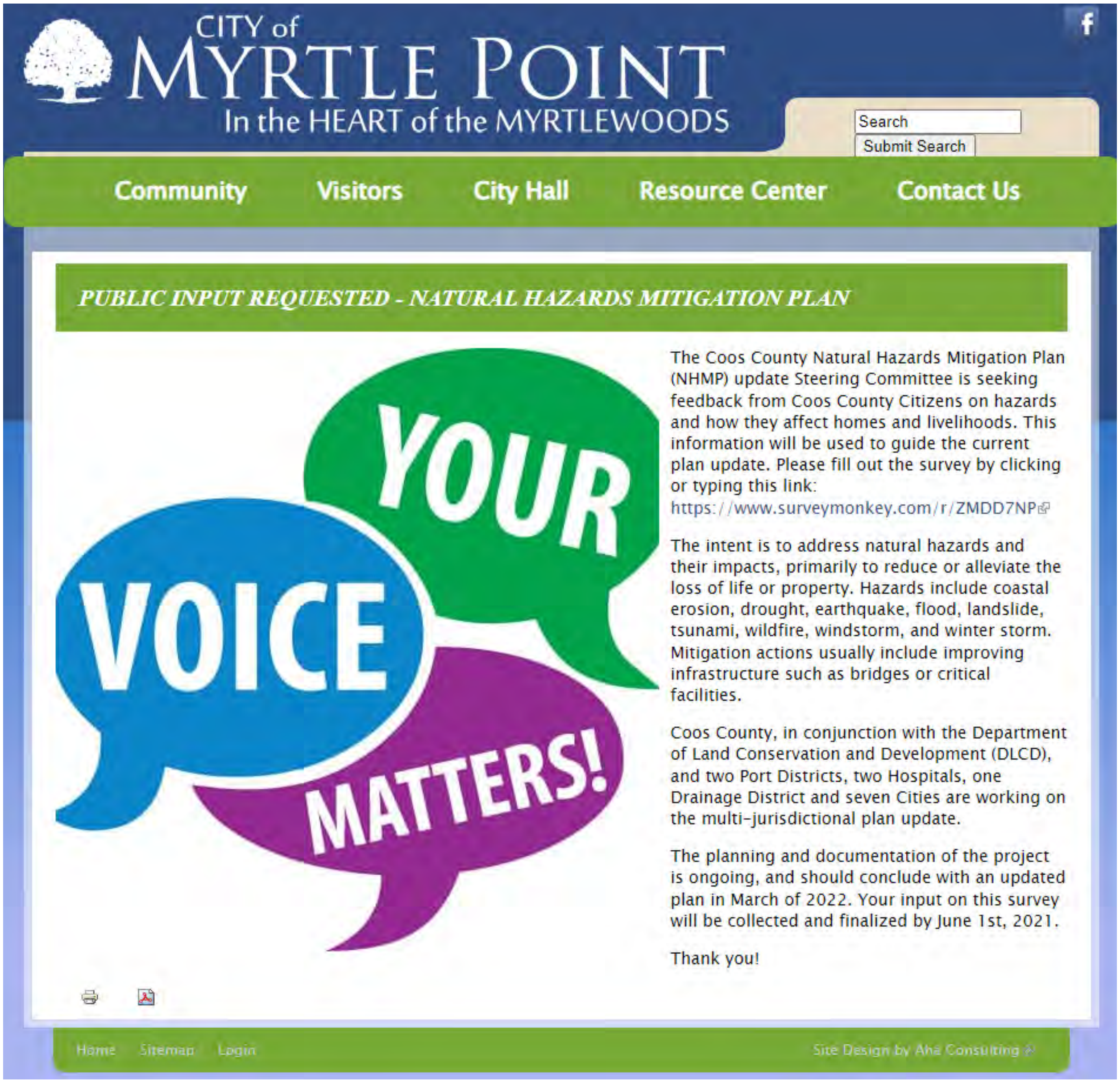
Application for Committee, Commission or Other Volunteer Position
Bandon Police Vacation House Check
City of Bandon COVID-19 Business Relief Application

View all Forms

Home | Sitemap | Staff Login | Mobile

Source: City of Bandon, 2021

Figure III-17. Myrtle Point Survey Outreach



City of Myrtle Point, 2022.

Public Meetings

Figure III-18. City of Coos Bay Webinar & Grant

City of Coos Bay

Webinars Regarding Oregon Coast's Rocky Shore Habitats

The City of Coos Bay has partnered with the Oregon Shores Conservation Coalition to prepare a series of webinars on key resources including eelgrass, saltmarshes, benthic communities, endangered species, and rocky intertidal habitats. These materials can also be adapted for school use at a later date. The first webinar is scheduled for Monday, November 16 at 6 p.m. and will be information about the Oregon coast's rocky shore habitats. Steve Rumrill of the Oregon Department of Fish and Wildlife (ODFW) will be the speaker. He will be discussing the basic ecology of tidepools and other rocky intertidal area, and explaining the importance of protecting rocky coastal habitats in light of the decline of species such as kelp, abalone, and sea stars. This event is free and open to all. For more information or to receive a link to the presentation, contact Jesse Jones at jesse@oregonshores.org.

Grant Helps City Plan for Natural Disasters

Coos Bay Fire Department applied for and was awarded a $97,840 grant through the Oregon Office of Emergency Management's Homeland Security Grant Program. This competitive grant process is open to any government agency in the State that has a direct involvement in response or recovery from terrorism or natural disasters.

This year's grant award of $97,840 is being used to continue the City of Coos Bay's goal to provide essential needs for at least 10% of the City's population for two weeks after a natural disaster, such as the anticipated Cascadia Subduction Zone earthquake and tsunami.

The Fire Department has strategically placed shipping containers full of supplies throughout the City that will provide food, water filtration, sleeping supplies, and emergency medical supplies to 400 citizens each. Each container costs just under $60,000 to purchase, install, and fill with the needed supplies. This grant along with already budgeted City funds will complete two more containers.

Although this grant helps to meet some of the anticipated need, residents of Coos Bay should still work to prepare to be "Two Weeks Ready." For more information on the "Two Weeks Ready" Campaign, visit: https://www.oregon.gov/OEM/hazardsprep/Pages/2-Weeks-Ready.aspx

Email Lists

On March 4, 2021, North Bend sent a notice of the new plan update website to their email subscribers.

Figure III-19. North Bend Email Notification March 4, 2021

Emailed to subscribers of city's notices.
From: City of North Bend Oregon <northbend-or@municodeweb.com>
Sent: Thursday, March 4, 2021 3:10 PM
Subject: [Public Notices] Natural Hazard Mitigation Plan UPDATE

Natural Hazard Mitigation Plan UPDATE

The City of North Bend in conjunction with Coos County, the Department of Land Conservation and Development (DLCD), two Port Districts, one Hospital, one Drainage District, and six other Cities are working on the multi-jurisdictional plan update.

The intent is to include natural hazards and all possible risks for the county, in an attempt to permanently reduce or alleviate the loss of life or property. Hazards include coastal erosion, drought, earthquake, flood, landslide, tsunami, wildfire, windstorm, winter storm and volcanic ash.

The planning and documentation of the project is ongoing, and should conclude with an updated plan in March of 2022.

Please visit the project's website at: **https://www.co.coos.or.us/sheriff/page/natural-hazards-mitigation-plan** for additional information and to stay informed as the project progresses.

You can email ideas or input to EmergencyManagement@co.coos.or.us or to cschnabel@northbendcity.org.

Outreach Matrix

Table III-4. Public Engagement Plan Matrix page 1

Coos County Multi-Jurisdictional Natural Hazards Mitigation Plan Update—Public Engagement Plan Matrix

Outreach Strategy	Coos County	Bandon	Coos Bay	Coquille	Lakeside	Myrtle Point	North Bend	Powers	Port/Rail of Coos Bay	Port of Bandon	Southern Coos Hospital District
Steering Committee Meetings: • 4-7 over the course of the project	X	X	X	X	X	X	X	X	X	X	X
Public Meeting: ***Adoption Proceedings*** The final plan must be formally adopted by all participating jurisdictions.	X	X	X	X	X	X	X	X	X	X	X
Public Meeting: ***Plan Update Kickoff with public officials/ Draft Risk Assessment March 2021***		X	X	X	X	X	X			X	X
Public Meeting: ***Draft Mitigation Strategy***				X	X	X	X	X			
Public Meeting: ***Board/Council Workshop****		X	X	X	X	X	X	X		X	X
Public Meeting: ***Planning Commission****				X	X		X				
Public Meeting: ***Resiliency Summit*** Southern Coos Hospital District can support a large community meeting about hazards and how to mitigate them.											X
Public Meeting: ***Community presentations***	CCSO		X	X	X		?			X	
Other:											

FEMA Definitions: "PUBLIC": Businesses: neighboring communities; local and regional agencies involved in hazard mitigation activities; agencies that have the authority to regulate development; academia; and other private and non-profit interests.
"WHOLE COMMUNITY" sectors as set forth by FEMA: 1) Emergency management; 2) Economic Development; 3) Land Use and Development; 4) Housing; 5) Health and Social Services; 6) Infrastructure; and 7) Natural and Cultural Resources.

Table III-5. Public Engagement Plan Matrix page 2

Page 2

Coos County MJNHMP Update—Public Engagement Plan **November 2020**

Outreach Strategy	Coos County	Bandon	Coos Bay	Coquille	Lakeside	Myrtle Point	North Bend	Powers	Port/Rail of Coos Bay	Port of Bandon	Southern Coos Hospital District
WEBSITE: Establish a website where citizens can review and comment on plan drafts, learn about how to prepare, and otherwise learn about natural hazards and the NHMP.	CC Planning	X	X		X	X	X			X	X
LEGAL NOTICES: Create and publish legal notices for public meetings and other plan engagement opportunities via established media avenues print, radio, and television).	CC Planning				X	X	X			X	
EMAIL LIST: Jurisdiction will establish an email list where citizens, businesses, and other interested parties can receive news about the plan update.	CC Planning					X	X	X	X	X	
SOCIAL MEDIA: Jurisdiction will establish, or use established social media outlets (Facebook, Instagram, etc.) to convey meeting times, hazard information, and news about the plan update.	CCSO	X	X	X	X		X NBFD		X	X	
UTILITY BILLS: Jurisdiction will insert information about upcoming meetings and events into utility bills on a monthly or bimonthly cycle.			?		X		?				X
DISTRIBUTE TSUNAMI & other HAZARD INFORMATION: Provide information at booths or tables during public events; Deliver to local businesses; Display at Community Centers & Offices.	CCSO	X	X				X	X		X	X
SURVEY: Distribute NHMP survey via electronic or print methods; Return the results to Coos County in a timely fashion.	CC Planning	X	X			X	X		X		
OTHER: TOOLKIT: Coordinate with others to offer quarterly hazard information, graphics, links, and other information as an outreach media packet. Check this box if you would like to coordinate on the hazard toolkit.									X		

F. FEMA Review Tool

FEMA REGION 10 LOCAL MITIGATION PLAN REVIEW TOOL

The *Local Mitigation Plan Review Tool* demonstrates how the Local Mitigation Plan meets the regulation in 44 CFR §201.6 and offers States and FEMA Mitigation Planners an opportunity to provide feedback to participating jurisdictions.

1. The Multi-Jurisdiction Summary Sheet is used to document how each jurisdiction met the requirements in the Plan.
2. The Regulation Checklist provides a summary of FEMA's evaluation of whether the Plan has addressed all requirements.
3. The Plan Assessment identifies the plan's strengths as well as documents areas for future improvement.

The FEMA Mitigation Planner must reference the *Local Mitigation Plan Review Guide* when completing this *Local Mitigation Plan Review Tool*.

<table>
<tr><td>Jurisdiction:

Coos County, Oregon</td><td>Title of Plan:

Coos County

Multi-Jurisdictional

Natural Hazards Mitigation Plan</td><td>Date of Plan:

___ 2023</td></tr>
<tr><td colspan="2">Local Point of Contact:

Chip Delyria</td><td rowspan="3">Address:

250 N. Baxter

Coquille, Oregon 97423</td></tr>
<tr><td colspan="2">Title:

Emergency Manager</td></tr>
<tr><td colspan="2">Agency:

Coos County Sheriff's Office</td></tr>
<tr><td colspan="2">Phone Number:

541-396-7790</td><td>E-Mail:

cdelyria@co.coos.or.us</td></tr>
</table>

State Reviewer:	Title:	Date:

FEMA Reviewer:	Title:	Date:
Date Received in FEMA Region 10		
Plan Not Approved		
Plan Approvable Pending Adoption		
Plan Approved		

SECTION 1: MULTI-JURISDICTION SUMMARY SHEET (used only for multi-jurisdictional plans)

INSTRUCTIONS: The Multi-Jurisdiction Summary Spreadsheet is completed by listing each participating jurisdiction and which required Elements for each jurisdiction were 'Met' or 'Not Met,' and when the adoption resolutions were received. This Summary Sheet does not imply that a mini-plan be developed for each jurisdiction; it is used to ensure that each jurisdiction participating in the Plan has been documented and has met the requirements for those Elements (A through E).

MULTI-JURISDICTION SUMMARY SHEET (Add additional pages if necessary)											
#	Jurisdiction Name	Jurisdiction Type (city, district, etc.)	POC	Required Revisions / Comments	Requirements Met (Y/N)					
					A. Planning Process	B. Hazard Identification & Risk Assessment	C. Mitigation Strategy	D. Plan Review, Evaluation & Implementation	E. Plan Adoption	F. State Require-ments
1	Coos County	County	Chip Delyria							n/a
2	Bandon	City	Dan Chandler							n/a
3	Coos Bay	City	Mark Anderson							n/a
4	Coquille	City	Scott Sanders							n/a
5	Lakeside	City	Melissa Bethel							n/a
6	Myrtle Point	City	Darin Nicholson							n/a
7	North Bend	City	Ralph Dunham							n/a

MULTI-JURISDICTION SUMMARY SHEET (Add additional pages if necessary)											
#	Jurisdiction Name	Jurisdiction Type (city, district, etc.)	POC	Required Revisions / Comments	Requirements Met (Y/N)					
					A. Planning Process	B. Hazard Identification & Risk Assessment	C. Mitigation Strategy	D. Plan Review, Evaluation & Implementation	E. Plan Adoption	F. State Require-ments
8	Powers	City	Stephanie Patterson							n/a
9	Port of Bandon	District	Jeff Griffin							n/a
10	Port of Coos Bay	District	Mike Dunning							n/a
11	Bay Area Hospital	District	Jeremy Pittz							n/a
12	Southern Coos Hospital	District	Jason Cook							n/a
13	Haynes Drainage	District	Tom Koenig							n/a

SECTION 2: REGULATION CHECKLIST

INSTRUCTIONS: The Regulation Checklist is completed by FEMA. The purpose of the Checklist is to identify the location of relevant or applicable content in the Plan by Element/sub-element and to determine if each requirement has been 'Met' or 'Not Met.' The 'Required Revisions' summary at the bottom of each Element is completed by FEMA to provide a clear explanation of the revisions that are required for plan approval. Required revisions are explained for each plan sub-element that is 'Not Met.' Sub-elements are referenced in each summary by using the appropriate numbers (A1, B3, etc.), where applicable.

1. REGULATION CHECKLIST **Regulation** (44 CFR 201.6 Local Mitigation Plans)	**Location in Plan** **(section and/or**	**Met**	**Not Met**
ELEMENT A. PLANNING PROCESS			
A1. Does the Plan document the planning process, including how it was prepared and who was involved in the process for each jurisdiction? (Requirement §201.6(c)(1))	Acknowledgements pp 3-4; Sect. I.D. Community Risk Profile Process: 126-164, pp. 128-129, 132, 135, 138, etc. Local RA activities. Sect. II.A. Mission & Goals: pp. 171. Sect. III. Planning Process: 2023 Plan Update p. 233-234, Pre-Award SC Recruitment p. 235, Meetings pp. 237-241. Survey comments pp. 244-246, 253-258, 263-265, 273-276, 282-284, 290-303.		
A2. Does the Plan document an opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, agencies that have the authority to regulate development as well as other interests to be involved in the planning process? (Requirement §201.6(b)(2))	Acknowledgements pp 3-4; Sect. III. Planning Process: 2023 Plan Update p. 233-234, Pre-Award SC Recruitment p. 235, Meetings pp. 237-241; Coos Community Hazard Survey pp. 242-303.		
A3. Does the Plan document how the public was involved in the planning process during the drafting stage? (Requirement §201.6(b)(1))	Sect. III. Planning Process: 2023 Plan Update p. 233-234, III.C. Public Participation pp. 237-241, Coos Community Hazard Survey Results pp. 242-303, Survey comments pp. 244-246, 253-258, 263-265, 273-276, 282-284, 290-303. III.E. Plan Outreach pp.304-317.		
A4. Does the Plan describe the review and incorporation of existing plans, studies, reports, and technical information? (Requirement §201.6(b)(3))	Sect. I. Risk Assessment: I.A. Intro pp. 16-18; I.B. Community Profile pp. 19-51, I.C. Natural Hazards pp. 52-126. Appendices A-C pp.1-357.		
A5. Is there discussion of how the community(ies) will continue public participation in the plan maintenance process? (Requirement §201.6(c)(4)(iii))	Sect. III. Planning Process: III.A. Plan Maint. pp. 227-232		

1. REGULATION CHECKLIST **Regulation** (44 CFR 201.6 Local Mitigation Plans)	Location in Plan (section and/or	Met	Not Met
A6. Is there a description of the method and schedule for keeping the plan current (monitoring, evaluating and updating the mitigation plan within a 5-year cycle)? (Requirement §201.6(c)(4)(i))	Meeting Schedule p. 228 Sect. III. Planning Process: III.A. Plan Maint. pp. 227-232		
ELEMENT A: REQUIRED REVISIONS			
ELEMENT B. HAZARD IDENTIFICATION AND RISK ASSESSMENT			
B1. Does the Plan include a description of the type, location, and extent of all natural hazards that can affect each jurisdiction(s)? (Requirement §201.6(c)(2)(i))	Sect. I. Risk Assessment: I.A. Intro pp. 15,17; I.C. Natural Hazards pp. 52-126 I.D. Community Risk Profiles pp. 167-155		
B2. Does the Plan include information on previous occurrences of hazard events and on the probability of future hazard events for each jurisdiction? (Requirement §201.6(c)(2)(i))	I.A. Disaster Declarations pp. 18, I.C. Hazard History sections, Hazard chapters. pp. 54, 59, 63, 73-76, 97,106, 112, 119, 124. Probability across Hazard chapters, esp. in future climate condition sections pp. 52-126		
B3. Is there a description of each identified hazard's impact on the community as well as an overall summary of the community's vulnerability for each jurisdiction? (Requirement §201.6(c)(2)(ii))	See Risk Assessment I.D. Community Risk Profiles pp. 116-154. Appendices A pp.1-122, Appendices C 167-357.		
B4. Does the Plan address NFIP insured structures within the jurisdiction that have been repetitively damaged by floods? (Requirement §201.6(c)(2)(ii))	I.C. Flood Chapter pp.80-82		
ELEMENT B: REQUIRED REVISIONS			
ELEMENT C. MITIGATION STRATEGY			

1. REGULATION CHECKLIST **Regulation** (44 CFR 201.6 Local Mitigation Plans)	**Location in Plan** **(section and/or**	**Met**	**Not Met**
C1. Does the plan document each jurisdiction's existing authorities, policies, programs and resources and its ability to expand on and improve these existing policies and programs? (Requirement §201.6(c)(3))	I.B. Community Profile pp.19-51, especially Critical Facilities pp.36-51. Completed & Ongoing Mitigation Actions pp. 172-174 Appendix A.3. Local Tsunami Evac Planning Apx. pp. 5- 15; Appendix B Policy Framework, Apx.pp. 163-166.		
C2. Does the Plan address each jurisdiction's participation in the NFIP and continued compliance with NFIP requirements, as appropriate? (Requirement §201.6(c)(3)(ii))	I.C. Flood Chapter pp.72-87; especially NFIP pp. 81-83.		
C3. Does the Plan include goals to reduce/avoid long-term vulnerabilities to the identified hazards? (Requirement §201.6(c)(3)(i))	Sect. II.A. Mission & Goals: pp. 171-172.		
C4. Does the Plan identify and analyze a comprehensive range of specific mitigation actions and projects for each jurisdiction being considered to reduce the effects of hazards, with emphasis on new and existing buildings and infrastructure? (Requirement §201.6(c)(3)(ii))	II. C. Mitigation Actions 2023 pp. 175-186. II. B. Completed & Ongoing Mitigation Actions pp. 172-174		
C5. Does the Plan contain an action plan that describes how the actions identified will be prioritized (including cost benefit review), implemented, and administered by each jurisdiction? (Requirement §201.6(c)(3)(iv)); (Requirement §201.6(c)(3)(iii))	II. Mitigation Strategy pp. 170-223, C. Mitigation Actions 2023 pp. 175-192 and Action item Development pp. 187-192. Appendix B Funding & Policy Guide Apx. pp. 127-170		
C6. Does the Plan describe a process by which local governments will integrate the requirements of the mitigation plan into other planning mechanisms, such as comprehensive or capital improvement plans, when appropriate? (Requirement §201.6(c)(4)(ii))	Sect. I pp. 14-16 Sect. II A. Mission & Goals pp. 171 Section II.B. Completed & Ongoing Mitigation Actions, pp. 172-174. Sect. III. Planning Process: p. 229 Sect. III.A. Plan Maint. pp. 222-223.		
ELEMENT C: REQUIRED REVISIONS			
ELEMENT D. PLAN REVIEW, EVALUATION, AND IMPLEMENTATION (applicable to plan updates only)			
D1. Was the plan revised to reflect changes in development? (Requirement §201.6(d)(3))	Sect. IB. Community Profile pp. especially pp. 33-34, pp. 22-35.		
D2. Was the plan revised to reflect progress in local mitigation efforts? (Requirement §201.6(d)(3))	Section II.B. Completed & Ongoing Mitigation Actions, pp. 172-174. Sect. II.C. Mitigation Actions 2023 pp. 175-190, Sect. II.D. Mitigation Action Status 2016 pp. 193-225		

1. REGULATION CHECKLIST **Regulation** (44 CFR 201.6 Local Mitigation Plans)	**Location in Plan (section and/or**	**Met**	**Not Met**
D3. Was the plan revised to reflect changes in priorities? (Requirement §201.6(d)(3))	Sect. II.D. Mitigation Action Status 2016 pp. 193-225, New HHPD chapter added pp.89-94. New risk report and climate data throughout I.C. Natural Hazards pp. 52-126 and appended .in Appendix C Apx. pp. 167-357		
ELEMENT D: REQUIRED REVISIONS			
ELEMENT E. PLAN ADOPTION			
E1. Does the Plan include documentation that the plan has been formally adopted by the governing body of the jurisdiction requesting approval? (Requirement §201.6(c)(5))	Forthcoming Sect. III. Adoption Resolutions pp.330~359		
E2. For multi-jurisdictional plans, has each jurisdiction requesting approval of the plan documented formal plan adoption? (Requirement §201.6(c)(5))	Forthcoming Sect. III. APA letter p.329,, Approval letter pp. 5-6, 359.		
ELEMENT E: REQUIRED REVISIONS			
ELEMENT F. ADDITIONAL STATE REQUIREMENTS **(OPTIONAL FOR STATE REVIEWERS ONLY; NOT TO BE COMPLETED BY FEMA)**			
OEM's current contract (FY 17) with local EMPG jurisdictions (mostly counties) requires that they convene their "Natural Hazards Committee" at least twice per year. Oregon Administrative Rule (OAR) 104, Division 10 requires "Each county, tribal government and city must meet the following requirements to be eligible to participate in (EMPG): …Have a FEMA approved Natural Hazards Mitigation Plan that is updated every five years."			

SECTION 3: PLAN ASSESSMENT

A. Plan Strengths and Opportunities for Improvement

This section provides a discussion of the strengths of the plan document and identifies areas where these could be improved beyond minimum requirements.

Element A: Planning Process

How does the Plan go above and beyond minimum requirements to document the planning process with respect to:

- *Involvement of stakeholders (elected officials/decision makers, plan implementers, business owners, academic institutions, utility companies, water/sanitation districts, etc.);*
- *Involvement of Planning, Emergency Management, Public Works Departments or other planning agencies (i.e., regional planning councils);*
- *Diverse methods of participation (meetings, surveys, online, etc.); and*
- *Reflective of an open and inclusive public involvement process.*

Plan Strengths

-

Opportunities for Improvement

-

Element B: Hazard Identification and Risk Assessment

In addition to the requirements listed in the Regulation Checklist, 44 CFR 201.6 Local Mitigation Plans identifies additional elements that should be included as part of a plan's risk assessment. The plan should describe vulnerability in terms of:

1) *A general description of land uses and future development trends within the community so that mitigation options can be considered in future land use decisions;*
2) *The types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard areas; and*
3) *A description of potential dollar losses to vulnerable structures, and a description of the methodology used to prepare the estimate.*

How does the Plan go above and beyond minimum requirements to document the Hazard Identification and Risk Assessment with respect to:

- *Use of best available data (flood maps, HAZUS, flood studies) to describe significant hazards;*
- *Communication of risk on people, property, and infrastructure to the public (through tables, charts, maps, photos, etc.);*
- *Incorporation of techniques and methodologies to estimate dollar losses to vulnerable structures;*
- *Incorporation of Risk MAP products (i.e., depth grids, Flood Risk Report, Changes Since Last FIRM, Areas of Mitigation Interest, etc.); and*

- *Identification of any data gaps that can be filled as new data became available.*

Plan Strengths

-

Opportunities for Improvement

-

Element C: Mitigation Strategy

How does the Plan go above and beyond minimum requirements to document the Mitigation Strategy with respect to:

- *Key problems identified in, and linkages to, the vulnerability assessment;*
- *Serving as a blueprint for reducing potential losses identified in the Hazard Identification and Risk Assessment;*
- *Plan content flow from the risk assessment (problem identification) to goal setting to mitigation action development;*
- *An understanding of mitigation principles (diversity of actions that include structural projects, preventative measures, outreach activities, property protection measures, post-disaster actions, etc);*
- *Specific mitigation actions for each participating jurisdictions that reflects their unique risks and capabilities;*
- *Integration of mitigation actions with existing local authorities, policies, programs, and resources; and*
- *Discussion of existing programs (including the NFIP), plans, and policies that could be used to implement mitigation, as well as document past projects.*

Plan Strengths

-

Opportunities for Improvement

-

Element D: Plan Update, Evaluation, and Implementation (*Plan Updates Only*)

How does the Plan go above and beyond minimum requirements to document the 5-year Evaluation and Implementation measures with respect to:

- *Status of previously recommended mitigation actions;*
- *Identification of barriers or obstacles to successful implementation or completion of mitigation actions, along with possible solutions for overcoming risk;*
- *Documentation of annual reviews and committee involvement;*
- *Identification of a lead person to take ownership of, and champion the Plan;*
- *Reducing risks from natural hazards and serving as a guide for decisions makers as they commit resources to reducing the effects of natural hazards;*
- *An approach to evaluating future conditions (i.e. socio-economic, environmental, demographic, change in built environment etc.);*
- *Discussion of how changing conditions and opportunities could impact community resilience in the long term; and*

- *Discussion of how the mitigation goals and actions support the long-term community vision for increased resilience.*

Plan Strengths

-

Opportunities for Improvement

-

B. Resources for Implementing Your Approved Plan

Ideas may be offered on moving the mitigation plan forward and continuing the relationship with key mitigation stakeholders such as the following:

- *What FEMA assistance (funding) programs are available (for example, Hazard Mitigation Assistance (HMA)) to the jurisdiction(s) to assist with implementing the mitigation actions?*
- *What other Federal programs (National Flood Insurance Program (NFIP), Community Rating System (CRS), Risk MAP, etc.) may provide assistance for mitigation activities?*
- *What publications, technical guidance or other resources are available to the jurisdiction(s) relevant to the identified mitigation actions?*
- *Are there upcoming trainings/workshops (Benefit-Cost Analysis (BCA), HMA, etc.) to assist the jurisdictions(s)?*
- *What mitigation actions can be funded by other Federal agencies (for example, U.S. Forest Service, National Oceanic and Atmospheric Administration (NOAA), Environmental Protection Agency (EPA) Smart Growth, Housing and Urban Development (HUD) Sustainable Communities, etc.) and/or state and local agencies?*

G. FEMA APA Letter

H. Adoption Resolutions

Adoption Resolution: Coos County

RESOLUTION NO. 23-03-063L

A RESOLUTION ADOPTING THE 2023 COOS COUNTY MULTI-JURISDICTIONAL NATURAL HAZARDS MITIGATION PLAN

WHEREAS, natural hazards threaten life, businesses, property, and environmental systems throughout Coos County.

WHEREAS, an understanding of the nature, extent, and potential impacts of natural hazards is the foundation for developing strategies to reduce or eliminate those impacts.

WHEREAS, natural hazards mitigation planning is the process through which such understanding and strategies are developed and a process for implementation is established.

WHEREAS, it is in the interest of Coos County and the cities and special districts located therein to undertake natural hazards mitigation planning and implementation together as coordinated planning strengthens communities and better serves all.

WHEREAS, Coos County and the Cities of Bandon, Coos Bay, Coquille, Lakeside, Myrtle Point, North Bend, and Powers previously prepared, implemented, and updated a multi-jurisdictional natural hazards mitigation plan in accordance with the Disaster Mitigation Act of 2000. These plans were each approved by the Federal Emergency Management Agency (FEMA) for a period of five years.

WHEREAS, the Port of Coos Bay, the Port of Bandon, the Southern Coos Hospital, Bay Area Hospital, and Haynes Drainage District, each participated updating the 2023 Coos County Multi-Jurisdictional Natural Hazards Mitigation Plan, in accordance with the Disaster Mitigation Act of 2000, thereby developing their first natural hazards mitigation plans.

WHEREAS, the 2016 Coos County Multi-Jurisdictional Natural Hazards Mitigation Plan is the most recent and expired on September 12, 2021.

WHEREAS, having a natural hazards mitigation plan developed in accordance with the Disaster Mitigation Act of 2000 and approved by FEMA is a prerequisite for local government eligibility for certain federal hazard mitigation funds, particularly Hazard Mitigation Assistance (HMA) programs, such as Building Resilient Infrastructure and Communities (BRIC), Hazard Mitigation Grant Program (HMGP), and Flood Mitigation Assistance (FMA).

WHEREAS, adoption of the updated 2023 Coos County Multi-Jurisdictional Natural Hazards Mitigation Plan is required for FEMA approval of the 2023 Coos County Multi-Jurisdictional Natural Hazards Mitigation Plan.

WHEREAS, adoption of the updated 2023 Coos County Multi-Jurisdictional Natural Hazards Mitigation Plan demonstrates Coos County's commitment to reducing or eliminating the potential impacts of natural hazards and to achieving the Plan's goals.

NOW, THEREFORE, BE IT RESOLVED BY COOS COUNTY:

Section 1. The Coos County Board of Commissioners hereby adopts the recitals above in support of this resolution.

Section 2. The Coos County Board of Commissioners hereby adopts the Coos County Multi-Jurisdictional Natural Hazards Mitigation Plan.

DATED this 7 day of March, 2023.

____

Name, Chair, Coos County Board of Commissioners

ATTEST:

____

Name, Title

APPROVED AS TO FORM:

____

Name, Title

I. FEMA Approval Letter

IV: APPENDICES

A. Appendix A

1. Hospital Resilience Guidance

This report informed the consideration of earthquake and tsunami hazards for the local mitigation strategies developed or updated for the 2022 Coos County Multi-Jurisdictional Natural Hazard Mitigation Plan Update.

Cascadia Region Earthquake Workgroup (CREW) Guidance Documents

The guidance documents provide basic information on the importance of preparing hospitals by addressing issues related to building structures and the power and water services required to operate the hospital. They are designed to be easy to understand, promote resilience action planning, and point to detailed reference documents.

- Preparing Hospitals for Earthquakes: Structural and Nonstructural Issues (CREW Fact Sheet 9, 659 KB PDF) https://www.oregongeology.org/pubs/ofr/O-19-02/CREW_Fact Sheet_9_Hosp_07-23-2018_final.pdf
- Emergency Power for Hospitals: Preparing for Cascadia (CREW Fact Sheet 10, 1,033 KB PDF)
- Emergency Water for Hospitals: Preparing for Cascadia (CREW Fact Sheet 11, 808 KB PDF)
- https://www.oregongeology.org/pubs/ofr/O-19-02/CREW_Fact Sheet_10_Hosp_power_07-23-2018_final.pdf

2. Tsunami References & Maps

These maps informed the consideration of tsunami impact, extent, duration, and frequency which inform the metrics necessary to calculate evacuation routes and timing. Considerations made as a part of the 2022 Coos County Multi-Jurisdictional Natural Hazard Mitigation Plan Update included findings that inform life safety, building loss and exposure, and lifeline loss and exposure.

Allan, J.C. (2020). *Maritime tsunami response guidance for the Port of Coos Bay, Coos County, Oregon.* (MTRG-2020-OR-01). Newport, OR: Oregon Department of Geology and Mineral Industries. https://www.oregongeology.org/pubs/mtrg/MTRG-2020-OR-01_Port-of-Coos-Bay.pdf

Allan, J.C., Zhang, J., O'Brien, F.C., and L.L.S. Gabel. (2020). *Coos Bay tsunami modeling: Toward improved maritime planning response.* (Open-File Report O-20-08). Newport, OR: Oregon Department of Geology and Mineral Industries. https://www.oregongeology.org/pubs/ofr/p-O-20-08.htm

Gabel, Laura L. S., O'Brien, F.E., Bauer, J.M., and J.C. Allan. (2019). *Tsunami evacuation analysis of communities surrounding the Coos Bay estuary: Building community resilience on the Oregon Coast.* [Beat the Wave] (Open-File Report O-19-07). Newport, OR: Oregon Department of Geology and Mineral Industries. https://www.oregongeology.org/pubs/ofr/p-O-19-07.htm

Northwest Association of Networked Ocean Observing Systems (NANOOS). (2021). *Northwest Visualization System (NVS) Tsunami Evacuation Zones viewer*. http://nvs.nanoos.org/TsunamiEvac

Oregon Tsunami Clearinghouse. (2013). *Large-Extent Tsunami Evacuation Maps*. Newport, OR: Oregon Department of Geology and Mineral Industries. https://www.oregongeology.org/tsuclearinghouse/pubs-evacbro.htm

Wang, Yumei and K.L. Nourse. (2019.) *Resilience Guidance for Oregon Hospitals* (Open-File Report O-19-02). Portland, OR: Department of Geology and Mineral Industries. https://www.oregongeology.org/pubs/ofr/O-19-02/O-19-02_report.pdf

Tsunami Inundation Maps (TIMs) SERIES: COOS 01-17

Coos-01	*12/18/2012*	preview/download	Coos	Lakeside West
Coos-02	*12/18/2012*	preview/download	Coos	Lakeside East
Coos-03	*12/18/2012*	preview/download	Coos	Saunders Lake
Coos-04	*07/17/2012*	preview/download	Coos	Haynes Inlet
Coos-05	*07/15/2012*	preview/download	Coos	Coos Bay - North Bend
Coos-06	*07/19/2012*	preview/download	Coos	Coos River North
Coos-07	*07/19/2012*	preview/download	Coos	Coos River South
Coos-08	*07/17/2012*	preview/download	Coos	Charleston - Cape Arago
Coos-09	*07/17/2012*	preview/download	Coos	Barview - South Slough
Coos-10	*07/12/2012*	preview/download	Coos	Isthmus Slough
Coos-11	*07/12/2012*	preview/download	Coos	Catching Slough
Coos-12	*09/10/2012*	preview/download	Coos	Bullards Beach
Coos-13	*09/10/2012*	preview/download	Coos	Leneve
Coos-14	*09/10/2012*	preview/download	Coos	Coquille
Coss-15	*09/11/2012*	preview/download	Coos	Coquille River
Coos-16	*09/12/2012*	preview/download	Coos	Bandon
Coos-17	*09/12/2012*	preview/download	Coos	New River

Bandon Example

https://www.oregongeology.org/pubs/tim/p-TIM-Coos-16.htm

Distant Tsunami Inundation Map:
https://www.oregongeology.org/pubs/tim/Coos16_Bandon_Plate2_onscreen.pdf

Local Tsunami Inundation Map:

https://www.oregongeology.org/pubs/tim/Coos16_Bandon_Plate1_onscreen.pdf

3. Local Tsunami Evacuation Planning

City of North Bend

Tsunami Evacuation Route Improvement Plan Appendix of the Transportation System Plan

https://www.oregon.gov/lcd/OCMP/Documents/NorthBend_TEFIP_Final_Jan2021.pdf

Tsunami Hazard Overlay Zone Map

https://www.oregon.gov/lcd/OCMP/Documents/NorthBend-THOZ-Map.pdf

For more information about tsunami planning, see:

https://www.oregon.gov/lcd/OCMP/Pages/Tsunami-Planning.aspx

Coos County

In October 2019, Coos County adopted a Tsunami Evacuation Facility Improvement Plan (TEFIP) in addition to other improvements to the Coos County Comprehensive Plan to guide development away from harm by natural hazards. Details of these changes can be found online in the signed ordinance.

https://www.co.coos.or.us/sites/default/files/fileattachments/planning/page/19201/signed_ordinance.pdf

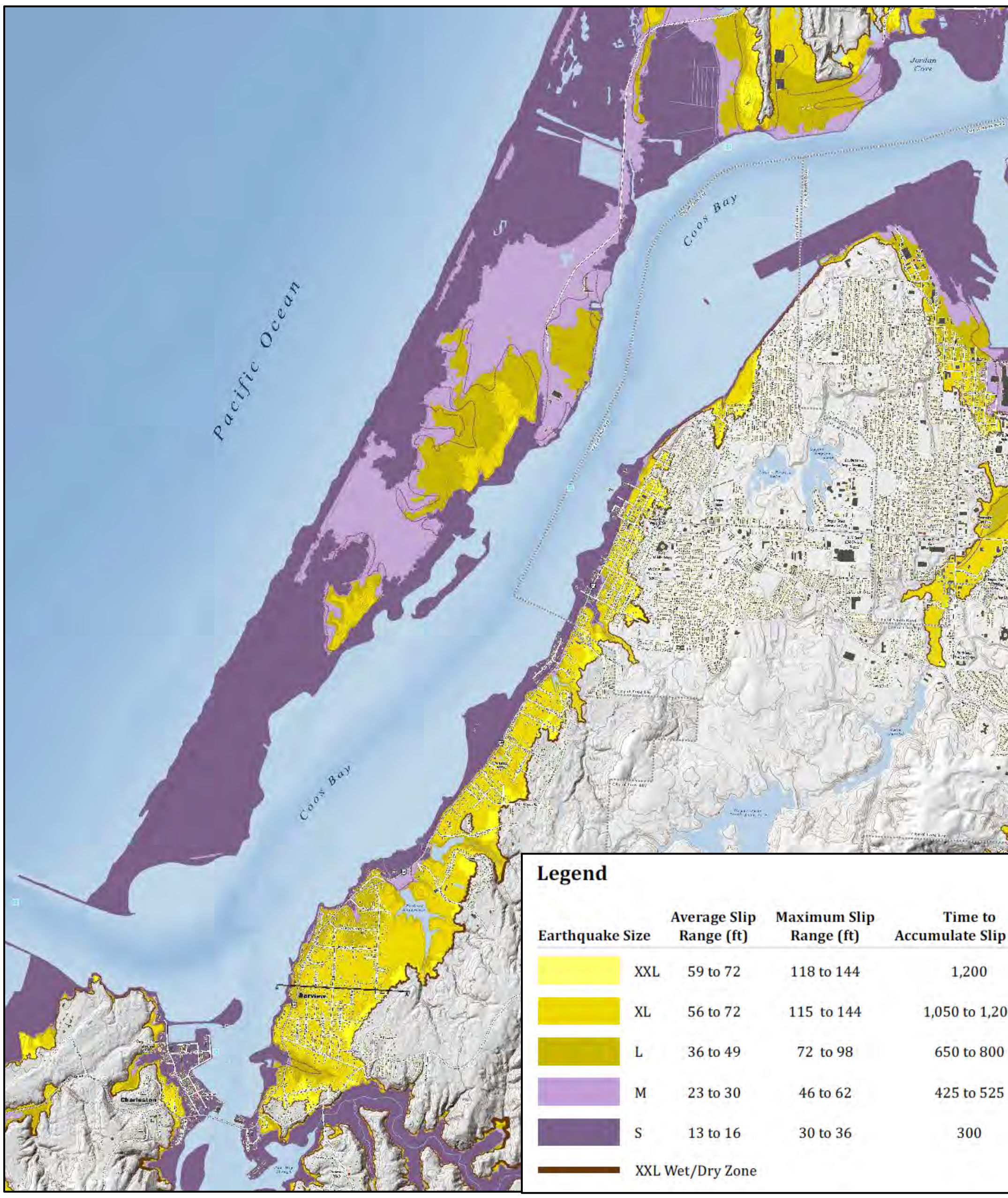
Coos County Tsunami Evacuation Facility Improvement Plan Appendices present tsunami risk in three types of maps: Tsunami Inundation Maps (TIMs), Wave Arrival times, and Beat the Wave pedestrian evacuation timing maps; potential funding opportunities are also highlighted.

TEFIP Appendix A: Tsunami Inundation Map
TEFIP Appendix B: Wave Arrival Times
TEFIP Appendix C: Beat the Wave Maps

Appendix A: Tsunami Inundation Map

The Tsunami Inundation Map (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.

Below is a portion of the Coos Bay estuary TIM. See www.oregongeology.org/tsuclearinghouse/pubs-inumaps.htm for the whole map and for more information.

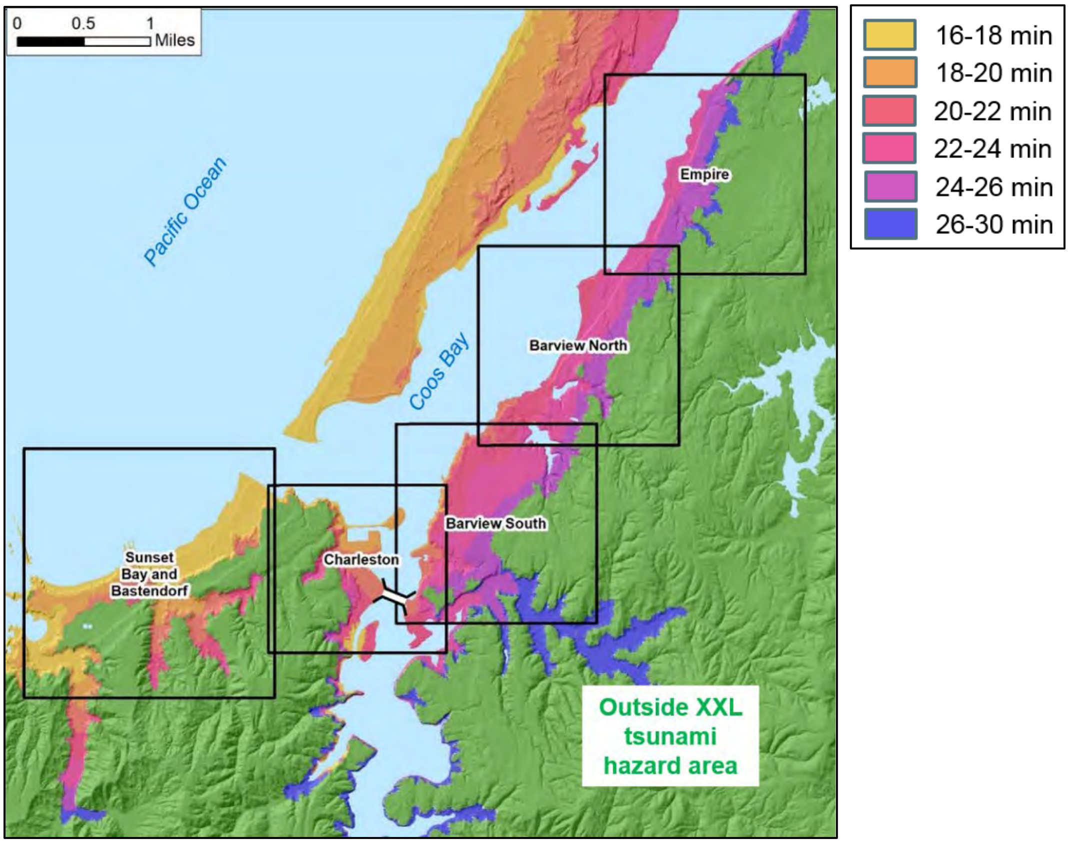


Legend

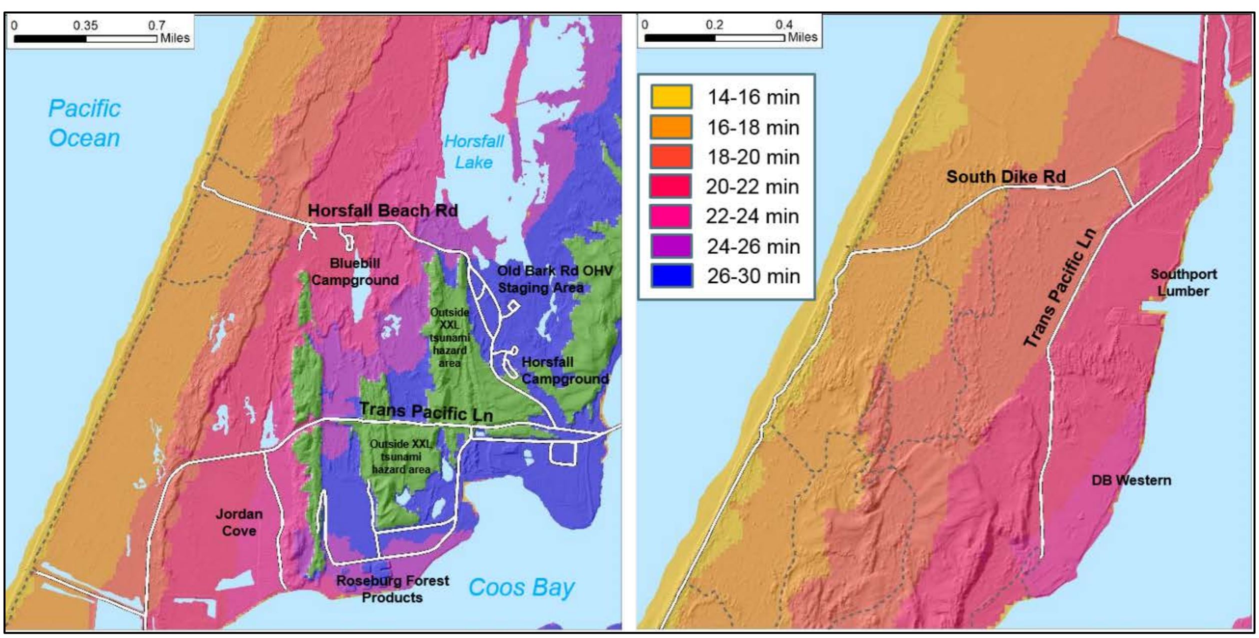
Earthquake Size		Average Slip Range (ft)	Maximum Slip Range (ft)	Time to Accumulate Slip (yrs)	Earthquake Magnitude
	XXL	59 to 72	118 to 144	1,200	~9.1
	XL	56 to 72	115 to 144	1,050 to 1,200	~9.1
	L	36 to 49	72 to 98	650 to 800	~9.0
	M	23 to 30	46 to 62	425 to 525	~8.9
	S	13 to 16	30 to 36	300	~8.7
	XXL Wet/Dry Zone				

Appendix B: Wave Arrival Times

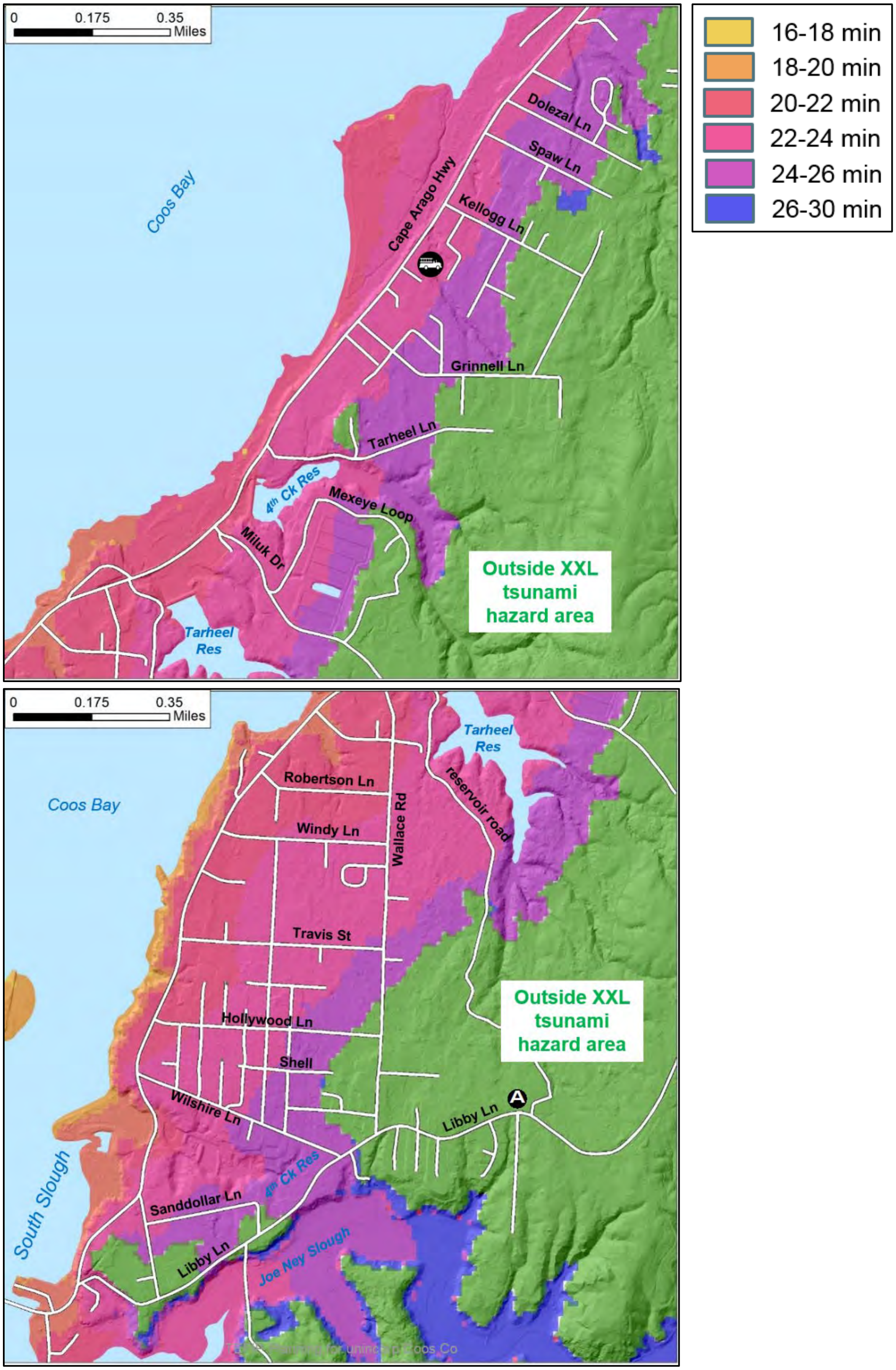
Map of XXL tsunami wave arrival times after a Cascadia subduction zone earthquake for the Coos Bay estuary.



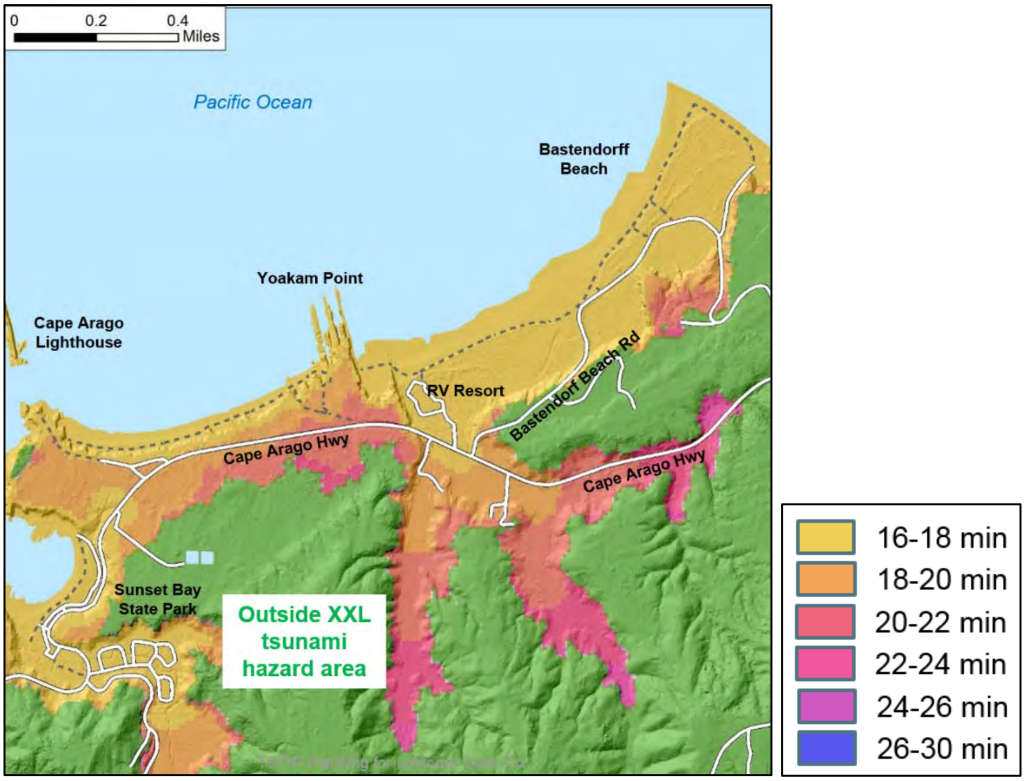
B.1 North Spit Wave Arrival Times:



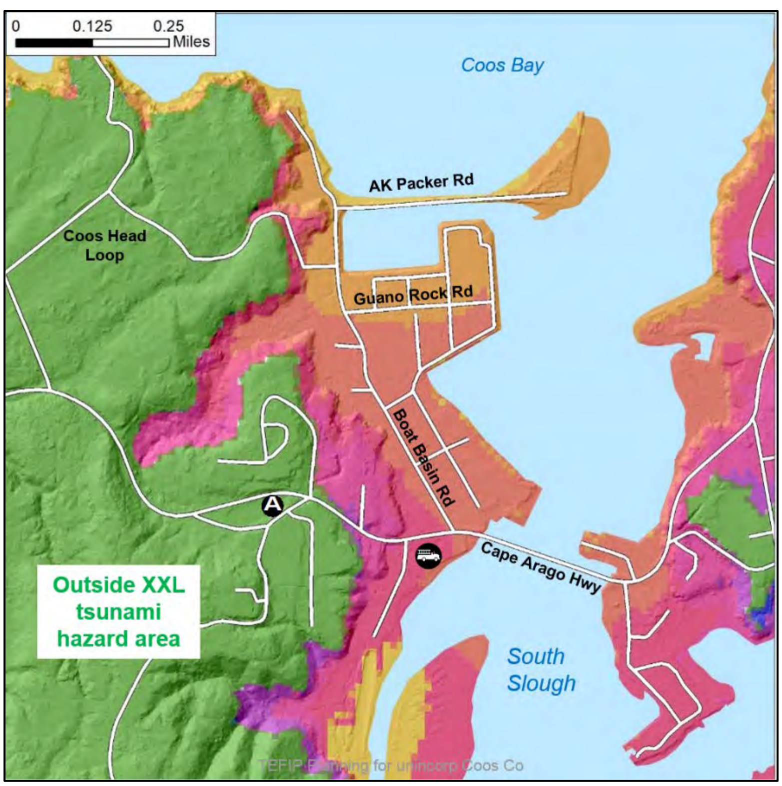
B.2 Barview Wave Arrival Times (north and south):



B.3 Charleston Wave Arrival Times:



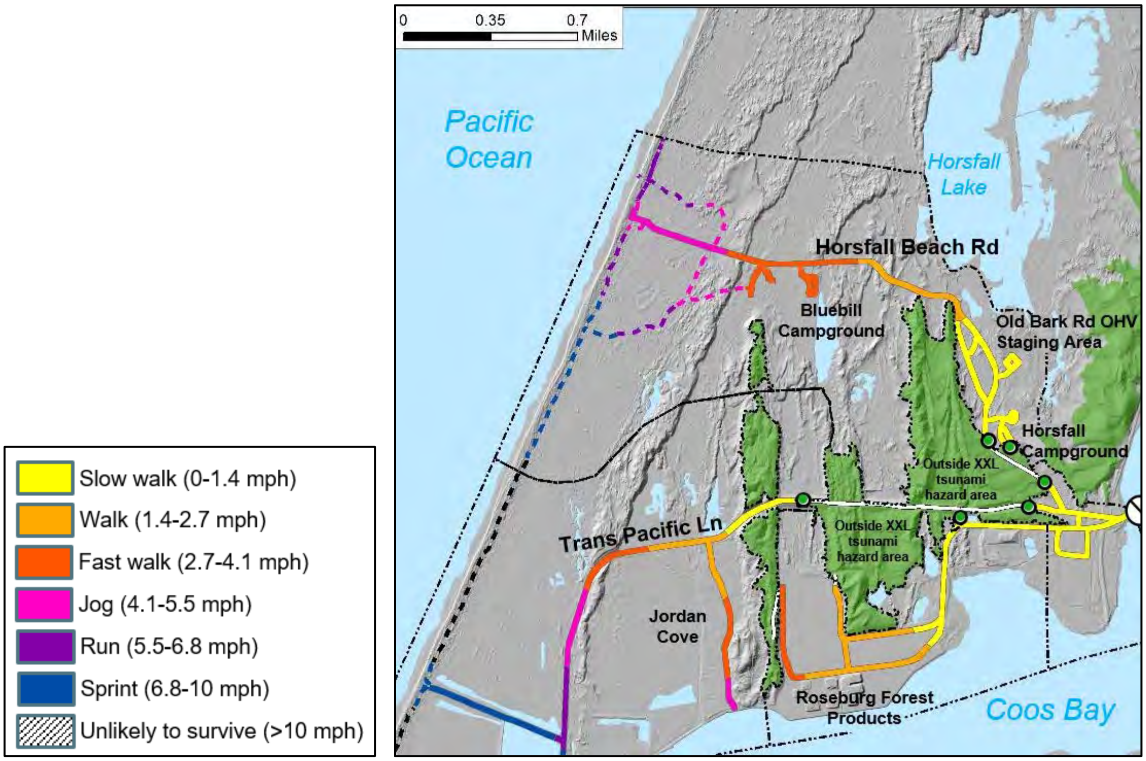
B.4 Bastendorff Beach & Sunset Bay State Park Wave Arrival Times:

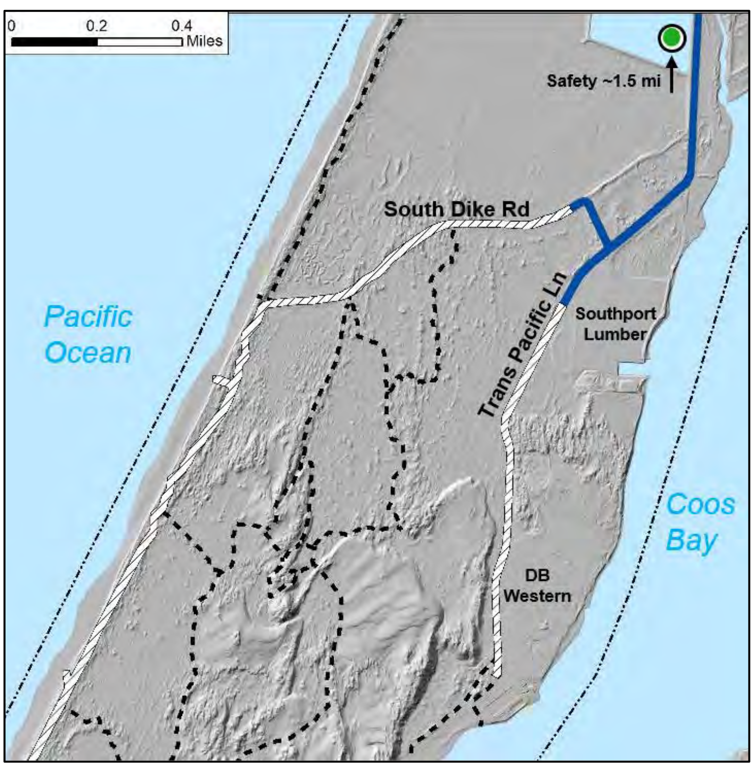


Appendix C: Beat the Wave Maps

C.1 North Spit, north (top) and south (bottom) – existing conditions:

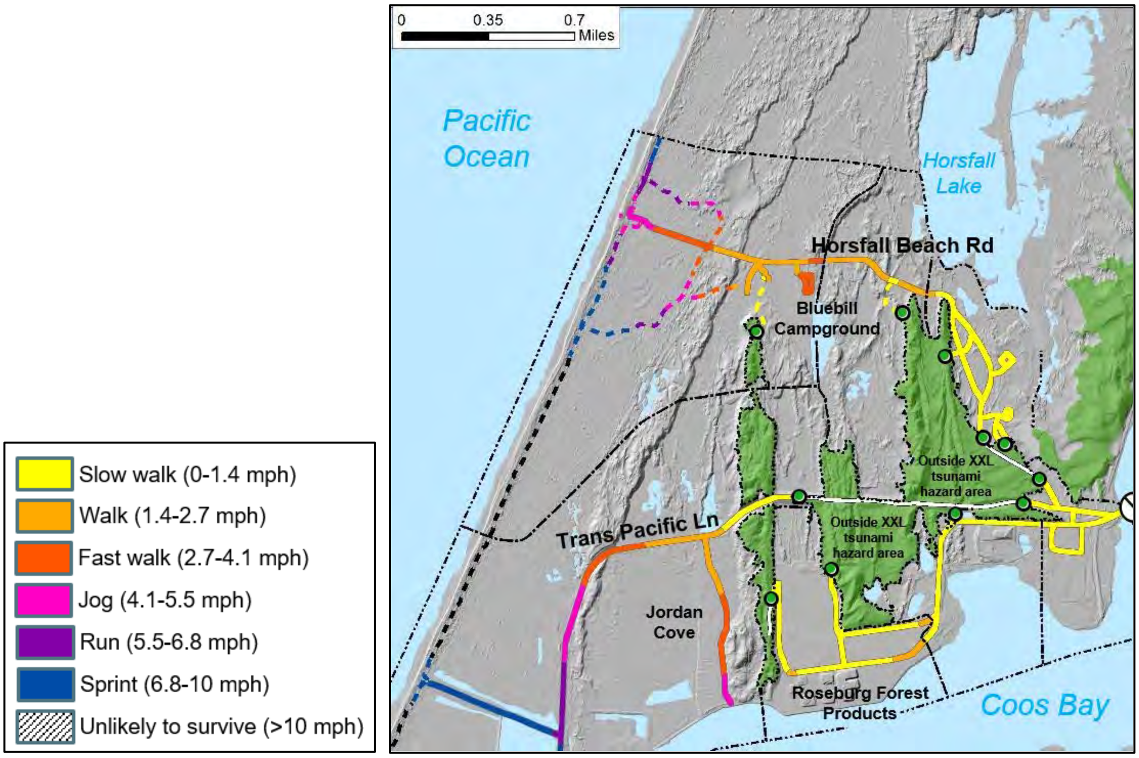
Beat the Wave pedestrian evacuation speeds are indicated by road color. Green dots indicate safety destinations and green shaded areas are outside of the XXL tsunami inundation zone.

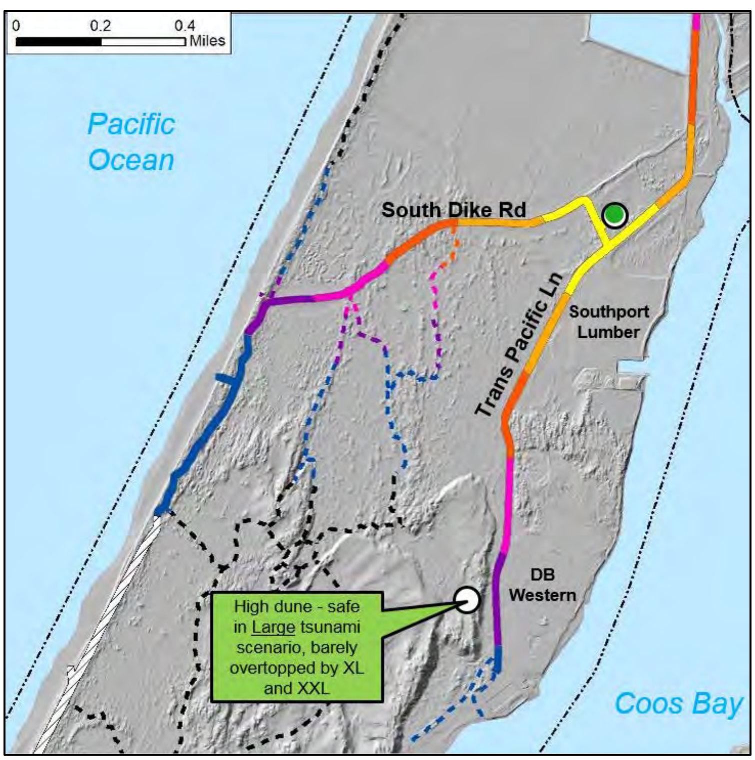




C.2 North Spit, north (top) and south (bottom) with hypothetical mitigation options:

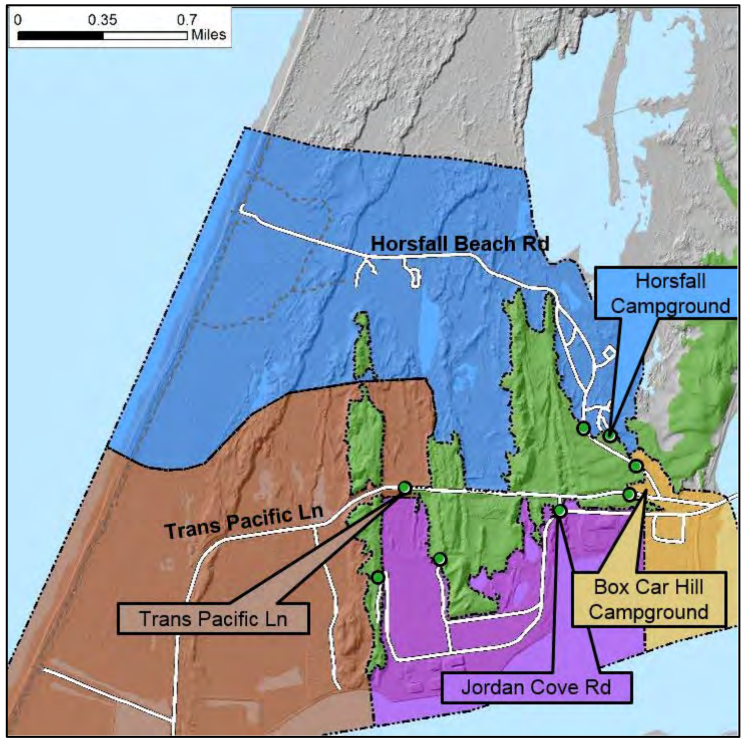
Beat the Wave pedestrian evacuation speeds are indicated by road color. On the north image, yellow dotted lines indicate hypothetical pedestrian trails off Horsfall Beach Rd. On the south image, the green dot near Southport Lumber indicates a hypothetical vertical evacuation structure. Green dots indicate safety destinations and green shaded areas are outside of the XXL tsunami inundation zone.

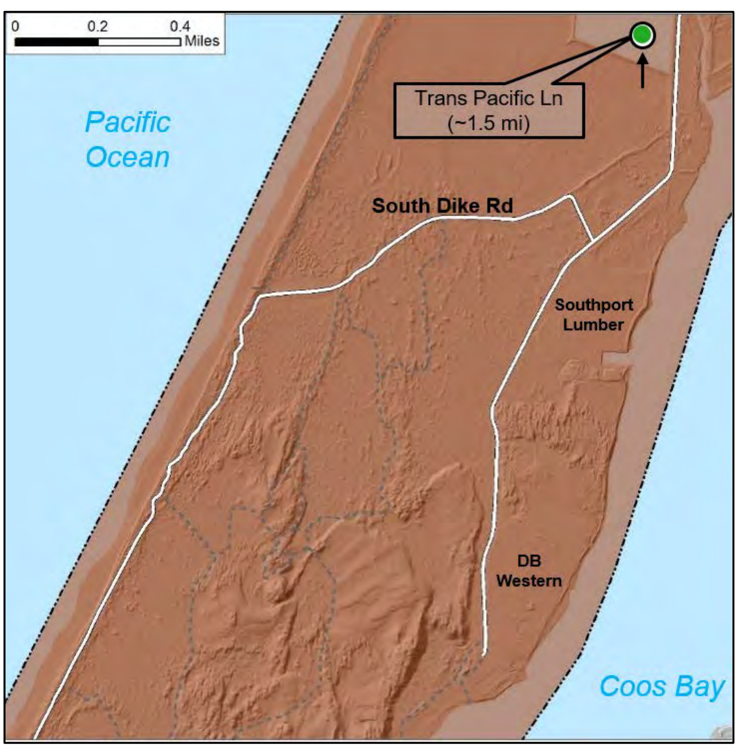




C.3 North Spit, north (top) and south (bottom) – evacuation communities:

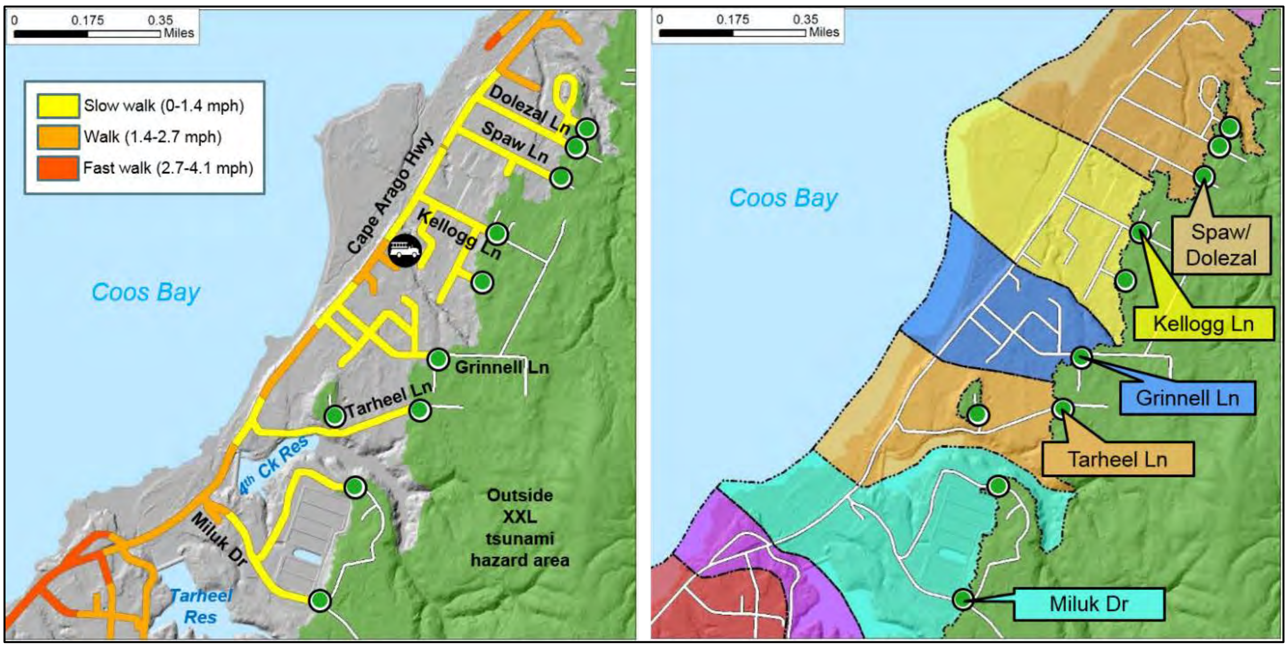
Colored areas bounded by black dotted lines indicate evacuation communities. People should evacuate to the green dot nearest them, which indicates high ground from the XXL tsunami event. On the southern part of the spit, the closest safety destination is on Trans Pacific Lane. Green shaded areas are outside of the XXL tsunami inundation zone.

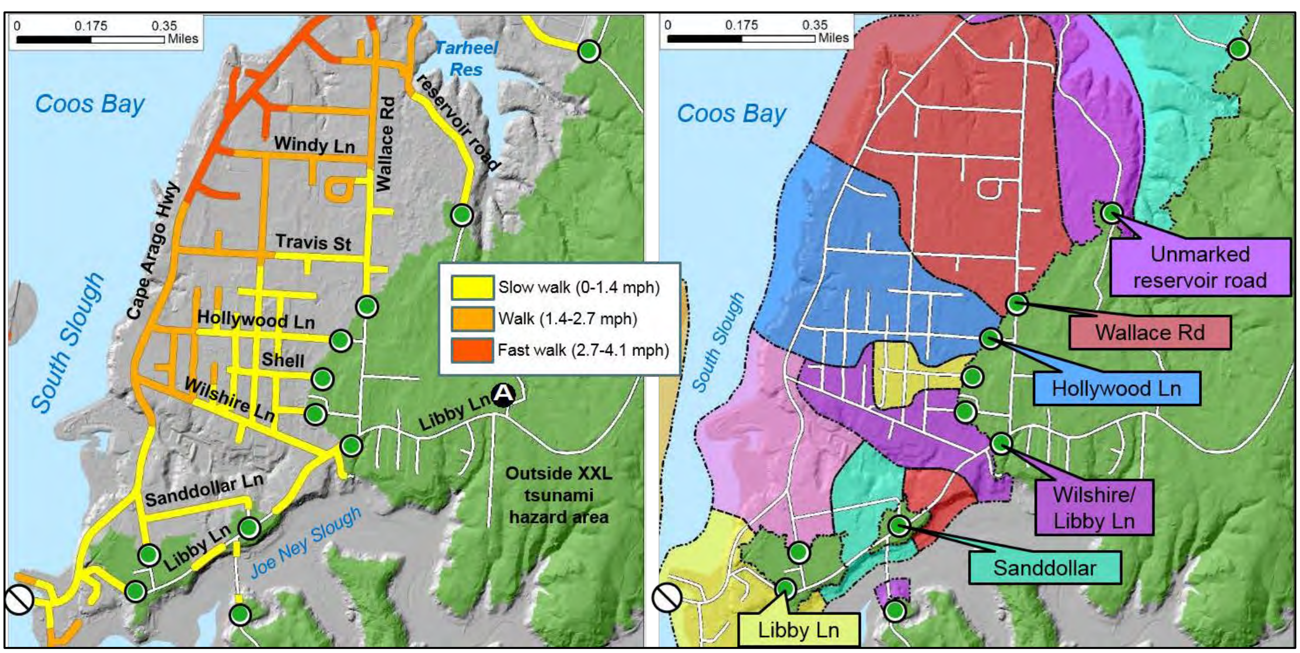




C.4 Barview, north (top) and south (bottom) – pedestrian speeds & evacuation communities:

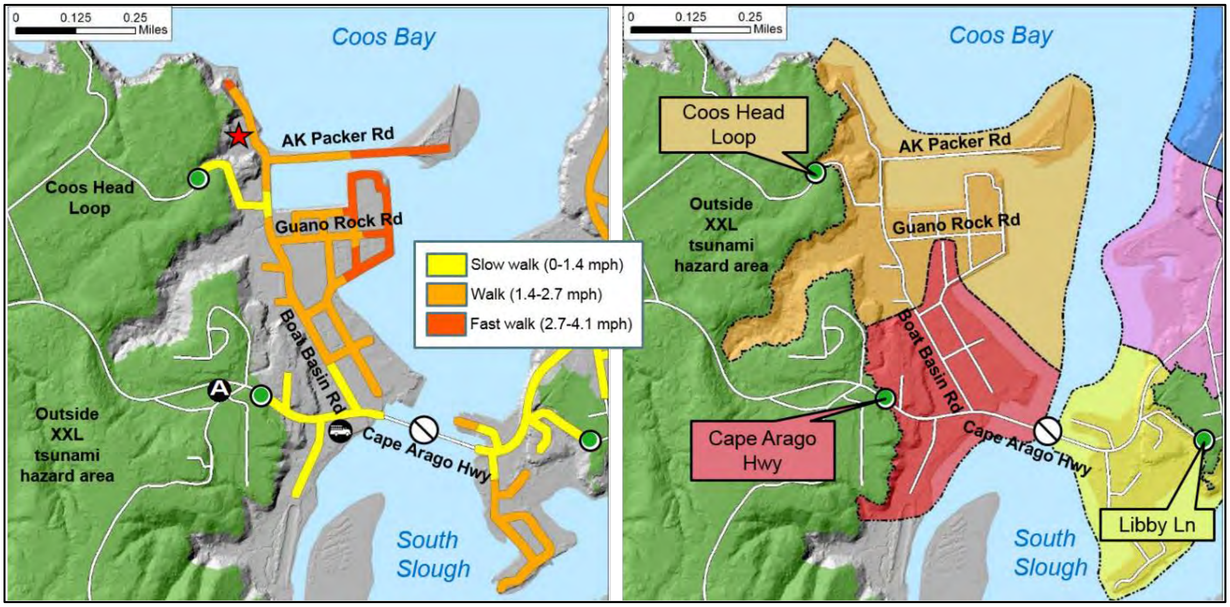
Beat the Wave pedestrian evacuation speeds are indicated by road color on the left. Evacuation communities (colored areas – on the right) define the area of evacuation and the associated nearest safety destination(s) indicated by the green dots. Green shaded areas are outside of the XXL tsunami inundation zone.





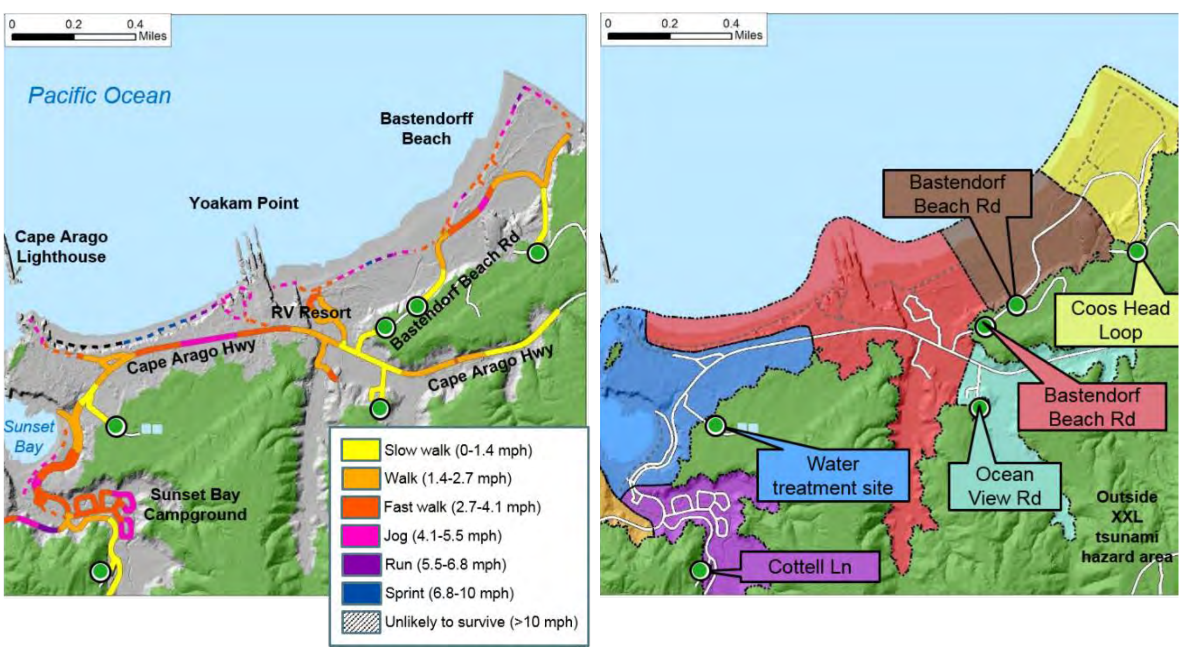
C.5 Charleston – pedestrian speeds & evacuation communities:

Beat the Wave pedestrian evacuation speeds are indicated by road color on the left. Evacuation communities (colored areas – on the right) define the area of evacuation and the associated nearest safety destination(s) indicated by the green dots. Green shaded areas are outside of the XXL tsunami inundation zone.



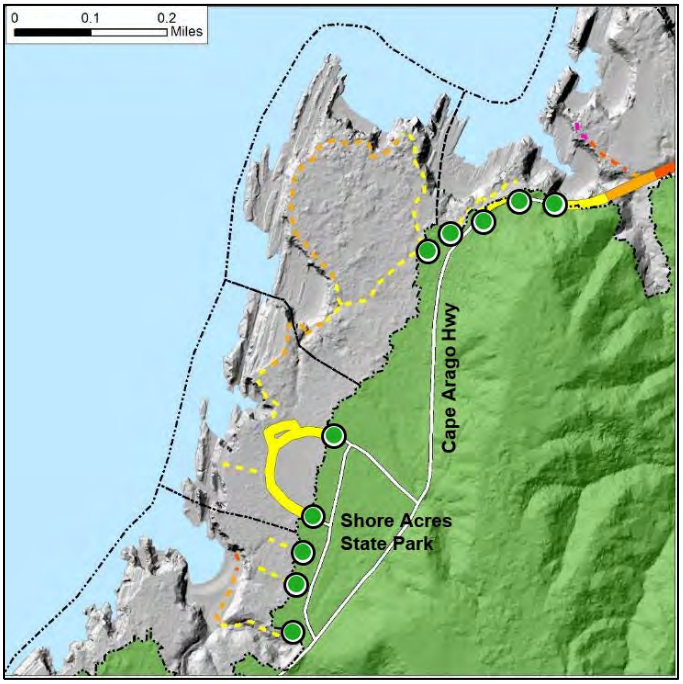
C.6 Outer Coast (south of Coos Bay Estuary) – pedestrian speeds & evacuation communities:

Beat the Wave pedestrian evacuation speeds are indicated by road color on the left. Evacuation communities (colored areas – on the right) define the area of evacuation and the associated nearest safety destination(s) indicated by the green dots. Green shaded areas are outside of the XXL tsunami inundation zone.



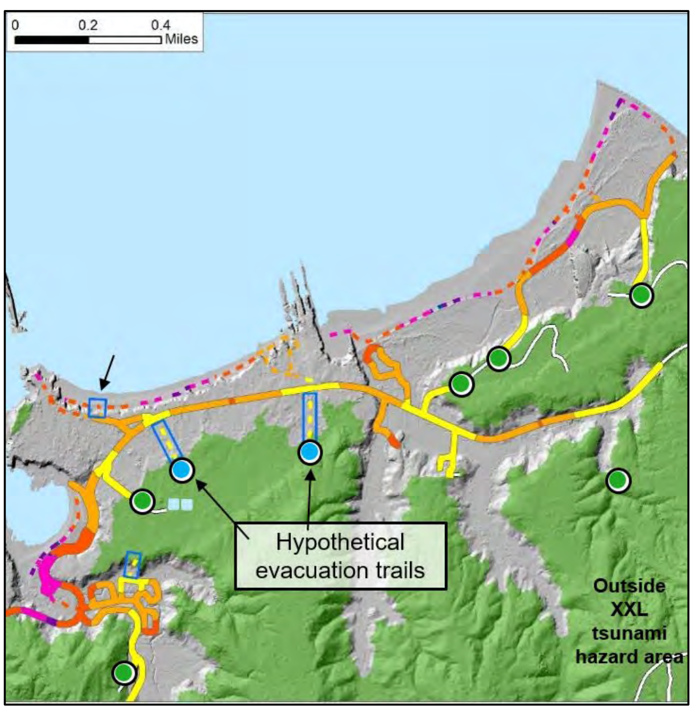
C.7 Shore Acres State Park – pedestrian evacuation speeds:

Beat the Wave pedestrian evacuation speeds are indicated by road color. Green dots indicate safety destinations and green shaded areas are outside of the XXL tsunami inundation zone.



C.8 Sunset Bay State Park with hypothetical mitigation options:

Beat the Wave pedestrian evacuation speeds for Sunset Bay to Bastendorff Beach with hypothetical pedestrian trails indicated in blue boxes (leading to blue dots). Such trails would help reduce evacuation speeds. Green shaded areas are above the XXL tsunami scenario.



4. Earthquake and tsunami impact analysis

The report below, released in 2022, supports the risk assessment for the 2023 Coos County Multi-Jurisdictional Natural Hazard Mitigation Plan Update. It is cited as Allan and O'Brien, 2022 within this document.

Open-File Report O-22-06, Earthquake and tsunami impact analysis for coastal Lane, Douglas, and Coos Counties, Oregon, by Jonathan C. Allan and Fletcher E. O'Brien; 124 p. report, including data tables and community-specific profiles.

WHAT'S IN THIS REPORT?

This report evaluates a Cascadia Subduction Zone earthquake (MW 9.0) and tsunami (M1, L1, and XXL1 scenarios) affecting coastal Lane, Douglas, and Coos counties, Oregon, to understand the degree of potential destruction, including building losses, debris generated, fatalities and injuries, and estimated numbers of the displaced populations. The goal is to help coastal communities prepare for this inevitable disaster.

PUBLICATION DOWNLOADS

The following are available at: https://www.oregongeology.org/pubs/ofr/O-22-06/p-O-22-06.htm

Report and appendix (124 p., 65 MB PDF), including an appendix of 42 tabloid-page-size community-specific profiles for Florence, Dunes City, Siltcoos River Campgrounds, Reedsport, Winchester Bay, Umpqua South Jetty, Lakeside, Coos Bay, North Bend, Barview, Charleston, Sunset Bay State Park, Bullards Beach State Park, and Bandon.
Report only (80 p., 3.1 MB PDF)
Appendix A community profile sheets only (44 p., 62 MB PDF)
Spreadsheets only (Three Excel spreadsheets, 163 KB .zip file) - contains all the data that are the basis for this report's tables and figures

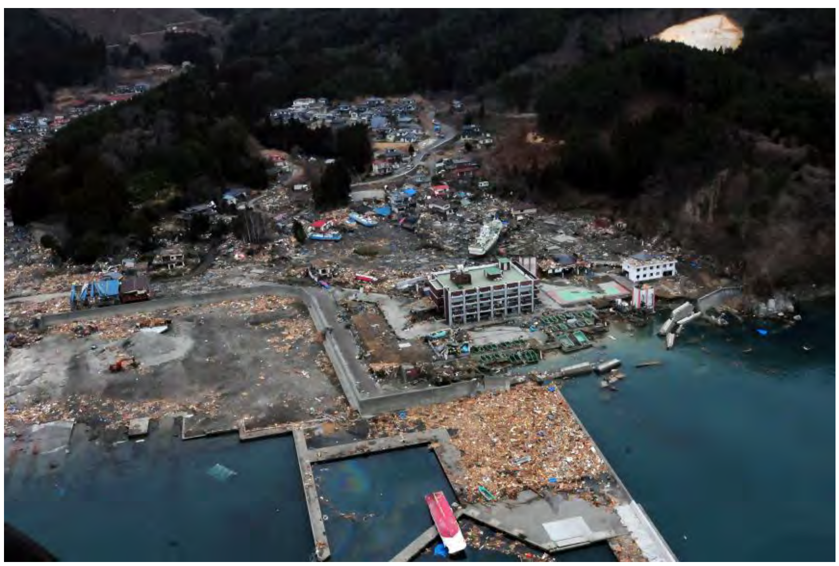
Publication bundle (report, appendix, spreadsheets; 61 MB .zip file

State of Oregon
Oregon Department of Geology and Mineral Industries
Ruarri Day-Stirrat, State Geologist

OPEN-FILE REPORT O-22-06

EARTHQUAKE AND TSUNAMI IMPACT ANALYSIS FOR COASTAL LANE, DOUGLAS, AND COOS COUNTIES, OREGON

By Jonathan C. Allan[1] and Fletcher E. O'Brien[2]



2022

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WHAT'S IN THIS REPORT?

This report evaluates a Cascadia Subduction Zone earthquake (M_W 9.0) and tsunami (M1, L1, and XXL1 scenarios) affecting coastal Lane, Douglas, and Coos counties, Oregon, to understand the degree of potential destruction, including building losses, debris generated, fatalities and injuries, and estimated numbers of the displaced populations. The goal is to help coastal communities prepare for this inevitable disaster.

Cover: Photo from Wikimedia commons: https://commons.wikimedia.org/wiki/File: US Navy 110315-N-5503T-307 An aerial view of damage to Otsuchi, Japan, after a 9.0 magnitude earthquake and subsequent tsunami devastated the area in northern Japan.jpg.

U.S. Navy photo by Mass Communication Specialist 3rd Class Alexander Tidd, March 15, 2011

Oregon Department of Geology and Mineral Industries Open-File Report O-22-06
Published in conformance with ORS 516.030

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EXCEL SPREADSHEET

A Microsoft Excel spreadsheet for each county showing data that are the basis for this report's tables and figures is available in the digital file set of this report.

EXECUTIVE SUMMARY

This report provides an evaluation of the potential impacts of a Cascadia earthquake and accompanying tsunami in coastal Lane, Douglas, and Coos counties. The analyses presented here include an assessment of the number of people, businesses, and critical facilities located in three Cascadia tsunami inundation zones (M1, L1, and XXL1). XXL1 represents the maximum-considered inundation scenario given our knowledge of the Cascadia Subduction Zone (CSZ). Large (L1) and Medium (M1) tsunami zones reflect smaller earthquake and tsunami scenarios that are more likely to occur than XXL1. L1 captures 95% of the uncertainty in tsunami modeling (there is a ~5% chance that the tsunami could exceed the L1 tsunami zone), whereas the M1 scenario captures 78% of the uncertainty (there is a ~22% chance that the tsunami could exceed the M1 tsunami zone).

A major focus of this study is to provide improved estimates of local population demographics in each community to better understand evacuation challenges that could affect different population groups, as well as socioeconomic impacts associated with a CSZ earthquake and tsunami. The results and analyses presented here reflect a comprehensive effort to document the likely effects the next great earthquake and tsunami will have on all three counties.

We used previously developed physical models of a CSZ earthquake and tsunami, "Beat the Wave" tsunami evacuation modeling, and the recently published Federal Emergency Management Agency (FEMA) Hazus Tsunami Model to develop standardized damage loss estimates for each community, as well as estimates of injuries, fatalities, and displaced population. From the building damage losses, we estimated the amount of debris generated. Our population model improves upon previous studies by providing spatially detailed estimates of permanent and temporary populations — the latter quantifying numbers of visitors, which vary widely throughout the calendar year. The tsunami injury and fatality modeling evaluates a nighttime (2 AM) evacuation scenario, which assumes people are in their homes/hotels/campgrounds at the time of the event (as opposed to on the beach or walking around town). We also maximize visitor occupancy by assuming all hotels/second homes/campgrounds are at capacity, to fully quantify potential impacts to permanent and temporary residents. Our major findings include the following:

- Total populations in coastal Lane, Douglas, and Coos counties that are within a tsunami zone are summarized below:

	Permanent population (M1 – XXL1)	Permanent + temporary population (M1 – XXL1)
Lane	550 – 1,870	2,600 – 6,040
Douglas	1,050 – 1,970	3,360 – 5,430
Coos	1,330 – 10,340	4,970 – 20,850

- The fraction of permanent residents within the three tsunami zones varies considerably between communities. These variations reflect contrasting patterns in the general shape and elevation of the county coastlines, whether it is open coast versus up an estuary; inundation extents; and the distribution of permanent residents within the communities. Notable observations:
  - **Siltcoos**, **Sunset Bay**, and **Bullards Beach** campgrounds are 100% inundated in all three scenarios.
  - For the M1 scenario, communities with the largest number of people in the tsunami zone include **Charleston** (32%), **Winchester Bay** (54%), and **Umpqua South Jetty** (49%).
  - **Winchester Bay** is mostly located in the M1 tsunami zone and is 100% within the L1 and XXL1 tsunami zones.

  - **Barview**, **Charleston**, and **Bandon** each have relatively large numbers of people located in the XXL1 tsunami zone — 73%, 52%, and 68% respectively.
  - **Florence**, **Dunes City**, **Lakeside**, **North Bend** and **Coos Bay** have relatively few people in the various tsunami zones.
- All 17 communities and parks distributed along the Lane, Douglas and Coos coastlines can experience significant influxes of visitors, well exceeding their local resident populations. Of note, the population of **Florence** can swell by ~420% to 300% (M1 to XXL1), **Winchester Bay** by ~1,360% to 950%, and **Bandon** by ~210% to 225%. The popularity of these communities as centers of tourism present challenges associated with preparing such a large transient population for a CSZ earthquake and tsunami.
- An understanding of how population demographics are geographically distributed within each tsunami zone can provide an insight into those communities that may experience evacuation challenges. We use people over 65 years of age as a proxy for those who may experience increased evacuation difficulty (reduced evacuation travel speeds). Numbers of people over 65 years of age within a particular tsunami zone is summarized below:

	% of population ≥65 years	Number of ≥65 within M1	Number of ≥65 within L1	Number of ≥65 within XXL1
Lane	35% (M1 & L1), 34% (XXL1)	189	324	715
Douglas	34% (M1 to XXL1)	325	526	617
Coos	33% (M1), 31% (L1), 28% (XXL1)	436	914	2,749

  - At the community level, **Florence**, **Winchester Bay,** and **Bandon** each have a large proportion (41%) of their resident population ≥65 in the XXL1 tsunami zone.
- The number of buildings located in a tsunami zone is a useful metric for determining exposure to the tsunami hazard. Building counts in the tsunami zones are particularly large in **Barview**, **Bandon**, **Coos Bay**, and to a lesser degree **Florence**. Interestingly, the largest single number of buildings fall within the "other" category (~2,102) in unincorporated Coos County, reflecting residential buildings established along the open coast outside of community boundaries, as well as along the shores of the Coos and Coquille estuaries. Communities with particularly high exposure to the tsunami hazard include:

	% buildings inside the tsunami zone		
	M1	**L1**	**XXL1**
Winchester Bay	56%	98%	98%
Charleston	58%	59%	70%
Barview	6%	17%	76%

- Building damage caused by earthquake shaking in the three coastal counties is estimated to be:
  - Lane County: $1.23 billion
  - Douglas County: $420 million
  - Coos County: $4.42 billion

  The large loss estimates for Coos County can be attributed to the effects of liquefaction (and lateral spreading) that are particularly damaging to bayfront infrastructure. Earthquake damage losses in the communities of **Coos Bay** and **North Bend** are substantial and are estimated to reach ~$1.8 billion. Nevertheless, the largest earthquake losses fall within the "other" category (~$1.9 billion) in Coos County, which reflect those buildings located throughout unincorporated Coos County.

- An M1 event could yield damage levels that range from ~10% at **Dunes City** to ~90% at **Bandon** and **Charleston**. Damage caused by the XXL1 tsunami reveals destruction levels of >70% in most coastal communities, including **Florence**, **Reedsport**, **Winchester Bay**, **Coos Bay**, **North Bend**, **Barview**, **Charleston**, and **Bandon**; complete destruction occurs at the Siltcoos, Bullards Beach and Sunset Bay campgrounds. These findings can be attributed to the powerful hydraulic forces associated with the tsunami, and the prevalence of light-frame construction material (i.e., wood frame) on the Oregon Coast.
- Combined earthquake and tsunami damage losses for each tsunami zone and scenario are estimated to be significant:

	M1	L1	XXL1
Lane	$1.25 billion	$1.27 billion	$1.36 billion
Douglas	$440 million	$464 million	$530 million
Coos	$4.52 billion	$4.62 billion	$5.14 billion

These estimates reflect community-wide losses associated with the earthquake, combined with destruction caused by the tsunami. Note that these estimates exclude building content losses, such that the numbers may be viewed as minimum estimates.

- The destruction of buildings in coastal Lane, Douglas, and Coos counties is expected to generate substantial debris:

	M1	L1	XXL1
Lane	40,000 tons	50,500 tons	108,000 tons
Douglas	71,200 tons	106,000 tons	149,000 tons
Coos	191,300 tons	358,000 tons	785,000 tons

This equates to ~4,000 dump trucks for M1 in Lane County to as much as 78,500 dump trucks for an XXL1 event in Coos County (assuming dump truck capacity of ~10 yd^3). These estimates are almost certainly on the low end, as they do not include debris associated with content from buildings (personal items, business equipment, furniture etc.), road rip-ups, vehicles, and vegetation.

- Modeled tsunami casualties (injuries and fatalities) vary widely between communities. This is due to many factors, but the most important is the relative distance to high ground. We estimate that, combined, countywide fatalities from the tsunami could reflect the following:

	M1	L1	XXL1
Lane	20	50	200
Douglas	610	1,180	1,380
Coos	440	1,070	5,290

  - Low casualties associated with the M1 scenario in Lane County is indicative of the fact that high ground is located close to the population centers, allowing for quick access to high ground, or the tsunami simply was not large enough to reach them.
  - For the XXL1 tsunami scenario — the largest-considered — the potential for significant fatalities is apparent for **Bandon** (~1,900), the "other" category in Coos County (~1,400), **Winchester Bay (**~1,200), and **Barview (**~980). Overall, the bulk of the fatalities (>61%) are likely to be from the temporary visitor population.

    - High casualties associated with the temporary visitor population is predicated on the assumption that these facilities are at 100% occupancy.
    - Several additional sites with the potential for large visitor fatalities include **Siltcoos River** Campground, **Umpqua South Jetty**, **Sunset Bay** campground and **Bullards Beach** campground. Fatalities in these areas are due to a combination of early wave arrivals and long travel distances required to reach high ground.
    - These results demonstrate a need to evaluate alternative forms of high ground (e.g., vertical evacuation structures) and/or evaluate retrofitting bridges (e.g., Winchester Bay) to withstand the earthquake shaking, thereby allowing for faster evacuation.
- Following the earthquake and accompanying tsunami, communities will have to deal with many hundreds to potentially thousands of displaced people requiring immediate short-term shelter and care (for days to a few weeks), after which many people are likely to be evacuated from the coast. Hazus modeling indicates that the number of displaced people is significantly higher in the XXL1 scenario (~25,400) compared to the M1 scenario (~9,800). We expect large numbers of displaced people to severely challenge the following communities: **Florence**, **Reedsport**, **Coos Bay**, **North Bend**, **Barview** and **Bandon**. Furthermore, an estimated 4,800 people outside of community urban growth boundaries (UGB) and unincorporated boundaries will require shelter and care.
- Compared to fatalities, injuries from the earthquake were found to be moderately low. Overall, the number of critically injured (requiring hospitalization) as a result of the earthquake is on the order of:
    - Lane County: 150
    - Douglas County: 30
    - Coos County: 380
- Injuries caused by the tsunami are expected to be on the order of:

	M1	L1	XXL1
Lane	~20	5	90
Douglas	~590	40	80
Coos	~180	350	1,700

Although each community in coastal Lane, Douglas, and Coos counties has unique circumstances and challenges, our results unequivocally demonstrate that in every community, ***injuries and fatalities from a tsunami can be minimized if people evacuate on foot toward safety as soon as possible and travel as fast as possible.***

1.0 INTRODUCTION

The destructive and life-threatening forces of tsunamis are well known globally, as demonstrated by the 2011 Tōhoku, Japan event that resulted in 15,899 killed and another 2,529 missing (as of September 10, 2020; National Police Agency of Japan, 2020). Most of the deaths in the event were due to drowning (Mori and Takahashi, 2012). The earthquake and tsunami destroyed 121,992 buildings. A total of 282,920 buildings experienced partial collapse, and 730,359 buildings were partially damaged. A total of 4,198 roads were damaged, along with 116 bridges (National Police Agency of Japan, 2020).

The Oregon Coast is similarly exposed to large megathrust subduction zone earthquakes, capable of generating catastrophic tsunamis (Witter and others, 2011). The Cascadia Subduction Zone (CSZ) geologic record contains evidence of at least 19 earthquakes >8.5 M_W over the past 10,000 years (Goldfinger and others, 2012, 2017; Priest and others, 2009; Satake and others, 2003; Walton and others, 2021; Witter and others, 2012). The most recent tsunami generated on the CSZ occurred on January 26, 1700 (Atwater and others, 2005). Goldfinger and others (2017) estimated the conditional probability of an earthquake on the CSZ at ~16–22% in the next 50 years; a partial rupture of the CSZ impacting the southern Oregon Coast has a conditional probability of ~37–43% (Goldfinger and others, 2012). Because many communities on the Oregon Coast have large numbers of people, residences, and businesses located in the tsunami zone, there is a high potential that the next great earthquake and tsunami will result in many fatalities, catastrophic destruction of local infrastructure, and lasting damage to Oregon's economy. The objective of this report is to examine community exposure to tsunami inundation and earthquake shaking and provide estimates of infrastructure damage and casualties for Coos, Lane and Douglas County on the southcentral Oregon Coast. In providing such information, we address a specific need expressed in the 2013 Oregon Resilience Plan — to document the "who," "what," and "where" in terms of population exposure, building damage, and socioeconomic impacts (OSSPAC, 2013). The overall approach presented here follows comparable efforts undertaken for Clatsop, Tillamook, and Lincoln counties (Allan and others, 2020a,b; Allan and O'Brien, 2021). The difference here is that we use an updated Cascadia earthquake scenario developed by Wirth and others (2020) and new geologic data summarized in Madin and others (2021).

Following the 2011 Tōhoku, Japan, tsunami, Federal Emergency Management Agency (FEMA) commissioned an effort to standardize quantification of tsunami impacts (FEMA, 2013), which was refined and eventually incorporated into FEMA's Hazus framework (FEMA, 2017). Hazus is a geospatial information system (GIS) software model that produces loss estimates for earthquakes, floods, hurricanes, and tsunamis based on state-of-the-art scientific and engineering risk analyses. Critical inputs needed by Hazus include a wide variety of tsunami modeling, engineering, and societal information, including earthquake ground motion and ground deformation, tsunami inundation, flow velocities and flow depths, building inventories, and population demographics.

In Oregon, considerable mapping and modeling has been undertaken by the Oregon Department of Geology and Mineral Industries (DOGAMI) to better advise local and state government agencies on the various geologic hazards that could impact the state. For example, DOGAMI and the U.S. Geological Survey (USGS) published ground motion/deformation maps for a magnitude (M_W) 9.0 CSZ earthquake (Madin and Burns, 2013). These data were integral in initial efforts to evaluate impacts from a CSZ event throughout Oregon (OSSPAC, 2013). The work of Madin and Burns (2013) have since been updated by Madin and others (2021) to account for new geological data, including updated soil, liquefaction and landslide information, as well as recently compiled Cascadia earthquake ensemble modeling undertaken by Wirth and others (2020).

Between 2010 and 2013, DOGAMI combined high-resolution terrestrial lidar-derived digital elevation models (DEMs) with detailed bathymetry to model five scenarios for CSZ generated tsunamis (Priest and others, 2013g; Witter and others, 2011). More recently, DOGAMI pioneered techniques for tsunami evacuation modeling (“Beat the Wave,” BTW) at Seaside and Gearhart (Priest and others, 2015), Warrenton/Hammond (Gabel and Allan, 2016), Rockaway Beach, (Gabel and Allan, 2017), Pacific City (Gabel and others, 2018a), Reedsport and Florence (Gabel and others, 2018b), Newport (Gabel and others, 2019a), Lincoln City/unincorporated Lincoln County (Gabel and others, 2019c), the Coos estuary (Gabel and others, 2019b), unincorporated Lincoln County (Gabel and others, 2019d), Port Orford (Gabel and others, 2020a), Nehalem Bay (Gabel and others, 2020b), and Gold Beach (Gabel and others, 2021). These BTW studies graphically demonstrate evacuation challenges and mitigation opportunities but do not quantify potential loss of life. Since 2015, Williams and others (e.g., Williams and others, 2021) developed a Hazus-compatible building inventory for all seven Oregon coastal counties, identifying the location, size, and primary usage (e.g., residential, commercial) of buildings, information fundamental to addressing fatalities and building damage potential.

Although most data needed by Hazus to model the effects of earthquake and tsunami impacts are in place, one key missing element is a spatially explicit population model for the Oregon Coast. Specifically, how many people are located in the tsunami zone, their demographics, and where they are located relative to safety from the tsunami at the time of the earthquake. Such a model is complicated because many Oregon coastal communities experience large influxes of daytime and overnight visitors throughout the year (Dean Runyan Associates, 2018). Many homes and condominium units located in the tsunami zone are second homes or vacation rentals (Raskin and Wang, 2017). Additionally, numerous coastal parks and campgrounds are located in the tsunami zone and potentially host many thousands of overnight visitors per day (White, 2018). Each of these considerations must be carefully evaluated and accounted for in order to generate meaningful statistics of both local and visitor populations and, ultimately, potential casualties and displaced populations associated with a CSZ earthquake and tsunami. Furthermore, *population estimates should assume the highest seasonal occupancy so that design capacities will be based on the maximum potential evacuation need*, while also identifying vulnerable population groups within the tsunami zone that may present special evacuation challenges (DLCD, 2015).

The purpose of this report is to evaluate the potential effect of a CSZ earthquake and accompanying tsunami in coastal Coos, Douglas, and Lane counties (**Figure 1-1**). Specifically, we evaluate estimates of potential building losses, generated debris, fatalities, and injuries, as well as estimates of the number of displaced people. The study also provides an assessment of vulnerable populations, essential facilities, and critical infrastructure, which is important to response and recovery. This study integrates previous tsunami modeling with a new Cascadia earthquake model and new population model (comprising permanent and temporary people) for the purpose of:

1. evaluating tsunami evacuation challenges and opportunities on the coast.
2. completing a detailed socioeconomic analysis using several data sources to identify vulnerable communities in the tsunami zone.

This report initially describes and documents our overall Hazus approach. Results from the countywide assessments are provided in Section 3, with broad conclusions outlined in Section 4. Summary information specific to each community and tsunami inundation zone is provided in Appendix A.

Figure 1-1. Location map showing coastal Lane, Douglas, and Coos county communities. Yellow zone depicts the XXL1 tsunami zone.

2.0 METHODS

2.1 Overview

Baseline information required by Hazus includes:

1. A physical description of the earthquake and tsunami hazard.
2. A comprehensive building database, with each building populated with an occupancy estimate derived from our population model.

For the earthquake hazard, we used the median CSZ M_W 9.0 earthquake, which is derived from an ensemble of 30 Cascadia earthquakes (Wirth and others, 2020). For the tsunami hazard, we provide results for three tsunami inundation zones: Medium (M1), Large (L1), and Extra Extra Large (XXL1) (Priest and others, 2013g; Witter and others, 2011). Thus, Hazus model results presented here reflect earthquake-related damage, debris weight, and casualties simulated for the entire community and for each of the three tsunami inundation scenarios. We do not model the earthquake damage and casualties that would occur for those communities located well inland from the coast (e.g., Eugene) that are part of a particular county. For injury and fatality estimation we analyzed a "2 AM" scenario, in which an earthquake strikes during the summer (when the number of visitors is the highest) at 2 a.m. (when most people are asleep). The modeling distinguishes the number of casualties experienced by both permanent residents as well as the temporary visitor population. We did not evaluate a 2 PM scenario because the 2 AM scenario defined for summer occupancy conditions assumes maximum occupancy and we believe it is sufficiently conservative to account for uncertainty associated with the movement patterns of day trippers.

2.2 Natural Hazard Dataset Development

2.2.1 Earthquake

Wirth and others (2020) recently developed ground-shaking estimates from 30 M_W 9.0 CSZ earthquakes, determined using a logic-tree approach that varied the location within the earth where the earthquake rupture starts, down-dip rupture limit, slip distribution, and location of strong-motion-generating sub-events. From these data, they produced an ensemble suite of ShakeMaps[1] based on the median scenario $\pm1\sigma$ and $\pm2\sigma$, which spans the 2nd and 98th percentile ground motions. For the median ensemble ShakeMap, they observed that the Modified Mercalli intensity (MMI), a measure of the ground-shaking intensity, is likely to range from MMI 8 ("severe" shaking) along the Oregon Coast to MMI ~7 ("very strong" shaking) within inland locations such as the Willamette Valley. The southern Oregon Coast could experience MMI ~8-9, which equates to "violent" shaking. According to Wirth and others (2020), the difference between the 2nd and 98th percentile ground motions (i.e., $\pm2\sigma$ around the medium) spans ~1.5-2 MMI units. For the purposes of this risk assessment, we used the bedrock ground motions associated with the median M_W 9.0 CSZ earthquake (Wirth and others, 2020) for use in the FEMA Hazus Advanced Engineering Building Module (AEBM; FEMA, 2010). The median M_W 9.0 CSZ earthquake data were compiled along with local ground characteristics that influence the amplification of ground shaking, namely liquefaction of soils, and earthquake-induced landslides by Madin and others (2021) to produce a

[1] https://earthquake.usgs.gov/data/shakemap/

new statewide seismic hazard map for Oregon. These latter datasets reflect years of surficial geologic mapping using high-resolution lidar data to produce accurate maps of areas subject to different coseismic geohazard conditions.

The bedrock ground motions were adjusted for discrete areas using National Earthquake Hazards Reduction Program (NEHRP) recommended site amplification factors (FEMA, 2015a, implemented as piecewise linear equations by Bauer and others, 2018, Appendix B). Updated NEHRP site classification (Figure 2-4 in Madin and others, 2021) and Hazus-scale liquefaction susceptibility GIS data (Figure 2-5 in Madin and others, 2021) were used in this study. Sites with NEHRP site classification "F" (meaning soil requires site-specific evaluations, as defined by FEMA, 2003, Section 3.5) were reclassified as "E" (soft soils) — a commonly implemented assumption for loss estimation purposes (Bauer and others, 2018; Madin and others, 2021). For liquefaction modeling, we assumed a water table level of zero feet (i.e., fully saturated soil). Hazus-scale landslide susceptibility data were obtained by processing landslide susceptibility GIS data compiled by Madin and others (2021). We mapped the 1–4 scale defined by Madin and others (2021) to the FEMA Hazus landslide susceptibility scale of 0–10 as follows: "Low" corresponds to 1, "Moderate" corresponds to 4, "High" corresponds to 7, and "Very High" corresponds to 10. The mapping corresponds to the "WET" scenario described by FEMA (2011, Table 4.15).

2.2.2 Tsunami

The earthquake scenarios and corresponding surface deformation used to simulate tsunami inundation for the Oregon Coast reflect a full-length rupture of the Cascadia megathrust (Witter and others, 2011, 2013). Four representative earthquake slip models were defined and tested, including slip partitioned to a hypothetical splay fault in the accretionary wedge and models that varied the updip limit of slip on the megathrust. Recurrence information was defined from a suite of scientific studies, including work undertaken in coastal estuaries (Nelson and others, 1996, 2006; Peterson and others, 1995; Witter and others, 2003) and on the continental shelf (Goldfinger and others, 2012). Inter-event time intervals that separate the 19 full-margin earthquakes and tsunamis range from as little as 110 to ~1,150 years (Witter and others, 2011, Table 1). Each tsunami scenario was then weighted using a logic tree, to account for the different models, convergence rates, and recurrence. From these data, four time intervals (mean values rounded to the nearest quarter century) were defined as representative of four general earthquake size classes:

- Small (SM) – Five events, mean inter-event time of 300 years (range=~110 to 480 years).
- Medium (M) – 10 events, mean inter-event time of 525 years (range=~310 to 660 years).
- Large (L) – Three events, mean inter-event time of 800 years (range=~680 to 1,000 years).
- Extra Large (XL) – One event, mean inter-event time of 1,150 years, rounded to 1,200 years.

The mean inter-event time interval multiplied by the CSZ plate convergence rate at each latitude equates to the amount of slip deficit released in each scenario earthquake. Slip was also reduced progressively from north to south on the CSZ to account for evidence in the paleoseismic record of increasing numbers of partial CSZ ruptures from north to south (Goldfinger and others, 2012; Witter and others, 2013). A fifth scenario termed Extra Extra Large (XXL1), which simulated a maximum-considered tsunami not seen in the geologic record, was eventually used to guide evacuation planning (Witter and others, 2011). This last hypothetical scenario assumes 1,200 years of slip deficit release but without any reduction of slip from north to south. According to Witter and others (2013), the defined earthquake size classes correspond to approximate recurrence rates as follows: SM, 1/2,000 years; M, 1/1,000 years; L, 1/3,333 years; and XL, <1/10,000 years. Recurrence for the XXL1 event is not known.

Maximum flow depths were obtained from Priest and others (2013a,b,c,d,e,f), and the maximum momentum flux was derived from Priest and others (2014a,b,c,d,e,f). The unstructured computational grid data were converted to raster format for use in Hazus using the Esri® ArcGIS Spatial Analyst Natural Neighbor tool. We specified a 3-m (~10-ft) grid resolution, noting that the mean distance between points in the terrestrial regions within the XXL1 tsunami zone was ~5 m (~16 ft). The Hazus tsunami building damage and casualty fragility curve parameters (determined by engineers) are based on median depth and momentum flux values, rather than maximum values (FEMA, 2017, section 4.6). To that end, the raster data were subsequently converted to both median depth and median momentum flux using a 0.66 multiplier; the results were also converted to non-SI (English) units for use in Hazus.

Wave arrival times at the tsunami runup limit were obtained from data originally developed by Priest and others (2013a,b,c,d,e,f). As documented by Bauer and others (2020), an independent spreadsheet that implements the Hazus tsunami casualty model was developed to facilitate analysis and reporting of injuries and fatalities resulting from a tsunami (see Section 2.6). The original approach relied on a single average wave arrival time per community. For this study, however, we modified the approach to support per-record maximum wave arrival times at the tsunami runup limit (in minutes). This was necessary due to the large variation in maximum wave arrival times observed along the Oregon Coast, especially within the various estuaries. For example, wave arrival times ranges from as little as 12 minutes for a tsunami arriving at the open coast near the mouth of the Coos estuary, compared with 42 minutes for the tsunami to reach downtown Coos Bay. These differences have an enormous bearing on the number of modeled casualties. To resolve this limitation, we used the evacuation flow zone polygons defined in our various "Beat the Wave" studies to associate a group of buildings with a particular tsunami safety destination or exit point. We then determined the maximum wave arrival time at a particular watershed's exit point and assigned that value (in minutes) to the polygon. All buildings within that watershed were then associated, via a spatial overlay, with that wave arrival time. In some open coast communities, such as Bastendorff Beach, the maximum wave arrival time varies only slightly, and a single value was assigned to all buildings. Wave arrival times for areas located outside our detailed "Beat the Wave" investigations were defined based on average wave arrival times for that particular section of coast.

2.3 Building Database Development

A Hazus-compatible building database contains a record for each distinct building. Each record contains essential information for estimating potential damage to the structure and harm to the building's occupants (**Table 2-1**). Information associated with the building record is populated primarily from county assessor records or, from ancillary datasets, and when better data is available (e.g., Lewis, 2007). We followed the methods established by Bauer and others (2018), starting with the incorporation of building records previously developed (e.g., Williams and others, 2021) and modifying or amending records where better information was available.

The User-Defined Facilities (UDF) datasets developed by DOGAMI attempts to identify all buildings that can be considered a residential facility, including traditional single-family residences, manufactured housing, multifamily residential buildings, condominiums, motels, and hotels, dormitories and assisted living facilities. The datasets contain information on building primary usage (Hazus "occupancy class"), square footage, number of stories, year built, and building type (e.g., wood frame, steel frame construction, etc.). Although the UDF dataset was a good starting point, it did not always correctly classify residential structures. Therefore, it required a thorough review, during which many records were manually updated to correct existing attributes.

We augmented the UDF dataset as follows. We added a "number-of-units" field, identifying the number of rooms, where available, for motels, multifamily residential, and dormitory building types (Hazus occupancy types "RES4," "RES3," "RES5," respectively). We further augmented the UDF dataset by adding records to capture the locations of individual tent and yurt sites, recreational vehicle spots, and boat slips in marinas that permit overnight docking. Such locations were digitized as points using orthoimagery and other ancillary data sources, such as Oregon State Park campground maps. We note that the Hazus earthquake and tsunami building damage model is limited to traditional buildings, and thus our building loss estimates exclude damage to temporarily occupied structures such as tents, recreational vehicles, and boats.

Table 2-1. Building information required by Hazus earthquake and tsunami model.

Hazus Attribute	Example	Purpose
Location of building	latitude, longitude	Extract ground motion and ground deformation data
Building usage	Single-family Residential; Retail Commercial	Repair/replacement cost; number of people per building
Building material	wood; steel	Building response to ground motion; debris
Year built	1968	Seismic design level: building response to ground motion
Number of stories	2	Building response to ground motion
Square footage	2,250	Building repair/replacement cost; debris; number of people per building
First floor height	3.0	(in feet) Tsunami nonstructural building damage estimate
Daytime occupancy+	2.1	Casualty estimate
Nighttime occupancy+	3.4	Casualty estimate

+*Daytime* and *Nighttime occupancy* are Hazus terminology. For our analysis purposes we populate *Daytime occupancy* with the number of temporary residents in the building at 2 p.m. and *Nighttime occupancy* with the number of permanent residents in the building at 2 a.m.

We used the RSMeans valuation method for estimating a building's replacement cost (Charest, 2017) where:

$$\text{RSMeans} = \text{building square footage} \times \text{standard cost per square foot} \quad (1)$$

Per-square-foot replacements costs are derived from the Hazus 5.0 database[2], which incorporated the 2014 RSMeans valuation. Adjustments for inflation or regional variation to the tabular data were not incorporated.

Building replacement cost is not the same as a property's assessed value. For analysis purposes, we assume repair or replacement costs to damaged structures will be charged at standard construction rates, independent of a building's age or the land on which the building is placed. Assessed value includes the land's value, which may fluctuate greatly depending on real estate markets, and home improvements. Assessors may also factor in the building's depreciation into the assessed value.

An abnormal shortage of skilled labor or materials can occur following a large-scale disaster. "Demand surge" is a phenomenon resulting in a higher cost to repair buildings after large disasters, compared with

[2] FEMA Hazus SQL tables [dbo].[hzRes1ReplCost] for single-family residential; [dbo].[hzReplacementCost] for all other occupancy types.

the same repair for damage after a small disaster (Olsen and Porter, 2011). Adjusting repair/replacement costs due to a likely demand surge was beyond the scope of this project.

Williams and others (2021) used street-level imagery to determine the building type of all non–single-family residential buildings, using the guidance provided by FEMA (2015b); selected records were updated with information from Lewis (2007) and other ancillary data sources. Williams and others (2021) were unable to locate additional building information that might have helped further refine the building type assignment, or any seismic retrofitting datasets that could be used to update an individual building's seismic design level. Finally, our observations from numerous field visits and analysis of street-level imagery suggested that the statistical distributions for building types identified by FEMA (2011, Tables 3.A1–3.A.10) are not applicable to the Oregon Coast. This is because most commercial and industrial buildings built on the Oregon Coast use wood-frame construction. For single-family residential buildings, our field observations confirmed the FEMA Hazus assumption of 99% wood/1% other (FEMA, 2011, Table 3A.17). For simplicity, we assigned wood frame to all single-family residences except manufactured housing.

2.4 Population Modeling

To estimate injuries and casualties from damaged buildings, the FEMA Hazus earthquake model requires estimates of individual building occupancy (FEMA, 2010). People occupying tents, yurts, recreational vehicles, and boats, or who happen to be outside of a building at the time of the earthquake are assumed uninjured from the ground motion. To estimate injuries and fatalities from a tsunami, the FEMA Hazus tsunami model requires the user to refine the population model further to include locations, numbers, population demographics (age), and distance to safety outside the tsunami zone (FEMA, 2017). Typically, people are associated with a building in tsunami modeling, but they can also be placed in temporary lodging, such as in a tent or recreational vehicle, or out on a beach. Given the dynamic human environment, the modeler must therefore make several assumptions about each parameter in order to simulate fatalities and injuries.

To minimize the complexity associated with a dynamic human environment, FEMA Hazus documentation recommends modeling be undertaken for two time periods:

- a midweek "2 PM" scenario, in which people are dispersed among work, institutional, and home buildings.
- a "2 AM" scenario, in which most people are in a residential structure (in the Hazus model, hotels/motels are considered residential structures; temporary structures such as a tent or RV were also accounted for in our model).

Such divisions, however, are inadequate to meet the needs of this project (Bauer and others, 2020). This is because Oregon coastal communities experience significant temporal (daily, seasonal, and annual) population fluctuations, with large visitor influxes occurring on weekends and in the summer months (Dean Runyan Associates, 2018). Community planners have expressed strong interest that our population model accounts for such variations, which could then be used to assist with identifying tsunami evacuation challenges and short-term sheltering needs. To better understand these effects, we distinguish two broad population groups:

- *permanent residents*, who have established residence within the tsunami zone.
- *temporary residents*, who are visiting the community.

At night, temporary residents occupy residential facilities such as second homes, vacation rentals, condominium units, bed and breakfast facilities, hotels, motels, and campgrounds; permanent residents typically occupy residential structures. During the day permanent and temporary residents may occupy institutional, educational, commercial, and industrial buildings, along with residential buildings, or may be dispersed throughout the tsunami zone (e.g., at the beach) and thus may not be directly associated with any particular building type.

Development of a detailed temporary population model was therefore motivated by several important factors (Bauer and others, 2020):

1. Computing an overall injury/fatality ratio[3] for the permanent population and assuming that the ratio could be applied to the temporary population could lead to significantly underestimating the numbers of fatalities and injuries. For example, analysis of U.S. Census data and observation of real estate dynamics on the Oregon Coast indicate a strong spatial correlation between the temporary population's preference to be close to the ocean, and thus farther away from tsunami safety, when compared to the permanent population (Raskin and Wang, 2017; illustrated with 2010 U.S. Census data in **Figure 2-1**).
2. It is reasonable to assume that the temporary population may be less aware of tsunami risk, locations of tsunami safe zones, signage, temporal urgency (e.g., if you feel strong ground shaking, evacuate immediately), and local evacuation routes compared to permanent residents.
3. Community planners expressed a need for detailed estimates of tsunami injuries and fatalities, as well as estimates of the number of displaced people following a Cascadia event. These data are essential for effective mass care planning. Thus, our modeling of tsunami-caused injuries and fatalities is undertaken assuming maximum occupancy, combining permanent and temporary residents, and distinguishing injuries and fatalities between the respective population groups. By doing so, we established a range that planners can use to estimate impacts at non-maximum occupancy periods.

Given project scope constraints and discussions with community members, we focused our attention on developing a summer weekend 2 AM population model for all communities to maximize estimates of the temporary population and thus provide a more realistic worst-case tsunami evacuation scenario for those communities. Although our summer weekend 2 AM population scenario does not account for day trippers to the coast, the injury, fatality, and displaced population estimates derived from this scenario may be considered a conservative estimate (i.e., upper bound), as the population model assumes maximum (100%) occupancy. Conversely, planners can use the permanent resident casualty estimates as a baseline (i.e., lower bound). FEMA guidelines (FEMA, 2012a, p. 3–6) note that full occupancy at the individual building level happens only occasionally and that "point-in-time population models can be used to develop a better understanding of the uncertainty in casualties associated with time, but it is necessary to perform a large number of realizations [...] to do this in a meaningful way." Such extensive modeling for all communities was beyond the scope of this project. Accordingly, within the baseline (permanent resident population) and upper bound population that includes temporary visitors, planners can estimate the number of temporary residents present in their communities at other times of year and assume the injury and fatality estimates will scale proportionally.

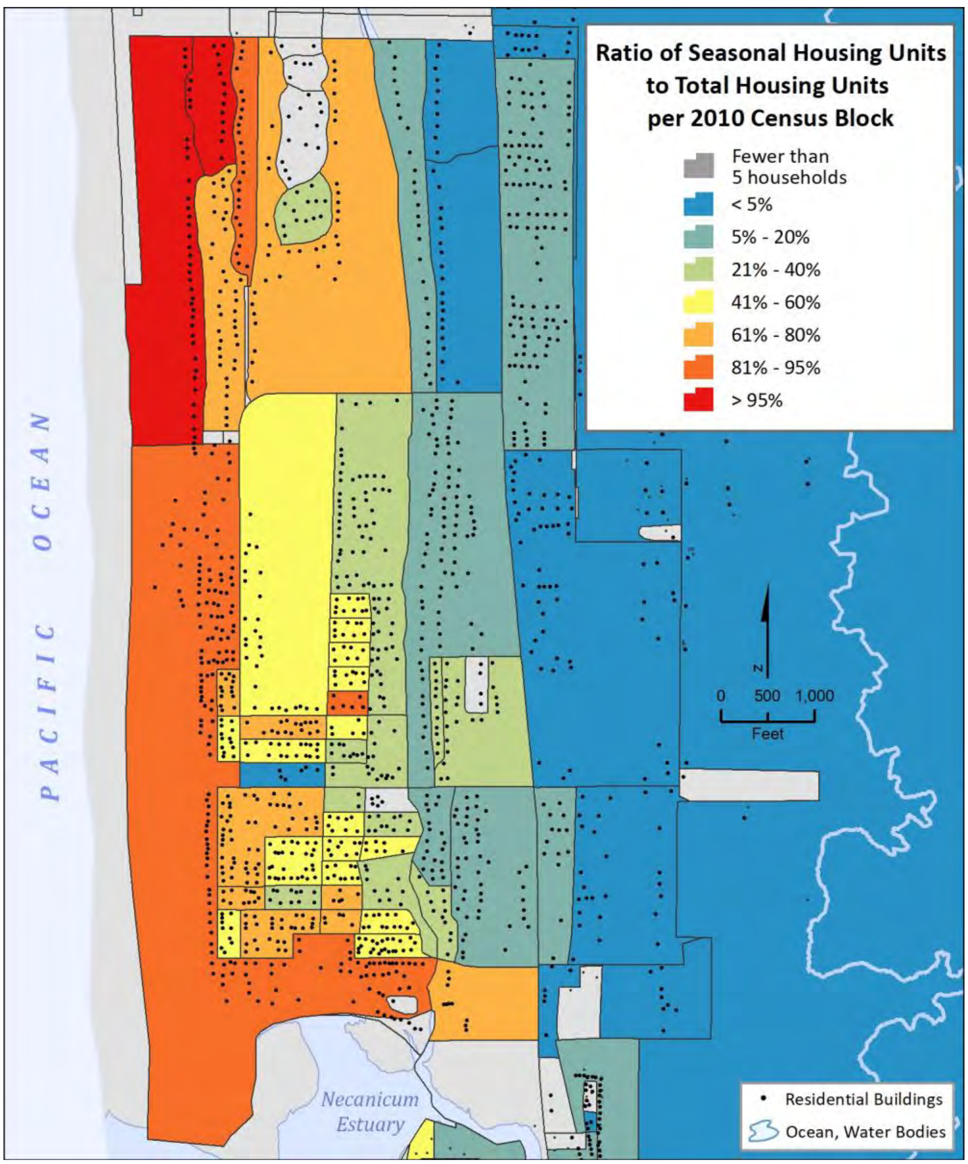
Our summer 2 AM weekend scenario assumes permanent residents are at their homes and that all available designated temporary lodging such as vacation rentals, second homes, vacation condominiums,

[3] Total number of tsunami injuries and fatalities divided by the total exposed permanent population.

campsites, marina boat slips, and recreational vehicle spots are fully occupied (i.e., 100% occupancy). Institutions and businesses, with certain exceptions, are considered to be unoccupied.

For permanent resident occupancy, we established locations, numbers of individuals, and age groups using 2010 U.S. Census data. Bauer and others (2020) used geocoded Oregon Department of Motor Vehicle (DMV) driver license registration records as of September 2017 to perform similar analyses for five coastal communities, as DMV records are typically associated with a single-family residential home. Although such an approach is more accurate for defining the permanent population, the time required to process DMV records on a countywide basis was beyond the scope of this investigation.

Figure 2-1. Example of "seasonally occupied households" as a percentage of total households per census block in Gearhart, Oregon, relative to the distance to the coast. XXL1 tsunami inundation zone shown as a light blue line on the far right. Census blocks with fewer than five households as of 2010 are shown in gray. Residential buildings shown as dots and include buildings constructed since 2010 that were not captured in the 2010 census. Census block data source: https://www.census.gov/data.html.



U.S. Census population data are organized into hierarchical spatial units of varying sizes, the smallest of which is the census block. Census blocks are typically "bounded by visible features such as roads, streams, and railroad tracks, and by nonvisible boundaries such as property lines, city, township, school district, and county limits, and short line-of-sight extensions of roads" (U.S. Census Bureau, n.d.). One level above that is the census block group, which is how the U.S. population is defined and distributed. Error! Reference source not found. provides summary statistics for census block groups in Lane, Douglas, and Coos counties:

Table 2-2. Census block group statistics for Lane, Douglas, and Coos counties.

	Census Block Group Size		
	Number of People	**Size Range**	**Mean Area**
Lane	1,160 people (ρ = ± 390)	110 hectares (270 acres) to 56,525 hectares (139,680 acres)	12,220 hectares (30,200 acres)
Douglas	980 people (ρ = ± 450)	40 hectares (100 acres) to 83,450 hectares (206,220 acres)	23,600 hectares (58,320 acres)
Coos	1,010 people (ρ = ± 430)	28 hectares (70 acres) to 86,635 hectares (214,080 acres)	6,780 hectares (16,750 acres)

In urban areas, census blocks are usually defined at the city block level, whereas in rural areas, census blocks may cover a several hundred square kilometers (few hundred square miles). Within each census block group, the population may range from negligible to several thousand people. However, unlike DMV records that associate a person with a specific address, census block groups provide a single aggregated population count. For our purposes, we used updated population statistics obtained from the American Community Survey (ACS; 2014–2018 census data downloaded from the U.S. Census Bureau; https://www.census.gov/programs-surveys/acs; data accessed 2021) at the census block group level. To estimate the size and distribution of the permanent population in our study area, we distributed the population per census block group among the residential buildings and pro-rated based on square footage. The specific steps associated with this process are summarized in **Table 2-3A** for the permanent population.

After populating the buildings, or in the case of multifamily residential structures, units, with permanent residents, we then assumed the proportion of residential buildings or units that are not occupied by a permanent resident are occupied on a temporary basis by out-of-town visitors. For single-family residential houses, we used the number of bedrooms (units) to determine temporary occupancy (**Table 2-3B**). We populated motels, campgrounds, recreational vehicle parks, and marinas using the number of rooms, tent or RV sites, or boat slips as a baseline, and multiplying by a people-per-unit occupancy assumption (**Table 2-3B**). To accomplish these steps, we used the 2010 census data to identify the residential household vacancy rate[4] at the census block level. For each UDF, we then multiplied the corresponding vacancy rate by the number of units, establishing the number of units occupied by temporary residents. This value is then multiplied by the people-per-unit value to derive a temporary population per household unit (**Table 2-3B**).

Finally, researchers have recognized that demographic factors can be an important factor in tsunami casualties (summarized by González-Riancho Calzada and others, 2015). This is because specific age groups have been recognized as having different evacuation speeds, which affects their evacuation

[4] H005006, "Total for seasonal, recreational, or occasional use" in the Total Vacancy data per census block, 2010 U.S. Census divided by total number of households in the census block, obtained from Table S1101.

potential. Accordingly, FEMA (2013, 2017) incorporated population demographics into the FEMA Hazus casualty model. This is accomplished by differentiating those people <65 years with those ≥65 years in the Hazus tsunami casualty model (FEMA, 2017), with the latter group assumed to evacuate at slower walking speeds. A 0.8 walking speed reduction factor was used to account for travel speeds used by persons ≥65 (see Section 2.6.2.4). Hence, for our tsunami casualty modeling purposes, an individual is identified as:

1) either permanent or temporary.
2) either < 65 years of age or ≥ 65 years (**Table 2-3**).

Table 2-3. Summary parameters and explanation used to define the process for distributing the permanent resident and visitor populations across U.S. census block groups.

	Occupancy Type	Number of Units	People Per Unit	People per UDF: Explanation	People Per UDF: Math	Age < 65 Ratio
A) Permanent Population	Single-family Residential	1 unit	The ACS 2014–2018 census data reports the number of permanent residents at the CBG level. For each CBG in the study area, divide the permanent population number by the total number of units within the CBG. This established a people-per-unit value.	The people-per-unit value is then multiplied by the total number of units belonging to each UDF to assign the total number of permanent residents.	[Number of Units] × ([Number of permanent people in CBG] / [number of units in CBG])	0.7
	Multifamily Residential	1 unit per 800 ft^2				0.7
	Dormitories	1 unit per 400 ft^2				0.9
	Assisted Living	1 unit per 600 ft^2				0.05
B) Temporary Population	Single-family Residential	2 units < 1,500 ft^2	2.0	The 2010 census data reports the residential vacancy rate at the census block (CB) level. For each residential UDF, the corresponding vacancy rate was multiplied by the number of units, establishing the number of units occupied by temporary residents. This was then multiplied by the people-per-unit value.	[People Per Unit] × [Number of Units] × [CB vacancy rate]	0.7
		3 units < 2,700 ft^2				
		4 units < 4,000 ft^2				
		5 units < 5,500 ft^2				
		6 units ≥ 5,500 ft^2				
	Multifamily Residential	1 unit per 800 ft^2	2.2			0.7
	Hotel/Motel	1 unit per 455 ft^2	1.7			0.7
	Dormitories	1 unit per 400 ft^2	1.0			0.9
	Recreational Vehicle	1 unit	3.22	For mapping simplicity, some UDF points are assigned multiple units, such as docks in boat marinas.	[Number of Units] × [People Per Unit]	0.3
	Tent, Yurt	1 unit	3.22			0.9
	Boat	1 unit	0.1			0.9

Notes:

Permanent population numbers are taken from ACS 2014–2018 census data at the census block group level.

Temporary vacancy rates are taken from 2010 census data at the census block level.

No permanent residents are assigned to Hotel/Motel, Recreation Vehicle, Tent, Yurt, or Boat.

No temporary residents are assigned to Assisted Living.

Average number of people staying in a recreational vehicle (includes camper trailers), tent, or yurt. Mean value derived from T. Bergerson (Visitor survey of day use and overnight use at Oregon State Park coastal region parks, unpublished Oregon State Parks report, 2012, 151 p.), who evaluated the numbers of recreational visitors camping in coastal state parks.

Estimates of those residing on a boat were derived from consultation with local ports and marinas in both Clatsop and Lincoln County.

2.5 Building Damage and Building Debris Estimation

2.5.1 Earthquake

To calculate combined building losses from an earthquake and tsunami, the Hazus model requires the user to first model earthquake damage using the Hazus User-Defined Facilities (UDF) earthquake model (FEMA, 2011, 2017). In the Hazus earthquake simulation, we used Hazus 5.0 to model a fully saturated soil scenario, with groundwater level at the surface, thereby incorporating the potential impacts of liquefaction. We believe this is a reasonable assumption for low-lying coastal areas.

As noted previously, we model the effects of three discrete tsunami inundation scenarios described by Witter and others (2011) and Priest and others (2013e): M1, L1, and XXL1. These reflect the following CSZ earthquake moment magnitudes (M_W): 8.9 (M1), 9.0 (L1), and 9.1 (XXL1) respectively. Each event is characterized by a unique deformation model to account for the coseismic response. These scenarios contrast with the terrestrial ground motion data from Madin and others (2021), which assume a moment magnitude (M_W) 9.0 CSZ earthquake. For Hazus loss estimation purposes, we determined that the ±0.1 difference in moment magnitude is minor and accounted for by our choice of the "default betas" in the Hazus Advanced Engineering Building Model (probability of damage state; Kircher and others, 2006; Kircher, 2002). The default betas (also referred to as relaxed betas) were crafted by Hazus earthquake model developers to account for greater uncertainties in the ground motion for an earthquake scenario compared to an instrumented earthquake event.

Building repair cost estimates were obtained by using the probability of damage state (PDS) values for each building[5]. The Hazus UDF earthquake model currently overestimates repair costs for UDFs by using overly conservative PDS multipliers for determining a building loss ratio (Bauer, 2016); the building loss ratio reflects the ratio of building damage states relative to the total number of buildings. Using corrected PDS multipliers (described by Bauer, 2016), we calculated per-building repair cost estimates, and then summarized building repair costs due to earthquake ground motion and earthquake-induced ground deformation by community.

2.5.2 Tsunami

The M1, L1, and XXL1 median depth and momentum flux grids were input into the Hazus tsunami tool as "Level 3" tsunami data (FEMA, 2017), which reflect advanced level user-provided tsunami model scenarios. We summarized building repair costs for the M1, L1, and XXL1 tsunami events by community[6].

2.5.3 Combined earthquake and tsunami

The Hazus tool combines the per-building damage state probabilities from the earthquake and tsunami into an overall damage state probability and then calculates per-building repair cost estimates (FEMA, 2017, Section 5.7). We summarized the combined building repair costs for the earthquake and for each of the tsunami inundation scenarios by community[7].

[5] Hazus SQL table [dbo].[eqUserDefinedFlty].

[6] Per-building repair cost estimates from the tsunami event by itself were obtained by exporting the Hazus SQL table [dbo].[tsUserDefinedFlty].

[7] Per-building repair costs that combine earthquake and tsunami events were obtained by exporting the Hazus SQL table [dbo].[tsCombUserDefinedFlty]. The table also contains structural and nonstructural probability of damage state (PDS) data for each building.

Building recovery times are provided in the FEMA Hazus methods (FEMA, 2017, Table 7.10), but we chose not to report them, as Bauer and others (2020) argued that the assumptions behind the tabular entries are overly optimistic given the spatial scale of a M_w 9.0 CSZ earthquake and tsunami and the likely catastrophic nature of the event on core infrastructure. Thus, access to labor, material, and investment capital may be constrained for prolonged periods during recovery, in large part due to the anticipated damage to western Oregon's transportation network, infrastructure, and fuel supply (ODOE, 2017; ODOT, 2014; OSSPAC, 2013).

2.5.4 Building debris

The Hazus version 5.0 model (FEMA, 2017, 2018) presently does not provide support for debris estimation from a tsunami event, due in part to the challenges of accounting for debris redistribution from advection, including debris washed out to sea, sediment transport, and uprooted vegetation. While recognizing the complexities associated with estimating debris caused by the earthquake and tsunami, we contend that estimates of debris tonnage derived from damaged buildings are valuable for community planners to better understand the scale of the disaster and, importantly, to develop post-disaster community debris plans. Timely recovery from a major earthquake and tsunami will depend not only on the localized damage in each community, but also on the ability of communities to stage and dispose of earthquake- and tsunami-generated debris. To that end, for each community, we provide estimates of debris generated by the earthquake and the three tsunami scenarios.

Estimates of the amount of debris (expressed as tonnage) generated by the earthquake can be obtained using guidelines provided by FEMA (2010). Our building debris estimates combine guidelines provided by FEMA (2013, Chapter 7, and 2011, Chapter 12). The Hazus tsunami model, when run in conjunction with the Hazus earthquake model, provides the combined probability of damage states for a building's structural and nonstructural components. We first calculated the weight of the building based on the model building type using the values provided by FEMA (2011, Table 12.1). Using the building weight, together with the probability of damage states estimate for each building (Section 2.5.3), we estimated the debris tonnage using the FEMA (2011) equation 12-3.

2.6 Injury and Fatality Estimation

We independently evaluated injuries and fatalities resulting from a CSZ earthquake and tsunami, using, the Hazus AEBM model (FEMA, 2010) and the Hazus tsunami model (FEMA, 2017), respectively. Unlike the building damage estimates described previously, the FEMA Hazus methods currently do not provide a method for combining injury and fatality estimates from the two events. The approach we used is described in more detail in the next two sections.

2.6.1 Injuries and fatalities from earthquake

We used the Hazus AEBM model (FEMA, 2010) to calculate injuries and fatalities, populating the individual buildings with the permanent and temporary population, 2 AM summer weekend occupancy estimates. The *`DayOccupants`* and *`NightOccupants`* fields were used as Hazus AEBM inputs for the two population groups. We note that the *`DayOccupants`* and *`NightOccupants`* are simply Hazus field names, and their usage does not suggest we modeled a daytime building occupancy.

The Hazus AEBM model first calculates a building's structural and nonstructural PDS from the ground motion and liquefaction/landslide data provided to the model. It then uses the PDS values to calculate injuries and fatalities based on the number of user-specified people occupying the building and the building type. The methodology assumes a strong correlation between building damage and the number and severity (injury level) of casualties (FEMA, 2011). According to FEMA (2011), casualties (both injuries and fatalities) are classified into four levels: minor injuries, injuries requiring hospitalization, life-threatening injuries, and deaths (**Table 2-4**).

Table 2-4. Hazus earthquake casualty level descriptions (FEMA, 2011).

Injury Severity Level	Injury Level Description
Level 1: Minor Injuries	Injuries requiring basic medical aid that could be administered by paraprofessionals. These types of injuries would require bandages or observation. Examples: a sprain, a severe cut requiring stitches, a minor burn (first degree or second degree on a small part of the body), or a bump on the head without loss of consciousness. Injuries of lesser severity that could be self-treated are not estimated by Hazus.
Level 2: Injuries Requiring Hospitalization	Injuries requiring a greater degree of medical care and use of medical technology such as X-rays or surgery, but not expected to progress to a life-threatening status. Examples: third-degree burns or second-degree burns over large parts of the body, a bump on the head that causes loss of consciousness, fractured bone, dehydration, or exposure.
Level 3: Life-Threatening Injuries	Injuries that pose an immediate life-threatening condition if not treated adequately and expeditiously. Examples: uncontrolled bleeding, punctured organ, other internal injuries, spinal column injuries, or crush syndrome.
Level 4: Deaths	Instantaneously killed or mortally injured.

Earthquake-induced casualties have been summarized by community, casualty level, and resident status (permanent versus temporary). For comparison with the Hazus tsunami casualty model, we summarized earthquake casualty levels 1 through 3 as “injuries” and casualty level 4 as “fatalities.” We note that in Oregon coastal communities, most residents occupy wood-frame structures at 2 a.m., and such structures are much less likely to be severely damaged in an earthquake compared to other building types (FEMA, 2011).

2.6.2 Injuries and fatalities from tsunami

The Hazus tsunami casualty model estimates are based on a rational actor pedestrian evacuation model in which all persons in the tsunami zone have acute awareness of the impending tsunami, that they possess knowledge of or can quickly determine the most optimal route to a tsunami safety area, and that all individuals seek safety as pedestrians and not via vehicles. The model assumes a group average (median) departure time and travel (walking) speed and accounts for individual variations from the group average using a lognormal distribution (FEMA, 2017). Although human behavior in an emergency is likely to be highly variable, we believe the results from the Hazus tsunami casualty model provide critically important data for planners to assess the likely impacts of a tsunami and identify areas in their communities where injury and fatality rates will likely be higher, while also providing the ability to quantify the efficacy of proposed mitigation solutions such as tsunami vertical evacuation structures. The following sections describe, in more detail, the overall approach and assumptions used to define injuries and fatalities from a CSZ tsunami.

2.6.2.1 Model implementation

Bauer and others (2020) integrated the Hazus tsunami casualty model into a standalone Excel spreadsheet to estimate the likelihood of a casualty for every person, incorporating the individual's distance to the nearest tsunami safety destination, assumptions on group median departure time, and median travel speed. A travel dispersion coefficient (C_{STD}) was also incorporated in the spreadsheet to account for variations (uncertainty) within the group's departure time and evacuation travel speeds. Motivations for developing the spreadsheet versus using the dedicated Hazus tsunami tool are:

1. Our existing tsunami evacuation modeling already provides the needed distance to safety data needed by the Hazus tsunami casualty model; the Hazus tsunami casualty model includes the USGS Pedestrian Evacuation Analyst Tool (PEAT; Jones and others, 2014), which performs the same calculations as the DOGAMI approach. Thus, rerunning this capability within Hazus is not warranted.
2. Our project requires a model with considerable flexibility for evaluating alternative population and evacuation scenarios (including distinguishing temporary and permanent residents), and, crucially, for testing population assumptions and model parameter settings.
3. Importantly, the Hazus tsunami model currently estimates casualties at the census block level, not at the building level, and thus uses a worst-case assumption of time-to-safety for all occupants within a particular census block (D. Bausch, written communication, July 2018). The Hazus approach is thus too coarse for our objective, which includes a more refined population model disbursed across individual buildings and campgrounds.

More detail on our spreadsheet casualty model is provided by Bauer and others (2020, Appendix C). There, the functional equivalence of the spreadsheet with the FEMA Hazus tsunami Level 2 casualty tool is demonstrated. To minimize confusion, we use the term "Hazus tsunami casualty model" to refer to the FEMA-established methods of estimating injuries and fatalities resulting from a tsunami, and not a specific tool or spreadsheet.

A local source tsunami provides no warning — the ground shaking itself is the signal to evacuate. Thus, the warning time (T_W) discussed by FEMA (2017) is assumed to be zero for a CSZ tsunami. Furthermore, tsunami modeling by Witter and others (2011) indicates that the maximum tsunami runup from a CSZ earthquake is typically associated with the first wave arrival[8].

2.6.2.2 Distance to safety

The Hazus tsunami casualty model requires the user provide a GIS file that specifies the distance to tsunami safety at all points along the established evacuation routes. Previous "Beat the Wave" efforts undertaken for multiple coastal communities (Gabel and Allan, 2016, 2017; Gabel and others, 2018a,b, 2019a,b,c,d, 2020a; Priest and others, 2015) have used the anisotropic least-cost distance approach established by Wood and Schmidtlein (2012) to calculate a distance to safety at all locations along evacuation routes. The distance to safety (referred to as "path distance") is adjusted to account for the slope of the ground (steep versus flat) and terrain type (e.g., sand versus pavement) that may slow down a person's ability to evacuate. Given that tsunami evacuation nearly always requires the evacuee to move up in elevation, this adjusted distance to tsunami safety is always greater than the straight line distance

[8] The Hazus tsunami casualty model is one-dimensional and does not incorporate time-sensitive inundation information en route to safety; it simply assumes an evacuee arrived at the maximum tsunami runup (tsunami safety) in time (T_{MAX}). Complex decision points, such as early wave arrivals or bridge failures that are likely to preclude or impact evacuation along certain routes are not evaluated.

measured on a map. In this report, our usage of "distance to safety" reflects the combined slope and adjusted walking distance.

We associate each building and its occupants with the tsunami evacuation network that specifies the distance to tsunami safety by using the Esri ArcGIS Near function. The linear distance from the building footprint's centroid to the evacuation network is added to the distance to safety from the GIS file to derive an overall distance to tsunami safety. We did not implement the method of Wood and others (2016), which has pedestrians evacuating via driveways typically generated on paths perpendicular to the road network. Visual inspection suggested the distance from the building centroid to the evacuation network was minor relative to the overall distance to safety, and such a refinement would only marginally improve the accuracy of the model's results. Moreover, the time to evacuate a building may be accounted for as simply an evacuation delay, which is described further below.

A community often has more than one tsunami evacuation scenario defined, which can include the impact of damaged bridges and/or the inclusion of a tsunami vertical evacuation structure. Each scenario has a unique distance to safety GIS dataset, which can be captured separately, when needed. Such scenarios have been evaluated previously for multiple communities including Florence and Reedsport (Gabel and others, 2018b) and the Coos estuary (Gabel and others, 2019b); modeling is currently underway for Bandon. For the purpose of this countywide Hazus assessment, we used the most conservative bridge-out scenario, to account for the likely failure of non-retrofitted bridges. Bridges that have been retrofitted or rebuilt to current engineering standards are designed to withstand the intense ground motion caused by the earthquake.

2.6.2.3 Departure time

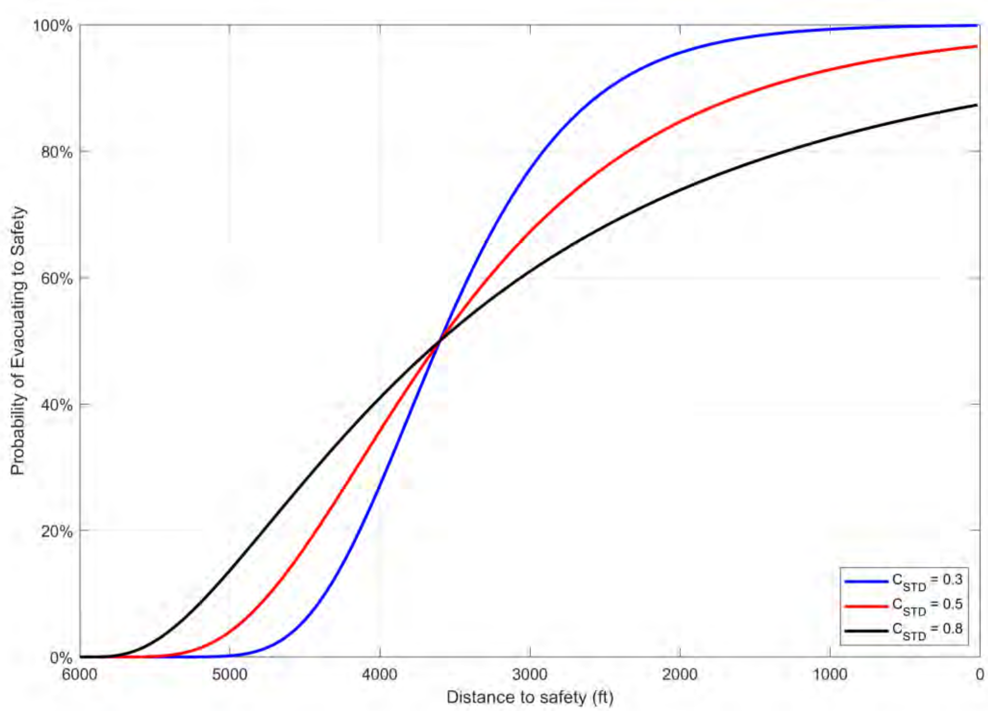
The Hazus tsunami casualty model uses the term "Community Preparedness Level" to reflect the time between the tsunami warning (i.e., earthquake shaking) and actual evacuation of the community (FEMA, 2017). The degree of preparedness is classified according to three categories — good, fair, or poor — and is dependent on a suite of factors, including tsunami awareness (education/knowledge), preparation of evacuation routes and signage, a community's risk management level, and the presence of emergency loudspeakers and tsunami sirens (FEMA, 2017). According to FEMA, a community with a "good" rating could be one that is designated "Tsunami Ready" by the National Oceanic and Atmospheric Administration (NOAA) National Weather Service. However, we contend that such designations do not truly reflect a community's level of preparedness given the large uncertainty in individuals' hazard awareness, their knowledge of evacuation routes, their actual response at the time of the event, and the degree of pre-disaster preparation undertaken by communities to prepare for such an event. Thus, for the purposes of this report we chose not to use the "Community Preparedness" terminology; instead, we focused our efforts on the importance of group departure times.

It is essential that our injury and fatality estimates quantify the impact of delays in departure times — often referred to as "milling time" in the literature (Buylova, 2018; Mostafizi and others, 2017; Wood and others, 2016; Wood and Schmidtlein, 2013). In this study, we provide injury and fatality estimates assuming 10-minute (good) and 15-minute (fair) group departure (delay) times; we did not model a poor preparedness level, as the casualty numbers associated with this specific category are very large and probably unrealistic.

The 10-minute (*good*) departure delay is the default value used in all our BTW tsunami evacuation modeling and refers to the time elapsed since the start of the earthquake. It accounts for up to five minutes of earthquake shaking during which people drop, cover, and hold on, followed by an additional five minutes of individual preparation — donning shoes and outdoor clothing, gathering immediate family, or collecting a go-bag — before leaving the building. We also model a 15-minute (*fair* level of preparedness) departure time to demonstrate how additional delay time causes community fatalities to increase significantly.

The departure time is assumed to be the group median value. In reality, some individuals may leave earlier and others later. Some may walk faster or slower than the group median evacuation speed. The Hazus tsunami casualty model accounts for these variations by adopting a dispersion factor (defined by a lognormal distribution), which can be accounted for by specifying a standard deviation (or *beta*) value (referred to as C_{STD} by FEMA, 2017). For the purposes of our study, we used the Hazus tsunami casualty model defaults of 0.3 and 0.5 for the 10-minute and 15-minute departure times, respectively, corresponding to the good/fair community preparedness levels noted above; theses values are the default standard deviation (C_{STD}) recommendations provided by FEMA (2017, Table 6.3). **Figure 2-2** illustrates the probabilistic nature of the lognormal distribution model. It assumes a group departure time of 10 minutes, a walking speed of 1.2 m per second (mps) (4 fps), and a wave arrival time of 25 minutes. An individual departing given those specifications can cover 1,097 m (3,600 feet). The standard deviation term, C_{STD}, models the dispersion in individual evacuation times and evacuation walking speeds. The model effectively assigns a probability of evacuating to safety that ranges between 0 and 1. As a result, an individual having traveled 1,097 m (3,600 feet) is not assumed to have safely evacuated but instead is assigned a probability of 0.5 of evacuating safely. As previously discussed, this value accounts for dispersion in departure times and walking speeds. Note the asymmetric nature of the lognormal distribution: it implements a conservative assumption regarding a tendency for humans to delay their departure times.

Figure 2-2. Hazus tsunami casualty model predictions for a hypothetical wave arrival time of 25 minutes (with no warning time), a group departure time of 10 minutes, an evacuation walking speed of 1.2 m per second (4 fps), and variations in the lognormal standard deviation term (C_{STD}).



We are unable to quantify how earthquake-induced building damage may inhibit rapid evacuation from a building prior to the arrival of a tsunami. This understudied concern may be important in older manufactured housing units that may slip off their foundation supports, warping framing and possibly jamming doorframes and windows (EERI, 2014; Maison and Cobeen, 2016; OBCD, 2010; SPA Risk LLC, 2014). The situation can also arise due to unsecured nonstructural elements such as large bookcases that are likely to tip over during shaking and block potential exits. FEMA (2012b, Section D) provides guidelines on minimizing potential constraints to egress, including advice on storing large crowbars and sledgehammers near primary door(s) to facilitate emergency exiting.

2.6.2.4 Evacuation speed

We assume a standard 1.2 mps (4 ft per second, fps) evacuation speed, which equates to 2.7 miles per hour (mph) as a baseline for estimating tsunami injuries and casualties; the 1.2 mps (4 fps) travel speed reflects a pace that may be used to define crosswalk times. Variations in individuals' walking speeds are incorporated into the C_{STD} standard deviation value discussed previously.

The Hazus tsunami casualty model incorporates a travel (walking) speed reduction factor for persons aged 65 and over (FEMA, 2017). This assumption is based on analyses of fatalities in recent tsunamis (González-Riancho Calzada and others, 2015; Koyama and others, 2012; Suppasri and others, 2016). Accordingly, we used a 0.8 walking speed reduction factor to account for travel speeds used by persons ≥65, which equates to an evacuation speed of 1 mps (3.2 fps, or 2.2 mph). It is important to emphasize that travel speed is modeled for the group average (median) and is applicable for the entire evacuation route.

The distance covered by an evacuee can be calculated as follows:

$$\text{Distance Covered} = (T_{ARRIVE} - T_{DEPART}) \times \text{WalkSpeed} \quad (2)$$

where T_{ARRIVE} is the time interval between the earthquake start and the tsunami first wave arrival, T_{DEPART} is the time interval between the start of the earthquake and when the population begins evacuating, and WalkSpeed is the specified travel (walking) speed. For reference, we calculate the distance an individual could travel prior to a tsunami arriving by using a range of evacuation speeds and wave arrival times (**Table 2-5**). As noted previously (Section **2.6.2.3**), although the group average (median) departure time may be 10 minutes, the Hazus tsunami casualty model accounts for individual variations from the group average by using the cumulative lognormal distribution and dispersion factor.

2.6.2.5 Tsunami injury and fatality estimation

The Hazus tsunami casualty model assumes a 99% likelihood of fatality and 1% likelihood of injury to an individual caught up in a tsunami where the wave depth exceeds 1.8 m (6 feet; FEMA, 2017). Conversely, where the tsunami wave depth is less than 1.8 m (6 ft) the model assumes a likelihood of 50% fatality and 50% injury for individuals caught by the tsunami; this region is referred to as the "partial safety zone." In practice, because the topography of many Oregon coastal communities is relatively steep, the horizontal distance between the 1.8 m (6 ft) and the 0-elevation contour (tsunami safety) is generally small compared to the typical distance to safety an individual must travel. Analyses by Bauer and others (2020) indicated that these partial safety distances along the open coast range from ~30 to 90 m (100 to 300 feet, **Figure 2-3**) from the tsunami inundation runup limit. However, more recent evaluations suggest that the partial safety zone can in fact vary substantially, especially in areas subject to broad gentle slopes (**Figure 2-3**). To address this issue, we defined a partial safety zone by creating a depth grid in which all areas of the raster <1.8 m (6 ft) were extracted. The extracted partial safety raster was then manually reviewed, and any false islands or spurious data were removed. Accordingly, the casualty estimates are reduced to 50% once individuals reach this latter zone. The Hazus tsunami casualty model provides injury and fatality estimates for each individual, with a likelihood between 0 and 1. We summarize the individual injury and fatality likelihoods to obtain overall injury and fatality estimates at the community level.

Table 2-5. Distance walked for several departure times and tsunami wave arrival times at the tsunami runup limit. We assume warning time is zero. Departure time is the time after earthquake ground motion begins.

Tsunami First Wave Arrival Time (minutes)	Walking Speed Category	Walking Speed		Distance Walked (in feet) for Various Departure Times (in minutes)			
		fps	mph	5 min	10 min	15 min	20 min
15	Slow Walk	2	1.4	1,200	600	—	—
	Moderate Walk	4	2.7	2,400	1,200	—	—
	Fast Walk	6	4.1	3,600	1,800	—	—
	Jog	8	5.5	4,800	2,400	—	—
	Run	10	6.8	6,000	3,000	—	—
20	Slow Walk	2	1.4	1,800	1,200	600	—
	Moderate Walk	4	2.7	3,600	2,400	1,200	—
	Fast Walk	6	4.1	5,400	3,600	1,800	—
	Jog	8	5.5	7,200	4,800	2,400	—
	Run	10	6.8	9,000	6,000	3,000	—
25	Slow Walk	2	1.4	2,400	1,800	1,200	600
	Moderate Walk	4	2.7	4,800	3,600	2,400	1,200
	Fast Walk	6	4.1	7,200	5,400	3,600	1,800
	Jog	8	5.5	9,600	7,200	4,800	2,400
	Run	10	6.8	12,000	9,000	6,000	3,000
30	Slow Walk	2	1.4	3,000	2,400	1,800	1,200
	Moderate Walk	4	2.7	6,000	4,800	3,600	2,400
	Fast Walk	6	4.1	9,000	7,200	5,400	3,600
	Jog	8	5.5	12,000	9,600	7,200	4,800
	Run	10	6.8	15,000	12,000	9,000	6,000

Note: “—" indicates individuals traveling at the designated speed would not reach safety before tsunami arrival.

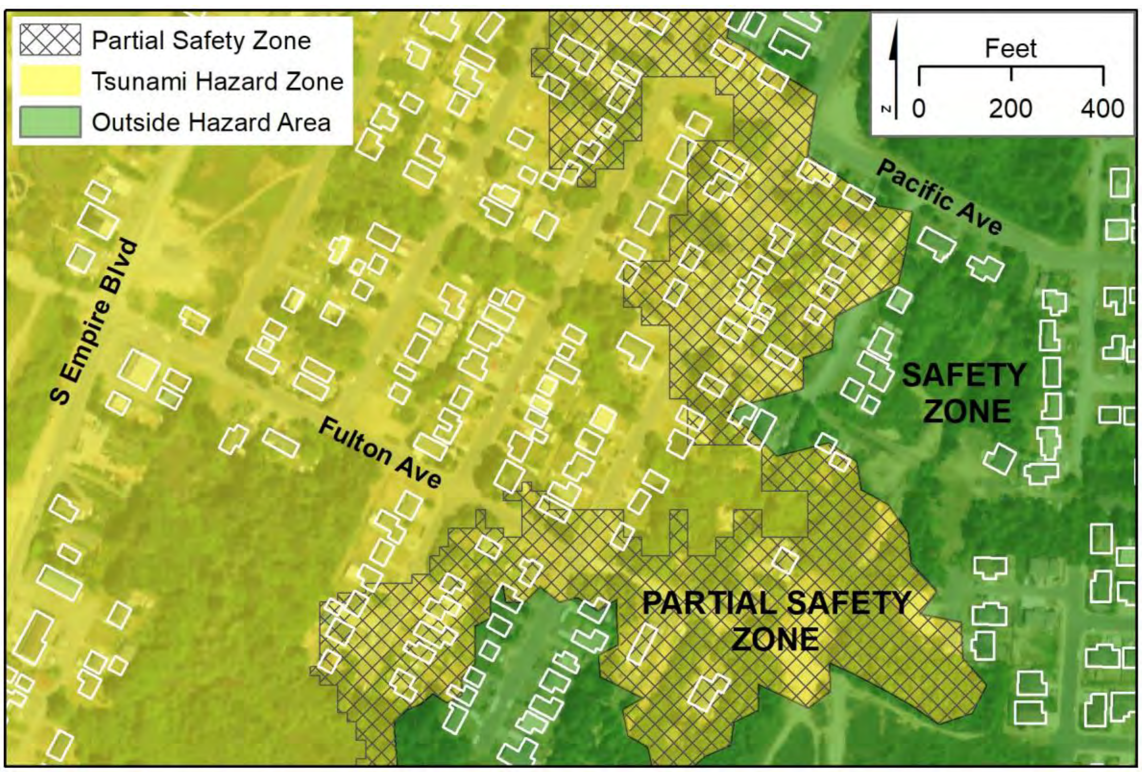
2.6.2.6 Sensitivity testing

We varied evacuation speeds (2 to 10 fps in 1-fps increments) and departure times (5 minutes to 20 minutes in 1-minute increments) consistent with Wang and others (2016) and calculated overall injuries and fatalities for each community. Such data can assist in gaining a better understanding of evacuation challenges facing communities. Furthermore, when presented in graphical form, these data can be used in education and outreach materials to reinforce existing tsunami evacuation messaging, stressing key points such as the need to evacuate immediately and, importantly, to travel as fast as possible in order to reach safety in time. We adjusted the dispersion factor (C_{STD}) as specified in section 2.6.2.3 proportionally for 10-minute and 15-minute departure times.

2.6.3 Combining earthquake and tsunami casualty estimates

The Hazus approach does not provide a method for combining injury and fatality estimates derived from the earthquake and tsunami modules. Some portion of the people injured during the earthquake may not be able to evacuate in a timely manner as they may be disoriented, need to tend to their own injuries or injuries sustained by another household member, or have sustained injuries that prevent or slow an on-foot evacuation. We report both sets of casualty numbers (earthquake and tsunami) to provide planners with a more complete accounting of the potential situation. The estimates do not include injuries or fatalities arising from, for example, heart attacks, bridge failures, automobile or maritime accidents, electrocutions from downed power lines, exposure to released hazardous materials, upstream dam failures, ground failures such as earthquake-induced landslides, or fires. Furthermore, large-scale natural disasters are known to contribute to illness, injury, or death from other factors such as lack of access to clean water or medicine, interruption of power to life-sustaining medical equipment, exposure due to lack of shelter, disease outbreak, domestic violence, and civil unrest. Quantifying these latter causes of injury or death were beyond the scope of the present investigation.

Figure 2-3. Example of median tsunami depth zone for an XXL1 tsunami at Empire, Coos County (yellow shading) and partial safety zone (hashed area), where the median water depth falls below 2 m (6 ft) near the tsunami inundation limit, per Hazus methods (Section 2.6.2.5). The green zone defines the safe area outside of the tsunami zone. Buildings depicted in white.



2.6.4 Displaced population

For mass care planning purposes, we calculated the number of uninjured individuals likely to have safely evacuated from the tsunami zone. Those individuals will need shelter, as their homes, motels, recreational vehicles, boats, and tents are assumed to be destroyed by the tsunami. The temporary population that happens to be visiting when the earthquake and tsunami strike will also have shelter needs that may be on the order of days to a few weeks, as arrangements for transportation out of the disaster zone may be delayed.

2.7 Essential Facilities and Key Infrastructure

We provide the names of essential facilities, special facilities, and key infrastructure located within each city's tsunami zone. For this report we use the "essential facility" definition provided in Oregon Revised Statute 455.447, "Regulation of certain structures vulnerable to earthquakes and tsunamis; rules" (2017[9]):

"Essential facility" 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.
(G) Structures and equipment in government communication centers and other facilities required for emergency response.

We define a "special facility" as one that is likely to contain population segments that may present additional tsunami evacuation challenges. This builds on, but is not limited to, the "special occupancy structure" definition provided in Oregon Revised Statute 455.447. Examples include assisted living facilities, detention facilities, facilities where groups of children are placed in the care of non–family-member adults, and facilities with particular focus on persons with a disability. Facilities with incidental usage by persons with disabilities are not included. Geocoded Quarterly Census of Employment and Wages (QCEW) data obtained from the Oregon Employment Division in September 2018 was another dataset used to evaluate other potential facilities. We created a lookup table wherein we identified a subset of employer types based on their six-digit North American Industrial Classification System code (OMB, 2017) that may host a population that may face additional tsunami evacuation challenges. The table was joined to the QCEW data, which identified specific businesses that could be considered a special facility.

Although great care was taken to develop as complete a list of special facilities in the tsunami zone as feasible, it is acknowledged that not all businesses may have been included. This is mainly because of the provisional nature of the QCEW data, such that some business locations may not have been captured in our overlay analysis. Furthermore, it is important to note that the designation of a building as a "special

[9] https://www.oregonlegislature.gov/bills_laws/ors/ors455.html

facility" should not be interpreted as any statement on the building owner or operator's level of tsunami preparedness. The analysis simply identifies those businesses located in the tsunami zone.

The "key infrastructure" list includes facilities necessary for community recovery but not covered in the essential facilities list and includes such facilities as water treatment plants and electrical substations. We constructed this list from visual inspections of orthoimagery and other ancillary geospatial data sources such as Homeland Infrastructure Foundation-Level Data (https://gii.dhs.gov/hifld/). As with the essential facilities and special facilities list, every effort was taken to develop as complete a list as possible.

2.8 Social Characteristics

The Department of Land Conservation and Development (DLCD; 2015) recommended that a tsunami risk and vulnerability assessment include analyses of the characteristics and locations of populations that may have additional needs or requirements for evacuation. Our modeling allowed us to provide demographic information classified into two broad age groups — <65 years of age and ≥65 years — for each tsunami zone. In addition to basic demographic information, we further queried the ACS data (U.S. Census Bureau, 2018, Table 1.1), in order to extrapolate additional information that may be useful for informing community tsunami education and evacuation planning. These included:

- S0101 Age and Sex.
- S1601 Limited English-Speaking Households.
- S1810 Disability Characteristics.

We obtained the selected ACS tables at the city ("community" in ACS terminology), county, and state level. The 2014–2018 ACS five-year estimates were based on data collected between January 1, 2014, and December 31, 2018. We chose the ACS five-year estimates based on U.S. Census guidance for smaller geographies (U.S. Census Bureau, 2018, Table 3.1). We note that the ACS estimates are for the city jurisdiction and not its UGB, and that the ACS data are not available by tsunami zone or at any unit finer than the city. We include the ACS-provided margin of error (MOE) to emphasize the sampling nature and uncertainty of the survey. The U.S. Census Bureau sets a 90% confidence level, where the estimate and the actual population value will differ by no more than the value of the MOE.

2.9 Model and Data Limitations

2.9.1 Earthquake

Our earthquake ground motion and deformation model is based on various assumptions about the Cascadia rupture zone (Madin and others, 2021). Soil amplification, liquefaction susceptibility, and landslide susceptibility values were assigned based on the best available local geologic data, mapped using high-resolution lidar imagery. Nevertheless, soils, liquefaction and landslide information compiled by Madin and others (2021) may include generalizations about local conditions that could be better refined in the future, with more detailed community or site-specific mapping efforts.

2.9.2 Debris

The weight of damaged building contents such as refrigerators and furniture and, where applicable, business inventory such as groceries were not included in our estimates of debris. Furthermore, we do not quantify the amount of buoyant debris from damaged buildings that may be washed out to sea, nor do we estimate the weight of concrete and asphalt that would be produced from damaged roads and bridges.

Debris from damaged automobiles, trucks, recreational vehicles, shipping containers, boats, and logs in staging areas are not included, but an estimate can be obtained by using the weights provided by FEMA (2013, Table 7.6). Estimates of the weight of sediment redistributed across the landscape or vegetation removed and transported by the tsunami were also excluded from our analyses.

Commercial movers provide guidelines for estimating the weight of typical household content (e.g., https://www.isapa.org/estimate-weight-household-goods-moving/). The contents of a three-bedroom house is generally estimated to weigh around five tons. Although we do not report on content damage in this study, a reasonable assumption is that nearly all the content of a house in the tsunami zone will be destroyed and will be added to the total debris. The building database developed for this study could be used to calculate the added weight of debris associated with household content.

2.9.3 Economic losses

Our economic loss estimates are limited to the direct cost of repairing a damaged building or replacing a severely damaged building with an equivalent structure. Our model assumes standard labor and material costs and availability of capital and credit. It does not factor in demand surge, which occurs following large disasters and results in higher costs to repair building damage relative to comparable damage observed in smaller disasters (described previously in section **2.3**). Olsen and Porter (2011) reported demand surges ranging from 10% to 40% following several large-scale disasters. Adjusting repair/replacement costs due to a likely demand surge was beyond the scope of this project. Further, we do not quantify permanent loss of use, and thus value, of the land due to ground failure, presence of spilled hazardous materials, loss of buildable land due to scour and erosion from the tsunami, or loss of use from tidal flooding due to coseismic subsidence.

2.9.4 Population models

Estimates of the permanent population in the tsunami zone are derived from U.S. Census data collected in 2010 and ACS data maintained by the U.S. Census Bureau. This approach differs from the approach of Bauer and others (2020), which used Oregon Department of Motor Vehicle records to identify the number of permanent people in the tsunami zone.

Table 2-6 presents results for four communities where we can compare the approach of Bauer and others (2020) to the approach developed here. With respect to defining the population, **Table 2-6** highlights two differences. First, both approaches yield comparable permanent population numbers in the communities of Gearhart and Rockaway Beach. This is due entirely to the fact that both these communities are virtually completely inundated under the XXL1 scenario, the extent of which is comparable to the boundaries of the CBG. Hence the values reported are similar. In contrast, **Table 2-6** indicates that the CBG results for the permanent population in Lincoln City and Newport are significantly (~20% to 40%) higher when compared with the DMV approach. There are three possible explanations. First, it may be a function of both communities having narrow inundation zones (having been built on high ground), with large portions of the communities outside of the tsunami zone. Thus, the CBGs in these areas account for people located outside of the tsunami zone. Hence, the process of distributing the permanent population across the UDFs based on those buildings in the tsunami zone may be overestimating the number of people actually residing in the tsunami zone. Second, it may be a function of the ACS data having more up-to-date population statistics, though this seems less likely given that DMV records should provide a good representation of numbers of people residing in both communities. Third, it is possible that Bauer and other (2020) may have undercounted the number of people residing in Lincoln City and Newport.

In contrast, estimates of the temporary population in the four communities (**Table 2-6**) using the population model approach developed in these countywide assessments are generally lower, when compared with the Bauer and others (2020) approach. For example, the visitor population in Lincoln City is substantially lower — a 45% difference. This change is primarily due to the number of people assigned to each room/unit. Bauer and others (2020) used a value of three people per room for Lincoln City; this was the preferred choice by community planners. However, for the purposes of this study, we chose to use a standard value of two people per room. Despite the lower numbers of temporary visitors observed in our latest population modeling and given the large uncertainty in the numbers of visitors in any given community on any given day, we remain confident in our overall estimates of potential visitor numbers in coastal Lincoln County.

Table 2-6. Comparison of the Bauer and others (2020) population model approach with the approach used in this study.

Community	Bauer and others (2020) (DMV Records)		This Study (CBG Approach)		Population Difference		Building Count		
	Permanent	Temporary[1]	Permanent	Temporary	Permanent	Temporary	XXL	Entire CBG[2]	Difference[3]
Gearhart	1,495	5,459	1,447	4,532	−3 %	−20 %	1,651	1,961	310
Rockaway Beach	1,440	7,592	1,503	6,642	4 %	−14 %	2,372	4,056	1,684
Lincoln City	2,154	11,844	2,692	8,167	20 %	−45 %	2,523	8,499	5,976
Newport	1,161	7,171	2,002	6,161	42 %	−16 %	1,642	8,394	6,752

Notes:

[1] The temporary population modeling script used by Bauer and others (2020) differed slightly from the present study. In Bauer and others, Lincoln City was assigned three people/bedroom when estimating the temporary population. In the present study we assign two people/bedroom for all communities.

[2] This is the total building count within all CBGs that intersected the community boundary.

[3] Difference in both building counts.

The potential for inaccurate population data in a census block group, including undercounting by Bauer and others (2020), is probably the most likely explanation for differences observed in **Table 2-6**. Inaccurate data may be a function of building UDFs not having been fully evaluated for attribute accuracy, leading to over- or undercounting of the local population. In the approach developed here, great care was taken to evaluate building attributes within the XXL inundation zone. The specific steps followed are:

1. Is the building a residential occupancy type? If it is, then it contains residents.
2. What type of residential building is it? For example, if it is a multifamily building such as an apartment, it likely contains both permanent and temporary residents, but if it is a hotel then it only contains temporary residents.
3. What is the square footage of the building? Depending on the occupancy type, the square footage determines the number of units/rooms, which influences the number of residents estimated to live there.

Manually checking the many thousands of buildings outside of the tsunami zone is challenging. An example of how the population statistics may be skewed is described here. Consider an apartment building housing 200 permanent residents that is located partly outside the tsunami zone, but within a CBG; the latter includes an area both within and outside the tsunami zone. Because the apartment building is located outside of the tsunami zone, it may have been skipped for further evaluation. However, because the apartment is included in the census block group, those 200 people are inadvertently counted as residing in the tsunami zone.

Continuing with this example, let us say that the apartment building was categorized as a hotel and no permanent residents were assigned to it. Now those 200 permanent residents, which are part of the CBG total, are distributed elsewhere in the CBG, skewing the results in other locations.

Other possible ways in which inaccurate population modeling may occur include:

1. A building is not categorized as a residential building – that means no residents are assigned to it.
2. The square footage is incorrect. That means that either more people or fewer people will be assigned to the building than is realistic.

In summary, although great care was taken to evaluate building UDF attributes, especially those adjacent to the tsunami zone boundary that could potentially skew the population statistics (e.g., multifamily residential), it is possible some of these buildings were misattributed.

Our assignment of 0.318 children for every adult between 18 and 64 years of age (described by Bauer and others, 2020, Appendix B) may either overestimate or underestimate actual numbers. Temporary resident estimates and age demographics were based on several key assumptions as described by Bauer and others (2020) and are without doubt the largest challenges when specifying the visitor population on any given day. Finally, our population model does not account for people living in the tsunami zone who are experiencing homelessness. Homeless encampments are likely present within the tsunami zone of many Oregon coastal communities.

2.9.5 Hazus tsunami casualty model

The Hazus evacuation modeling assumes the following responses:

1. Everyone in the tsunami zone will evacuate on foot at some time after the ground stops shaking.
2. Their exit from the building is unimpeded.
3. They take the most optimal route to safety.
4. Their evacuation speed is not limited by congestion from fellow evacuees or vehicles or the presence of obstacles on roads and trails.

Furthermore, it does not account for certain human behaviors and other factors that could result in higher fatality rates. For example, some portion of the population may be unaware of the impending threat and thus do nothing. Others may be fully aware of the threat but for various reasons, including a fatalistic outlook (Johnston and others, 2013), choose not to evacuate. Some may tend to a person with disabilities or a person who sustained injuries during the earthquake and thus fail to leave in a timely manner or are greatly limited in their travel speeds. Still others may spend time checking on neighbors. Fatigue may impact a portion of the population over longer travel distances, especially individuals with limited mobility or health-related problems. Delay introduced by descending multiple flights of stairs in multistory structures is also not considered.

Other non-behavior factors that the model does not account for include structural failures in a building leading to jammed doorways and blocked hallways and doorways, all of which may limit egress. Evacuation on roads and trails is likely to be affected by building debris produced by the ground shaking strewn onto roadways and sidewalks, deformed roads and trails due to lateral spreading resulting from liquefaction, the presence of liquefaction sand boils, and downed power lines. Depending on the number of evacuees, pedestrian and vehicle congestion at chokepoints could also influence evacuation travel speeds.

Occupants of boats docked in marinas are assumed to recognize the signs of a major earthquake and be able to safely leave their vessels and exit to high ground via intact docks and dock ramps. Neither seiching within enclosed marinas nor potential damage to the dock or its walkway to dry land is modeled.

Although the Hazus earthquake model estimates earthquake-induced building damage, the Hazus tsunami casualty model does not factor in how damage to a building from the earthquake itself may restrict egress and thus possibly impede evacuation of damaged buildings prior the arrival of a tsunami. This understudied concern may be especially pronounced in older manufactured housing units that may slip off their foundation supports, warping framing and possibly jamming doorframes and windows.

Although one can identify shortcomings with the FEMA Hazus tsunami modeling, given its assumptions of ideal behavior on the part of evacuees and intact, unimpeded evacuation routes, the injury and casualty results from the model should be perceived "as starting points and not an end point for tsunami risk-reduction discussions" (Wood and Schmidtlein, 2013, p. 1,625).

3.0 RESULTS

This section presents results of the Hazus analysis used to quantify earthquake and tsunami related impacts (i.e., building damage, debris, injuries, fatalities, etc.) for communities along the Coos, Douglas, and Lane County coastline. Each community is characterized by diverse population demographics, historical and contemporary development patterns, socioeconomic characteristics, tsunami risk, and bathymetric, topographic, and geologic circumstances that influence evacuation potential and building damage. These factors in turn influence community preparation, response, and, ultimately, recovery following a CSZ earthquake and tsunami.

3.1 Population Demographics

Summary population and demographic information for coastal Coos, Douglas, and Lane counties is presented in **Table 3-1** and **Figure 3-1**. Both identify the permanent population within each community's tsunami zone and include a conservative estimate of the temporary population that may also be present. As a reminder, the temporary population is determined from a summer 2 AM weekend scenario that maximizes visitor occupancy (i.e., assumes 100% occupancy in all hotel/motels, vacation homes and camping spots). Examination of **Table 3-1** indicates the following results:

1. The total population present on the Lane, Douglas, and Coos county coastline within a tsunami zone reflect the following:
    a. *Lane County*: ranges from ~550 (M1) to ~1,870 (XXL1) permanent residents (**Table 3-1**), increasing to ~2,600 (M1) to ~6,040 (XXL1) people when accounting for the temporary visitor population.
    b. *Douglas County*: ranges from ~1,050 (M1) to ~1,970 (XXL1) permanent residents (**Table 3-1**), increasing to ~3,360 (M1) to ~5,430 (XXL1) people when accounting for the temporary visitor population.
    c. *Coos County*: ranges from ~1,330 (M1) to ~10,340 (XXL1) permanent residents (**Table 3-1**), increasing to ~4,970 (M1) to ~20,850 (XXL1) people when accounting for the temporary visitor population.

Such dramatic increases in the local coastal population are indicative of the large number of vacation homes, hotels/motels, and campgrounds distributed throughout the three coastal counties.

2. As expected, the number of permanent and temporary residents within each tsunami zone increase as the tsunami inundation zone increases (i.e., from M1 to XXL1, **Figure 3-1**). By far the largest change occur between the L1 and XXL1 tsunami scenarios, especially in Barview, Charleston, and Bandon.
3. The fraction of the total permanent resident population residing within the three tsunami zones varies widely among communities and parks (**Figure 3-1**). For example, Winchester Bay is mostly located in the M1 tsunami zone and is 100% within the L1 and XXL1 tsunami zones (**Table 3-1**). Siltcoos, Sunset Bay, and the Bullards Beach campground are 100% inundated in all three scenarios. Barview, Charleston, and Bandon each have relatively large numbers of people located in the XXL1 tsunami zone (73%, 52%, and 68% respectively). Within the L1 zone, Charleston, Umpqua South Jetty, and Reedsport have 33%, 49%, and 24% of their populations in the tsunami zone, respectively. For the M1 scenario, communities with the largest number of people in the tsunami zone include Charleston (32%), Winchester Bay (54%), and Umpqua South Jetty (49%). Thus, Winchester Bay, Charleston and the Umpqua South Jetty are especially vulnerable since they have a relatively large proportion of their permanent (and visitor) populations in all three tsunami zones.
4. Florence, Dunes City, Lakeside, North Bend and Coos Bay have relatively few people in the various tsunami zones (**Figure 3-1**, center plot). Florence and North Bend are largely perched on marine terraces and therefore are mostly elevated out of the tsunami inundation zone. Similarly, Dunes City and Lakeside have few people in the tsunami zones, due to these communities being located at the distal end of the tsunami zone such that the tsunami has lost much of its energy as it travels up the Siltcoos River and Tenmile Creek.
5. All 17 communities and parks can experience relatively large influxes of visitors, with totals far exceeding their local resident populations (**Table 3-1** and **Figure 3-1**, right plot). Of note, Florence can swell by ~420% to 300% (M1 to XXL1), Winchester Bay can increase by ~1,360% to 950% (M1 to XXL1), and Bandon can increase by ~210% to 225% (M1 to XXL1). Accordingly, **Figure 3-1** demonstrates the importance of each of these communities as major tourist destinations with potentially large numbers of visitors located in the tsunami zones. Accompanying their popularity as centers of tourism, are challenges associated with preparing such a large transient population for a CSZ earthquake and tsunami.

Table 3-1. The number of residents in the tsunami-hazard zone for coastal communities in Coos, Douglas, and Lane counties, Oregon, based on census block and tsunami-hazard data.

Community	Total Permanent Resident Population	Combined Population (Permanent + Temporary[1])	Number of Permanent Residents			Permanent Residents (%)[2]			Number of Temporary Residents[1]			Permanent + Temporary Percent (%) Increase		
			Medium	Large	XX-Large	Medium	Large	XX-Large	Medium	Large	XX-Large	Medium	Large	XX-Large
Florence	10,291	16,669	404	612	1,326	4	6	13	1,289	1,622	2,709	10	13	24
Dunes City	1,208	2,555	3	6	43	0	0	4	6	11	109	0	1	6
Siltcoos	2	518	2	2	2	—	—	—	516	516	516	100	100	100
Other	5,871	9,796	141	286	495	2	5	8	232	454	841	4	8	14
Lane County Total	17,372	29,538	550	906	1,866	2	4	8	2,043	2,604	4,175	29	30	36
Reedsport	3,932	5,241	553	954	1,115	14	24	28	384	497	635	18	28	33
Winchester Bay	227	2,107	121	222	222	54	98	98	1,527	1,873	1,873	78	99	99
Umpqua South	83	389	41	41	43	49	49	52	301	301	301	88	88	88
Other	1,654	2,612	339	409	594	20	25	36	90	560	644	16	37	47
Douglas County Total	5,896	10,350	1,054	1,626	1,974	34	49	53	2,303	3,231	3,454	50	63	67
Lakeside	1,709	2,386	0	4	108	0	0	6	0	4	68	0	0	7
Coos Bay	15,652	19,483	448	1,022	2,517	3	7	16	545	1,054	1,630	5	11	21
North Bend	9,592	12,123	58	469	1,255	1	5	13	169	209	1,000	2	6	19
Barview	3,122	5,022	147	464	2,286	5	15	73	779	965	1,690	18	28	79
Charleston	190	724	61	62	98	32	33	52	475	476	487	74	74	81
Sunset Bay Park	0	425	—	—	—	—	—	—	425	425	425	100	100	100
Bullards Beach	5	669	5	5	5	100	100	100	284	664	664	43	100	100
Bandon	3,227	6,748	310	465	2,182	10	14	68	338	766	2,706	10	18	72
Other[3]	26,327	36,291	300	838	1,892	1	3	7	626	994	1,833	3	5	10
Coos County Total	59,824	83,872	1,328	3,329	10,343	7	11	34	3,642	5,557	10,503	28	38	54

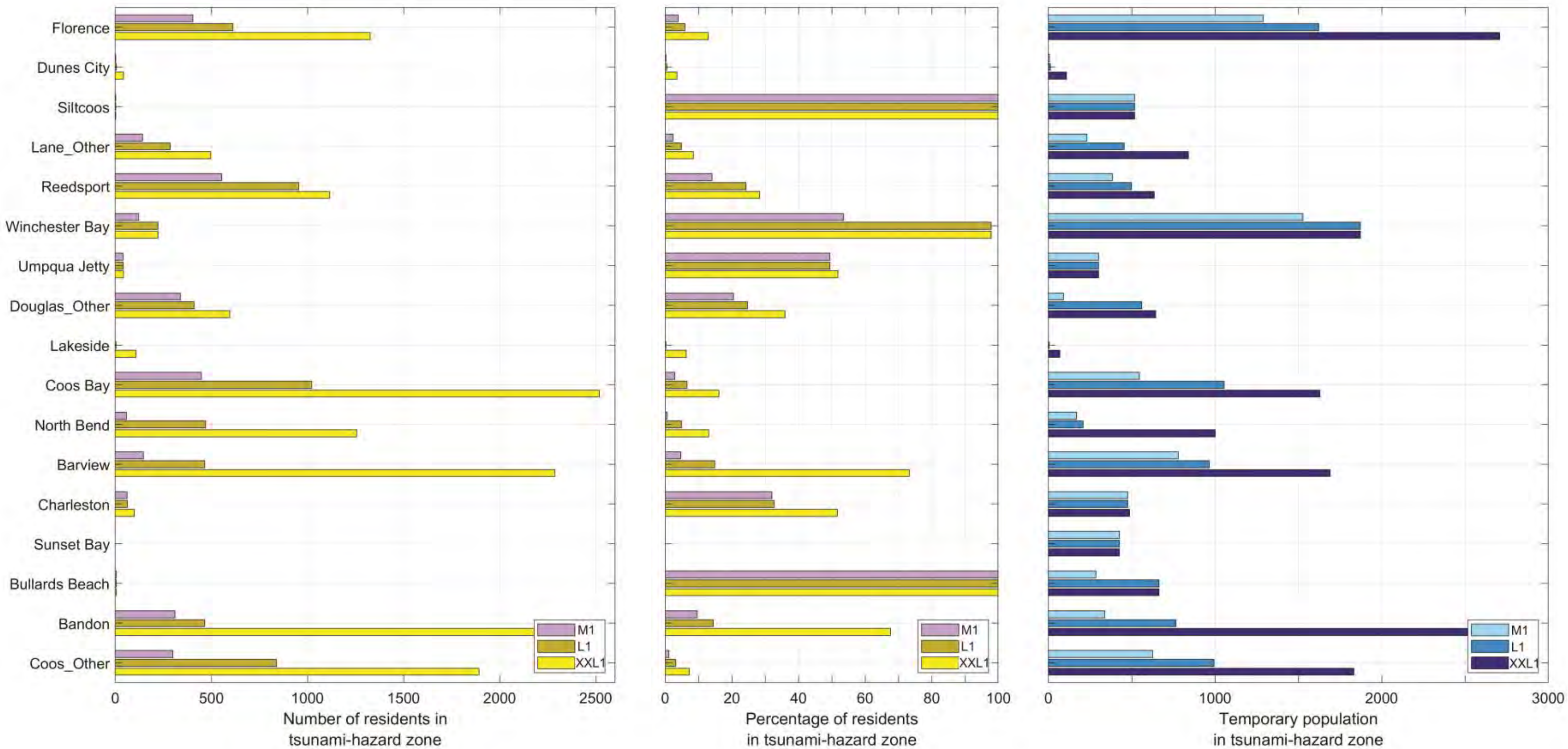
Notes:

[1] Assumes 100% occupancy of second homes, vacation rentals, condominium units, bed and breakfast facilities, hotels, motels, and campgrounds.

[2] Expressed as a proportion of the total resident population.

[3] Denotes all other areas impacted by a Cascadia earthquake and tsunami.

Figure 3-1. A breakdown of permanent and temporary populations inside the tsunami zone, by community. Left and center show the number and ratio, respectively, of permanent residents. Right shows the number of temporary (visitor) population. Note the larger x-axis, highlighting the significant influx of visitors to many of these communities.



Notes:

Percentage of residents expressed as a proportion of the total resident population.

Temporary population estimate assumes 100% occupancy of second homes, vacation rentals, condominium units, bed and breakfast facilities, hotels, motels, and campgrounds.

Figure 3-2 and **Table 3-2** differentiate the local resident population by age group (<65 and ≥65 years of age). Resident age has an important bearing on the ability of people to evacuate quickly, as it directly relates to the speed at which people may be able to travel by foot; recall that the evacuation speed for those ≥65 is reduced by 20% (a 0.8 walking speed reduction factor, see section 2.6.2.4). Thus, communities with larger numbers of people ≥65 years of age may want to consider evaluating where these people are situated, with a focus toward developing community evacuation response plans specific to their needs (e.g., prioritizing mitigation efforts such as constructing a vertical evacuation structure in one part of town over another because more older adults live in that area). As can be seen from **Table 3-2**, the countywide resident population ≥65 for Lane, Douglas, and Coos counties are:

1. *Lane County*: ~35% of the total population in the M1 and L1 tsunami zones, increasing slightly to 36% for XXL1; this equates to ~189, 324, and 715 Lane County residents ≥65 years of age in the M1, L1, and XXL1 zones, respectively.
2. *Douglas County*: ~34% of the total population in all three tsunami zones; this equates to ~325, 526, and 617 Douglas County residents in the M1, L1, and XXL1 zones, respectively, who are ≥65 years of age.
3. *Coos County*: ~33% of the total population in the M1 tsunami zone, decreasing to 31% in the L1 and 28% in the XXL1 tsunami zones; this equates to ~436, 914, and 2,749 Coos County residents in the M1, L1, and XXL1 zones, respectively, who are ≥65 years of age.

The actual number of people age ≥65 and older varies from one community to another, with Florence, Winchester Bay, and Bandon each having a much larger proportion (41%) of people ≥65 in the XXL1 tsunami inundation zones then other communities (**Table 3-2**).

Figure 3-2. Local resident population demographics. Example provided is for the XXL1 tsunami zone. Community profiles in Appendix A provide similar statistics for the M1 and L1 tsunami zones.

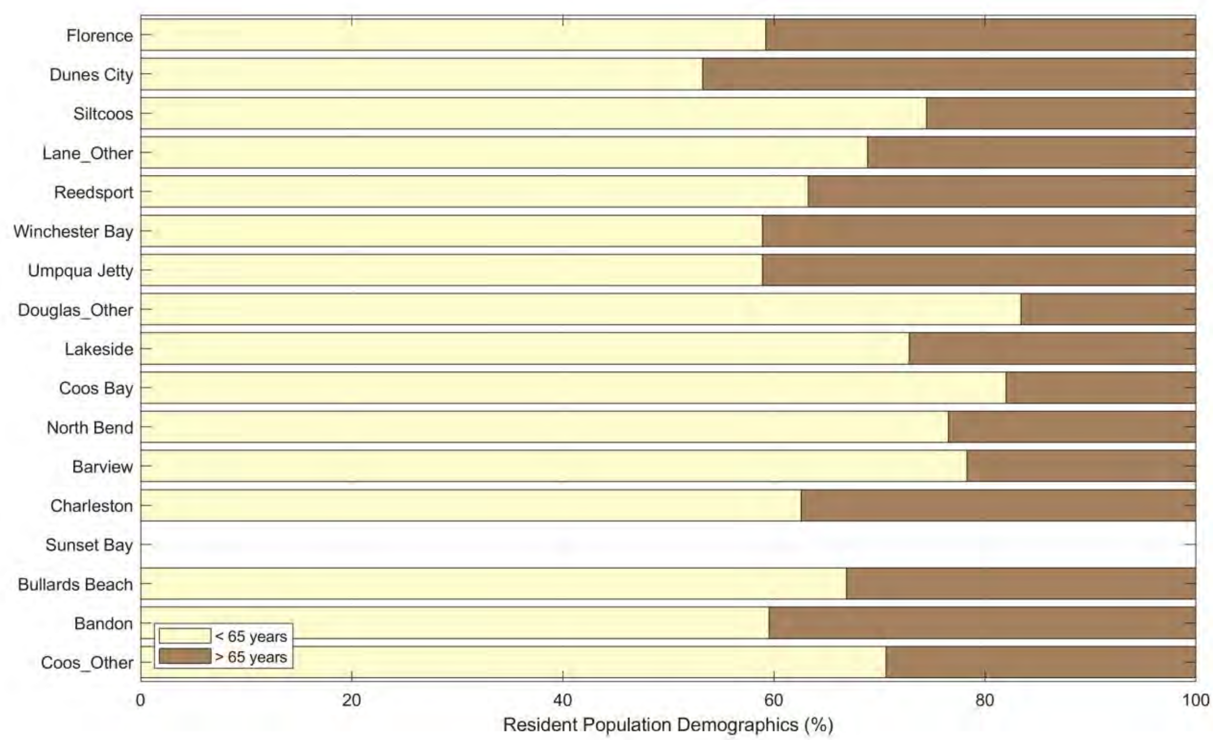


Table 3-2. Permanent resident age demographics per tsunami zone.

	M1			L1			XXL1		
Community	**<65**	**≥65**	**Older Age Ratio[1]**	**<65**	**≥65**	**Older Age Ratio[1]**	**<65**	**≥65**	**Older Age Ratio[1]**
Florence	259	144	36	379	233	38	785	541	41
Dunes City	2	1	47	3	3	47	23	20	47
Siltcoos	2	1	26	2	1	26	2	1	26
Other[2]	98	43	30	198	88	31	341	154	31
Lane County Total	361	189	35	582	324	35	1,151	715	36
Reedsport	349	204	37	603	352	37	705	409	37
Winchester Bay	71	50	41	131	91	41	131	91	41
Umpqua South	24	17	41	24	17	41	25	18	41
Other[2]	284	55	16	343	66	16	496	99	17
Douglas County Total	729	325	34	1,100	526	34	1,357	617	34
Lakeside	0	0		3	1	25	79	29	27
Coos Bay	385	63	14	858	163	16	2,065	453	18
North Bend	43	15	26	351	118	25	961	295	23
Barview	119	28	19	355	110	24	1,790	496	22
Charleston	38	23	37	39	23	37	61	37	37
Sunset Bay Park	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bullards Beach	4	2	33	4	2	33	4	2	33
Bandon	107	203	65	182	283	61	1,299	883	40
Other[2]	197	103	34	624	214	26	1,336	556	29
Coos County Total	892	436	33	2,415	914	31	7,594	2,749	29

Notes:

[1] Ratio of ≥65 relative to total resident population.

[2] Denotes all other areas impacted by a Cascadia earthquake and tsunami.

3.2 Building Damage and Debris

The number of residents (permanent and temporary) per building occupancy type and within the XXL1 tsunami zone is provided for each community in **Table 3-3** and summarized graphically in **Figure 3-3**. Apparent from both the table and figure are notable differences in where people live or visit among the communities. Permanent residents overwhelmingly reside in single-family dwellings, especially in Bandon (70%), Barview (69%), and Dunes City (69%). Multifamily residential buildings in the XXL tsunami zone are more common in North Bend (60%), Coos Bay (46%), Charleston (39%), Florence (37%), and Reedsport (31%). The Umpqua Jetty area (60%) reflects a small sub-section of the Winchester Bay community that contains few buildings as it is mostly dedicated to camping. Countywide averages for permanent residents reflect the following:

1. *Lane County*: single-family residential (74%), manufactured housing (13%), and multifamily residential (13%).
2. *Douglas County*: single-family residential (34%), manufactured housing (29%), and multifamily residential (37%).
3. *Coos County*: single-family residential (60%), manufactured housing (14%), and multifamily residential (25%).

There are notable differences in the predominant building occupancy type among the communities with respect to temporary residents. For example, hotel/motel availability is highest in Coos Bay (52%), followed by North Bend (50%), Florence (27%), Reedsport (26%), and Bandon (23%, **Table 3-3**; **Figure 3-3**). Apparent also from **Figure 3-3** are the large number of single-family residential rental units or vacation homes (e.g., VRBO or Airbnb) available throughout the three coastal counties. For example, Bandon is characterized with a large number (63%) of second homes that are used by temporary visitors, while 37% of homes in Florence are listed as second homes and may be used for vacation purposes. Similarly, Lakeside (84%), Barview (34%), and Reedsport (23%) also have notable numbers of vacation homes. RV and tent sites are particularly abundant in Winchester Bay (82%), Umpqua Jetty (95%), Charleston (82%), Barview (61%), and North Bend (32%); RV and tent camping comprise 100% the occupancy at Siltcoos, Bullards Beach and the Sunset Bay campgrounds. These latter results are especially important as they identify those locations where there are likely to be high visitor concentrations in the tsunami zone. Visitors may have little knowledge of the earthquake and tsunami risk and are less likely to know what to do following a major earthquake or how to locate the nearest area of high ground.

The number of permanent and temporary residents residing in single-family residential buildings in coastal Lane, Douglas, and Coos counties is further evaluated in the final two columns of **Table 3-3**. We focus on single-family residential buildings because they are the dominant housing type on the Oregon Coast and account for a potentially large group of vacationers that may not be directly exposed to tsunami awareness material or evacuation guidance that is occasionally found in hotels, motels, and campgrounds (Bauer and others, 2020). As can be seen in **Table 3-3**, the countywide ratio of permanent residents to single-family homes averages ~1.7, 1.5, and 1.84 in Lane, Douglas, and Coos respectively. Unlike Lincoln, Tillamook, and Clatsop counties, where we identified a surplus of single-family residential homes relative to the actual permanent population in those communities, no such surplus is apparent for Lane, Douglas, and Coos counties.

Table 3-3. Number of residents (permanent and temporary) per building occupancy type in the XXL1 tsunami zone in each community.

Community	Total Number of Single-Family Residential Homes	Number of Residents: Single-Family Residential		Manufactured Housing		Multifamily Residential		Hotel/ Motel		Mobile[1]		Other[2]		Total[3]		Ratio of Permanent Residents to Number of Single-Family Residential Homes	Ratio of Permanent and Temporary Residents to Number of Single-Family Residential Homes, Summer Weekend
		Perm	Temp	Perm	Temp	Perm	Temp	Perm	Temp	Perm	Temp	Perm	Temp	Perm	Temp		
Florence	639	586	1,003	248	114	492	345	0	722	0	524	0	0	1,326	2,709	1.30	3.05
Dunes City	26	29	48	9	6	4	1	0	22	0	32	0	0	43	109	1.47	3.52
Siltcoos	1	2	1	0	0	0	0	0	0	0	515	0	0	2	516	2.19	3.15
Other	251	408	436	67	20	21	10	0	49	0	325	0	0	495	841	1.89	3.71
Lane County Total	917	1,025	1,488	324	140	517	356	0	794	0	1,397	0	0	1,866	4,175	1.72	3.36
Reedsport	527	394	144	378	78	343	80	0	167	0	167	0	0	1,115	635	1.46	1.89
Winchester Bay	186	80	127	106	49	35	40	0	114	0	1,543	0	0	222	1,873	1.00	1.95
Umpqua South Jetty	13	3	2	10	3	30	10	0	0	0	287	0	0	43	301	1.00	1.35
Other	162	351	161	58	4	186	25	0	0	0	454	0	0	594	644	2.52	3.54
Douglas County Total	888	827	433	552	134	594	154	0	280	0	2,451	0	0	1,974	3,454	1.5	2.18
Lakeside	49	70	58	31	9	6	2	0	0	0	0	0	0	108	68	2.07	3.43
Coos Bay	609	1,152	276	210	9	1,156	111	0	852	0	382	0	0	2,517	1,630	2.24	2.70
North Bend	268	473	108	25	2	757	65	0	503	0	322	0	0	1,255	1,000	1.86	2.27
Barview	968	1,587	570	571	52	128	19	0	15	0	1,034	0	0	2,286	1,690	2.23	2.87
Charleston	48	53	26	6	1	38	9	0	51	0	400	0	0	98	487	1.24	1.79
Sunset Bay Park	0	0	0	0	0	0	0	0	0	0	425	0	0	0	425	NA	NA
Bullards Beach	3	5	4	0	0	0	0	0	0	0	660	0	0	5	664	NA	NA
Bandon	988	1,395	1,693	227	37	364	210	0	624	0	143	0	0	1,986	2,706	1.64	3.39
Other[4]	1,140	1,478	793	338	32	37	5	0	5	0	938	0	59	1,852	1,833	1.59	2.32
Coos County Total	4,073	6,214	3,527	1,408	142	2,485	420	0	2,050	0	4,304	0	59	10,108	10,503	1.84	2.68

Notes:

[1] Mobile includes tents, boats, and recreational vehicles.

[2] Other includes dormitories, retirement villages and private camps.

[3] Aggregate of all permanent and temporary building occupancy types.

[4] Denotes all other areas impacted by a Cascadia earthquake and tsunami.

"Perm" is permanent and "Temp" is temporary population.

Figure 3-3. Building occupancy type for permanent (left) and temporary (right) residents in the XXL1 tsunami zone, by community. ***(continued on next page)***

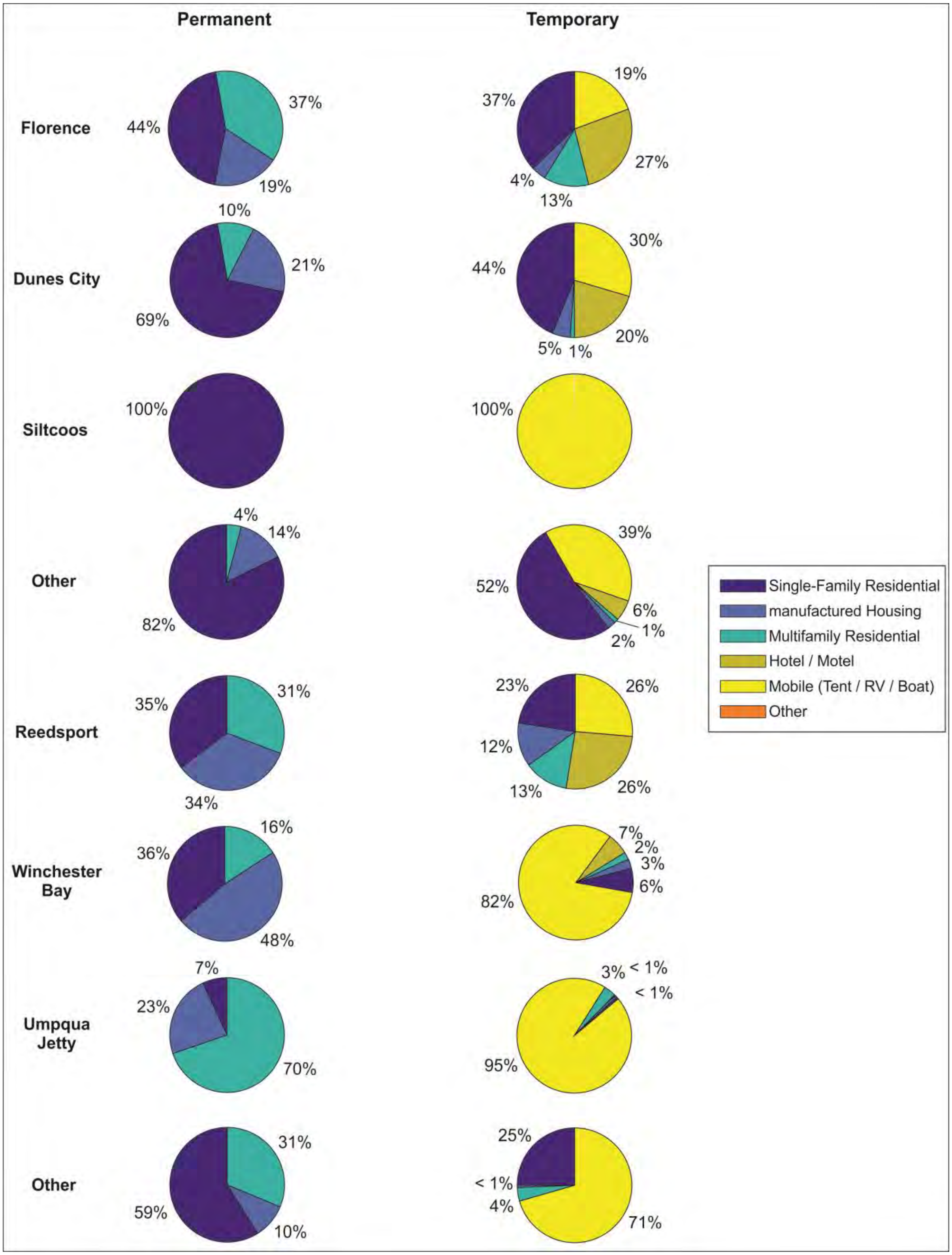
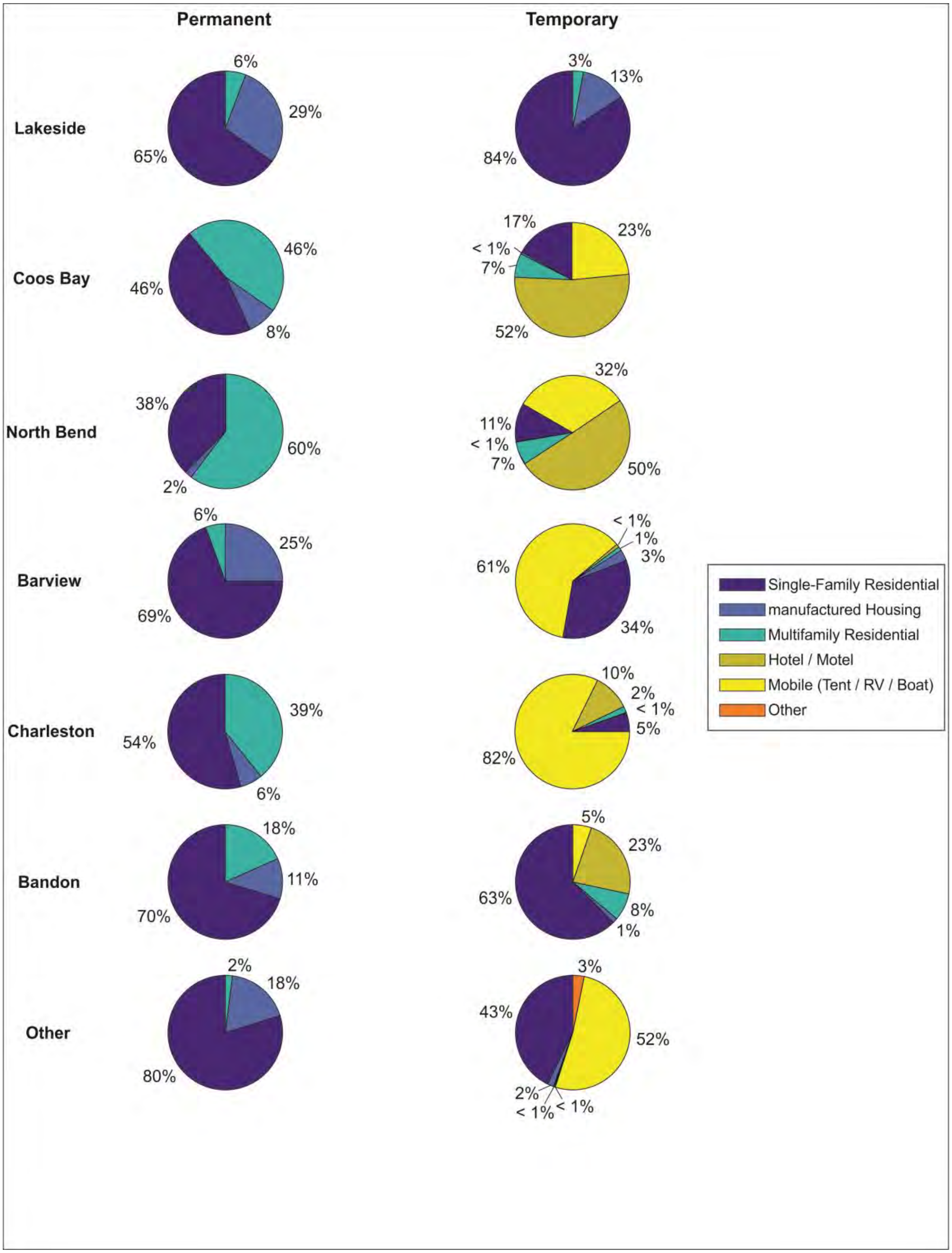


Figure 3-3. ***(continued)*** **Building occupancy type for permanent (left) and temporary (right) residents in the XXL1 tsunami zone, by community.**



An evaluation of the ratio of permanent and temporary visitors is provided in the final column of **Table 3-3**. It indicates the degree to which the local population may grow as visitors (predominantly vacationers) stay in those destinations. Larger ratios imply the availability of more beds, thereby highlighting those communities that are more likely to be major recreation destinations. In addition, the results may further help to highlight the importance of vacation homes, especially during a summer weekend when visits to the coast tend to be maximized compared with the baseline that considers just the permanent residents; compare the last two columns of **Table 3-3**. Bandon (3.4) and Florence (3.05) have the highest permanent and temporary populations relative to the number of single-family residential homes. Large ratios are also observed in the Lane and Douglas County "other" category (3.71% and 3.5%, respectively), which is likely capturing second homes located in the Heceta Beach and Gardiner areas. Hence, the local community in these areas may at times have an unusually large visitor population that may not be aware of the Cascadia tsunami hazard, let alone be prepared to deal with such an event.

Integral to pre- and post-disaster planning is knowledge of what will happen to buildings in the various communities because of earthquake ground motion and subsequent tsunami forces. These data are presented in **Table 3-4**. Note **Table 3-4** also includes estimates of the broader community-wide earthquake-related damage expected to occur both inside and outside of the tsunami zone. **Figure 3-4** graphically summarizes the results of **Table 3-4**.

The number of buildings located in each of the three tsunami zones is provided in the second through fourth columns of **Table 3-4** and plotted as bar graphs in **Figure 3-4** *(*upper left). Not surprisingly, Florence, Reedsport, Coos Bay, Barview, and Bandon have large numbers of buildings located in a tsunami zone. Nevertheless, in total the largest number of buildings occurs outside of the Coos County community boundaries and reflects those buildings summarized in the "other" category (~2,100). The bulk of these are residential buildings, established mainly along the shores of the Coos and Coquille estuaries, outside the city boundaries. For Charleston and to a lesser extent Umpqua River jetty, the relatively small change between M1 and XXL1 is indicative of the fact that these areas are inundated by tsunamis in all three scenarios, such that the exposure risk at these sites is especially high.

Building replacement costs (assuming complete destruction) are shown in **Figure 3-4** (upper right) for each of the tsunami zones. Coos Bay ($711 million), Bandon ($540 million), North Bend ($402 million), and Coos County "other" ($599 million) are likely to see significant building losses in the XXL1 tsunami zone. Countywide building replacement costs for each tsunami zone reflect the following:

1. Lane County: total $152 million (M1), $223 million (L1), and $385 million (XXL1).
2. Douglas County: total $204 million (M1), $306 million (L1), and $372 million (XXL1).
3. Coos County: total $675 million (M1), $1.25 billion (L1), and $2.63 billion (XXL1).

Damage caused by earthquake shaking is presented in **Figure 3-4C** for each tsunami zone, along with the community-wide earthquake-related damage estimate (cyan bars). These latter data reflect earthquake damage across the entire community urban growth boundary along the Oregon Coast. Since Lane and Douglas counties extend well into the Willamette Valley, we exclude those areas from the analyses and results presented here. As can be seen in **Table 3-4**, the costs associated with earthquake damage across the three tsunami zones are estimated to be:

1. Lane County: $84 million (M1), $114 million (L1), and $187 million (XXL1).
2. Douglas County: total $125 million (M1), $178 million (L1), and $209 million (XXL1).
3. Coos County: total $399 million (M1), $700 million (L1), and $1.3 billion (XXL1).

Table 3-4 and **Figure 3-4** show discrete community earthquake damage losses, which range from $400 million in Coos Bay to ~$2 million at the Umpqua South Jetty site. The state parks and recreation areas show damage levels in the tens of thousands. Earthquake damage losses in areas beyond the specified communities ("other" category) are estimated to reach $273 million in Coos County.

The countywide earthquake damage losses outside the tsunami zones are the difference between losses inside a tsunami zone and the countywide totals (determined from **Table 3-4**); this equates to ~$5.47 billion (M1), $5.09 billion (L1), and $4.35 billion (XXL1) in losses outside of the tsunami zones. These data become important when considering the total damage losses caused by the combined tsunami and earthquake. The decrease in damage losses outside the tsunami zones is indicative of the increasing inundation (and tsunami-caused damage) as one moves from M1 to XXL1.

Combined earthquake and tsunami damage for each tsunami zone is included in **Table 3-4** and **Figure 3-4D**. These results indicate losses that range from ~$733 million (M1) to ~$2.7 billion (XXL1) across the three counties. Factoring in the additional earthquake losses outside the tsunami zones, our analyses indicate total losses on the order of:

1. Lane County: ~$1.25 billion (M1), ~$1.27 billion (L1), and ~$1.36 billion (XXL1).
2. Douglas County: total ~$440 million (M1), ~$464 million (L1), and ~$530 million (XXL1).
3. Coos County: total ~$4.52 billion (M1), ~$4.62 billion (L1), and ~$5.14 billion (XXL1).

Note that these estimates exclude building content losses and damage to roads, so these totals may be viewed as minimum estimates. At the community level, Coos Bay experiences the largest combined losses (i.e., inside and outside the tsunami zone), which reaches ~$1.2 billion, followed by damage losses in areas beyond the specified communities ("other" category) at ~$2.1 billion.

As can be seen from the earthquake building loss ratio (**Table 3-4E**), earthquake damage accounts for the bulk of the total building damage in Lane County. Significant building damage due to earthquake shaking is observed in Florence, Reedsport, Coos Bay, Charleston and Bandon. This is probably due to a combination of factors, including ground failure through liquefaction and lateral spreading, and the presence of older buildings.

Incorporating damage caused by the tsunami results in destruction levels for an M1 event that range from ~10% (Dunes City) to 90% (Charleston and Bandon; **Figure 3-4E)**. Destruction levels for an M1 event are especially high in Barview (79%), Coos Bay (72%), North Bend (70%), and Reedsport (70%). For an XXL1 size event, **Table 3-4** indicates >84% destruction in multiple communities, including Florence, Reedsport, Winchester Bay, Barview, Charleston and Bandon. The lowest destruction levels are generally observed in the more distal tsunami zone, such as Dunes City (~56% destruction) and Lakeside (52% destruction). Significant destruction at Winchester Bay, Barview, Charleston, and Bandon is indicative of the large number of buildings in the tsunami zone, large hydraulic forces associated with the tsunami and the prevalence of light-frame construction material (i.e., wood frame) on the Oregon Coast. Combined earthquake and tsunami damage estimates (**Table 3-4**) are:

1. Lane County: ~67% destroyed in the M1 event, 69% in the L1 event, and 81% in the XXL1 event.
2. Douglas County: ~69% destroyed in the M1 event, 71% in the L1 event, and 85% in the XXL1 event.
3. Coos County: ~73% destroyed in the M1 event, 72% in the L1 event, and 78% in the XXL1 event.

Although not included in **Table 3-4**, our Hazus analyses indicate that of the total number of buildings assessed, damage potential is estimated to be on the order of:

1. Lane County: 30% are expected to be destroyed, 27% are expected to experience extensive damage, and 22% of the buildings are expected to suffer moderate damage. 16% of the remaining buildings are expected to experience slight damage, and ~5% are expected to experience no damage.
2. Douglas County: 28% are expected to be destroyed, 21% are expected to experience extensive damage, and 17% of the buildings are expected to suffer moderate damage. 19% of the remaining buildings are expected to experience slight damage, and ~15% are expected to experience no damage.
3. Coos County: 23% are expected to be destroyed, 28% are expected to experience extensive damage, and 31% of the buildings are expected to suffer moderate damage. 14% of the remaining buildings are expected to experience slight damage, and ~3% are expected to experience no damage.

Finally, **Table 3-4** and **Figure 3-4F** indicate that the weight of debris generated countywide could range from ~33,000 tons (M1) in Lane County to ~785,000 tons (XXL1) in Coos Cunty. This equates to ~3,300 dump trucks for M1 and as many as 78,500 dump trucks for an XXL1 event. These estimates are almost certainly on the low end, as they do not include debris associated with content from buildings (personal items, business equipment, etc.), road rip-ups, vehicles, and vegetation. If we assume an additional five tons of personal items as debris per residential building (typical for most residential buildings), this adds ~4% additional weight to the building debris estimates provided in **Table 3-4**.

Table 3-4. Earthquake- and tsunami-induced building damage and debris estimates by community.

	Number of Buildings by Tsunami Zone			Building Replacement Cost by Tsunami Zone[1] ($ Million)			Earthquake Building Loss by Tsunami Zone[2] ($ Million)			Earthquake Building Loss by Community[3]		Combined Earthquake and Tsunami Building Loss by Tsunami Zone ($ Million)			Combined Earthquake and Tsunami Building Loss by Tsunami Zone (%)			Combined Earthquake and Tsunami Building Debris by Tsunami Zone (Tons)		
Community	**Medium**	**Large**	**XX-Large**	**Medium**	**Large**	**XX-Large**	**Medium**	**Large**	**XX-Large**	**($ Million)**	**Building Loss Ratio**	**Medium**	**Large**	**XX-Large**	**Medium**	**Large**	**XX-Large**	**Medium**	**Large**	**XX-Large**
Florence	153	310	909	117	163	279	69	92	150	832	299%	81	120	241	70%	73%	86%	23,555	36,004	79,809
Dunes City	4	6	41	1	1	6	0	0	3	62	992%	0	0	4	10%	19%	56%	9	12	1,288
Siltcoos	1	1	1	0	0	0	0	0	0	0	53%	0	0	0	100%	100%	100%	71	71	71
Other[4]	153	290	477	34	59	100	15	22	34	336	337%	19	34	68	57%	57%	69%	9,299	14,383	26,766
Lane County Total	311	607	1,428	152	223	385	84	114	187	1,230	420%	101	154	313	59%	62%	78%	32,934	50,469	107,934
Reedsport	472	762	897	122	183	212	78	108	122	284	134%	86	123	177	70%	67%	84%	44,888	62,441	84,911
Winchester Bay	168	292	292	29	46	46	15	24	24	24	52%	18	38	45	60%	84%	98%	8,491	16,954	20,330
Umpqua South Jetty	26	27	31	6	6	7	2	2	2	5	75%	3	6	6	46%	94%	96%	972	1,695	2,053
Other[4]	134	210	349	46	71	107	30	45	61	111	104%	33	50	86	72%	71%	80%	16,845	24,789	41,491
Douglas County Total	800	1,291	1,569	204	306	372	125	178	209	424	91%	140	217	315	62%	79%	89%	71,196	105,878	148,784
Lakeside	0	6	75	0	4	17	0	2	7	100	608%	0	2	9		62%	52%	0	184	2,991
Coos Bay	312	619	1,233	298	511	711	186	308	400	1,061	149%	214	356	501	72%	70%	71%	88,628	150,401	203,529
North Bend	75	265	613	85	204	402	52	113	208	690	172%	60	137	288	70%	67%	72%	18,207	47,576	102,404
Barview	123	330	1,492	32	75	289	17	39	156	195	68%	25	61	271	79%	81%	94%	9,557	20,913	106,748
Charleston	186	189	223	64	64	71	41	42	44	51	72%	58	63	69	90%	97%	97%	25,394	28,068	30,806
Sunset Bay Park	3	3	3	0	0	0	0	0	0	0	81%	0	0	0	100%	100%	100%	187	188	188
Bullards Beach	13	13	14	2	2	2	1	1	1	1	47%	1	2	2	56%	95%	100%	471	749	919
Bandon	182	290	1,447	89	139	540	57	80	241	412	76%	80	117	480	90%	84%	89%	31,249	45,586	168,123
Other[4]	373	918	2,088	105	247	597	44	115	272	1,912	320%	54	158	422	52%	64%	71%	16,574	64,052	168,929
Coos County Total	1,267	2,633	7,188	675	1,246	2,630	399	700	1,329	4,424	177%	492	896	2,043	73%	72%	78%	190,266	357,717	784,638

Notes:

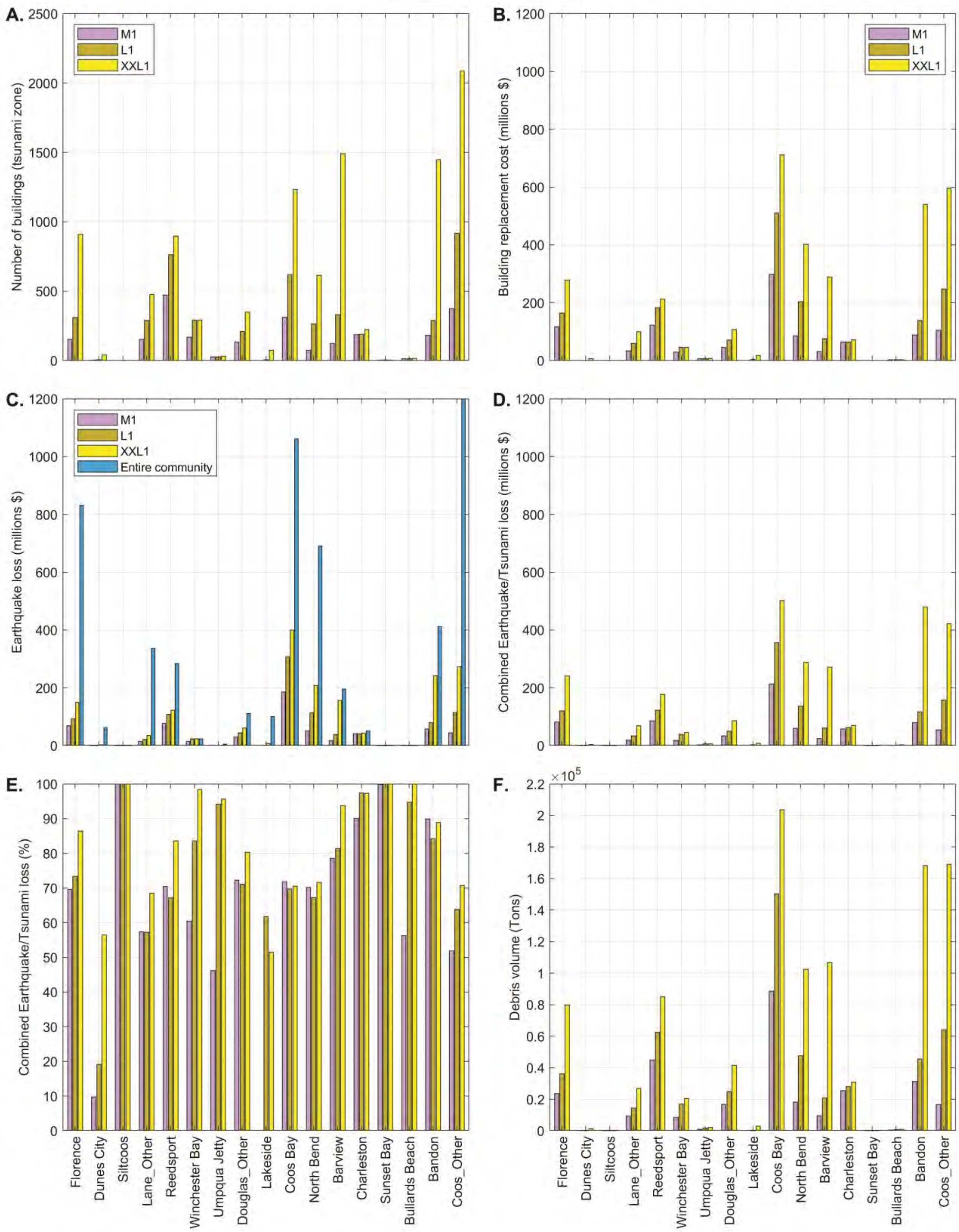
[1] Total cost to replace buildings in each tsunami zone

[2] Earthquake building losses defined for each tsunami zone

[3] Earthquake building losses defined for the entire community (inside and outside the tsunami zone)

[4] Denotes all other areas impacted by a Cascadia earthquake and tsunami.

Figure 3-4. Community overview showing (A) number of buildings per tsunami zone, (B) total replacement costs (millions of $), (C) earthquake losses (millions of $), (D) combined tsunami and earthquake losses (millions of $), also expressed as a (E) ratio, and (F) debris generated (weight).



3.3 Earthquake-Caused Injuries and Fatalities

Our Hazus analyses indicate that injuries from a CSZ earthquake greatly outnumber fatalities (**Table 3-5**). Modeled injuries experienced by residents and visitors are expected to be highest in Florence, Coos Bay and North Bend, followed by the "other" category. The latter numbers are of concern as these will be spread out over a very broad area. This will make it extremely challenging and time consuming to medivac the injured to appropriate field hospitals.

Table 3-5. Earthquake-induced injuries and fatalities determined for each community, expressed as a total for the county.

		Permanent Residents				Temporary Residents			
Community Zone	**Total Population[2]**	**Level 1**	**Level 2**	**Level 3**	**Level 4**	**Level 1**	**Level 2**	**Level 3**	**Level 4**
Florence	16,669	291	72	5	9	116	28	2	4
Dunes City	2,555	12	3	0	0	19	5	0	1
Siltcoos	518	0	0	0	0	0	0	0	0
Other[1]	9,796	98	23	1	2	42	10	1	2
Lane County Total	29,538	401	97	7	11	177	42	4	6
Reedsport	5,241	56	14	1	2	13	3	0	1
Winchester Bay	2,107	8	2	0	0	9	3	0	1
Umpqua South Jetty	389	2	0	0	0	0	0	0	0
Other[1]	2,612	31	7	1	1	6	1	0	0
Douglas County Total	10,350	96	24	2	4	28	7	1	2
Lakeside	2,386	47	12	1	2	13	3	0	1
Coos Bay	19,483	289	71	6	11	58	16	2	4
North Bend	12,123	157	39	4	7	51	15	2	4
Barview	5,022	86	21	2	3	16	4	0	0
Charleston	724	5	1	0	0	5	2	0	1
Sunset Bay State Park	425	0	0	0	0	0	0	0	0
Bullards Beach	669	0	0	0	0	0	0	0	0
Bandon	6,748	79	20	2	3	88	25	3	6
Other[1]	36,291	424	97	7	11	102	24	2	4
Coos County Total	83,872	1,088	261	21	37	333	87	10	19

Notes:

See **Table 2-4** for a more complete description of Hazus-defined injury levels. Level 1 denotes minor injuries, level 2 denotes injuries requiring hospitalization, level 3 denotes life-threatening injuries, level 4 denotes fatalities.

[1] Denotes all other areas impacted by a Cascadia earthquake and tsunami.

[2] Assumes 100% occupancy of second homes, vacation rentals, condominium units, bed and breakfast facilities, hotels, motels, and campgrounds.

Of the total number of injuries identified across all three counties (~2,000), Hazus estimates ~560 people are likely to require hospitalization (i.e. level 2 and level 3 injuries). The low fatality (~50) and injury estimates relative to the total population in these communities and caused by earthquake are likely due to the prevalence of wood-frame construction. However, we note that even if injuries are minor, impacted persons may delay evacuation from a tsunami zone while they tend to injuries.

3.4 Tsunami-Caused Injuries and Fatalities

Casualty numbers (injuries plus fatalities) attributed to a Cascadia tsunami are presented in **Table 3-6** and graphically in **Figure 3-5**. Overall, our Hazus modeling indicates that tsunami related casualties will greatly exceed earthquake-related casualties, especially when accounting for the combined resident and visitor populations. Notably, injuries caused by the tsunami average about 29% (±16%) of the total number of casualties, indicating that tsunami related deaths account for a larger proportion of the casualties (**Table 3-7**). This is because the Hazus tsunami casualty model estimates that people who do not escape from the tsunami zone are much more likely to die than to be injured and survive. Those who are injured are largely confined to a small narrow band where the tsunami flow depth falls below 1.8 m (~6 feet; see Section 2.6.2.5).

As can be seen in **Table 3-6** and **Figure 3-5**, modeled tsunami casualties vary widely between the communities. This is due to many factors, but most important is the relative distance to high ground. For the M1 scenario, estimated casualties are confined mainly to three areas: Winchester Bay (~6 residents/1,140 visitors), Charleston (~6 resident/195 visitor), and Sunset Bay State Park (~0 residents/145 visitors). Casualties in these three communities are overwhelmingly related to the campgrounds. Hence, for the M1 tsunami scenario, our Hazus modeling suggests either few or no casualties in the remaining three counties; note that these latter estimates fall within the margin of error in the Hazus modeling. Aside from the previously mentioned communities located at the open coast, low casualty numbers determined for the M1 scenario are indicative of the fact that most of the communities are:

1) built on high ground (e.g., marine terraces at Florence),
2) high ground is located close to the population centers allowing for quick access out of the inundation zone, or
3) are located well away from the coast (e.g., Dunes City and Lakeside) such that the M1 event does not reach them.

The number of casualties associated with the XXL1 tsunami scenario increase dramatically from the M1 scenario, ranging from no expected casualties (e.g., Dunes City, Reedsport, Lakeside, and North Bend) to as many as ~1,900 at Bandon, ~1,400 in the Coos County "other" category, ~1,200 in Winchester Bay, and ~980 in Barview (**Table 3-6**). In each of these areas, most of those expected to lose their lives (>69% in Lane and Douglas County and ~61% in Coos County) are likely to be visitors. Overall, we find the average number of fatalities observed in the permanent population across all three counties is low, averaging ~1.5% for the M1 scenario, increasing to 7.4% for the XXL scenario. For some communities such as Bandon and Barview, the percentage of resident fatalities are 38% and 21%, respectively, for the XXL1 scenario. Several additional sites characterized by the potential for large visitor fatalities include the Siltcoos River Campground, Umpqua South Jetty, Sunset Bay campground, and Bullards Beach campground. The large number of potential fatalities at each of the campgrounds can be attributed to a combination of early tsunami wave arrivals and the significant travel distances required to reach high ground. High casualty numbers in Bandon and Winchester Bay are also due to early wave arrivals and potentially large numbers of people in the tsunami zone. Evacuation modeling of Winchester Bay (Gabel and others, 2018b) and Barview (Gabel and others, 2019b) identified a few key mitigation options that could be implemented to reduce fatalities, including retrofitting the Salmon Harbor Bridge in downtown Winchester Bay and improving signage in places like Barview. Use of a vertical evacuation structure in Barview was discounted largely because such structures would not effectively serve the community since no single road emerges as a primary evacuation route, with evacuation routes being broadly dispersed among several roads in the area.

We estimate that, combined, countywide fatalities from the tsunami could reflect the following:

1. Lane County: ~20 killed in an M1 event, ~50 in an L1 event, and ~200 in an XXL1 event.
2. Douglas County: ~610 killed in an M1 event, ~1,180 in an L1 event, and ~1,380 in an XXL1 event.
3. Coos County: ~440 killed in an M1 event, ~1,070 in an L1 event, and ~5,290 in an XXL1 event.

As noted above, most of the potential fatalities are likely to come from the temporary visitor population. Given that these casualty estimates are only for 11 communities and three major state parks, total deaths caused by even an M1 CSZ tsunami, when accounting for all 38 communities (and numerous state parks) on the Oregon Coast, will likely exceed Oregon Seismic Safety Policy Advisory Commission's original estimate of ~5,000 people killed (OSSPAC, 2013). For context, tsunami casualties provided by OSSPAC (2013) are based on an M1 tsunami earthquake scenario, which covers ~79% of the DOGAMI tsunami inundation scenarios and did not consider the temporary visitor population. Using the same event scenario, our combined assessment for Clatsop (Allan and others, 2020a), Tillamook (Allan and others, 2020b), Lincoln (Allan and others, 2021) and those reported here indicate ~4,100 fatalities within the resident population for the M1 scenario, along with an additional ~10,600 fatalities within the visitor population. These results indicate that estimates by OSSPAC (2013) are low for a major Cascadia event.

Figure 3-5 presents a graphical summary of the estimated fatalities and displaced population for all three tsunami scenarios. Casualties are presented on the left of **Figure 3-5**, and estimates of the displaced population are on the right. The permanent resident population reflects the following color scheme: purple (M1), gold (L1), and yellow (XXL1). We provide contrasting cool colors to characterize different visitor occupancy levels (we assume 10%, 50%, and 100% occupancy level scenarios).

Since the permanent resident population is easiest to define in our population model, we argue that this likely reflects a low-end estimate of casualty numbers associated with each of the three tsunami events. This is shown in **Figure 3-5** by the left edge of the dark blue bars. Conversely, the resident plus visitor population (assuming 100% occupancy), is characterized by the length of the entire bar (right edge of the pale blue shaded region). Accordingly, the area in between reflects the uncertainty associated with the visitor population that could be present in the tsunami zone within each of the communities. One could speculate on visitor occupancy as we have done here by developing scenarios that vary from 10% (e.g., winter occupancy conditions, dark blue shading) or 50% (an average visitor occupancy, cyan shading) to define the potential number of casualties and displaced people. Refining such estimates, guided by local input, would help clarify a range of possible scenarios leading to more informed evaluations. As noted previously, the large number of casualties estimated for Winchester Bay in Douglas County in each of the three Cascadia scenarios (**Figure 3-5**, left) demonstrates the importance of a single pedestrian bridge in that community for effective evacuation to high ground and hence safety from the tsunami. Discussions with county personnel suggest that this key bridge is expected to fail, which forces people to take a much longer evacuation route westward toward the Umpqua lighthouse, in the direction of the oncoming tsunami. Large casualty numbers may also occur at Barview and Bandon during an XXL1-size tsunami due to the potentially large numbers of people and businesses in the tsunami zone. Conversely, low casualty numbers in most of the other communities are due entirely to the fact that high ground is close by (or the communities are at the distal ends of the tsunami zone), enabling more people to reach safety in time. Regardless of differences in local geography, it is evident from **Figure 3-5** that the number of casualties associated with even an M1 size event (especially when factoring in the temporary visitor population) has the potential to be large when scaled up to the rest of the Oregon Coast.

For the displaced population (**Figure 3-5**, *right* and **Table 3-8**), we can make similar assumptions about the local population groups. Apparent from the figure is the extremely large number of displaced visitors that each community could potentially have to deal with. This is most apparent for Florence, Coos Bay, North Bend, Barview, and Reedsport, each of which might potentially have to deal with several thousand people, many of whom would be nonresidents. The extremely large number of displaced people in the Coos 'Other' category after an XXL1 event will be especially challenging post disaster as many of these people will be disbursed widely across the county, making evacuation extremely difficult. Identifying these groups early on and providing or encouraging pre-disaster preparation (e.g., being two-week ready) will be key to their survival.

Although the number of displaced people increases significantly from M1 (~9,800) to XXL1 (~25,400) (**Table 3-8**), our Hazus results demonstrate that even a medium (M1) event would result in the displacement of many thousands of people. These numbers are indicative of the fact that many of these coastal communities are major tourist destinations with large numbers of vacation homes, camping spots, and to a lesser extent hotel/motels located in the tsunami zone. The low number of displaced people in places such as Sunset Beach State Park and Umpqua South Jetty under the XXL1 scenario (**Figure 3-5**, right) suggests that most people would be killed, because high ground under this scenario is not easily reached in time. In this case, evacuees traveling at a walking pace would not survive. In these areas, required evacuation speeds needed to survive the XXL1 event are faster than a walk (e.g., fast walk to jog).

Finally, the assumptions and observations described previously about tsunami casualties are predicated on the fact that people will evacuate from the tsunami zone within 10 minutes from the start of earthquake shaking. If people respond slowly and take an additional five-minute delay (i.e., a 15-minute departure time), the casualty numbers will increase significantly (**Table 3-7**). As can be seen from the table, a five-minute difference in the departure delay could cause the number of casualties to increase by 4,400 people. Thus, efforts directed at reducing human response times are critical for reducing overall casualties.

Table 3-6. Estimated injuries and fatalities associated with three CSZ tsunami scenarios by community, based on a 2 AM summer weekend scenario . Tsunami injury and fatality estimates assume a departure time of 10 minutes after the start of earthquake shaking.

	Number of Permanent Residents by Tsunami Zone			Estimated Number of Temporary Residents by Tsunami Zone[1]			Injuries and Fatalities to Permanent Residents by Tsunami Scenario			Injuries and Fatalities to Temporary Residents by Tsunami Scenario[1]			Injuries and Fatalities to Permanent Residents by Tsunami Scenario, Percent[2]			Injuries and Fatalities to Temporary Residents by Tsunami Scenario, Percent[3]		
Community Zone	**Medium**	**Large**	**XX-Large**	**Medium**	**Large**	**XX-Large**	**Medium**	**Large**	**XX-Large**	**Medium**	**Large**	**XX-Large**	**Medium**	**Large**	**XX-Large**	**Medium**	**Large**	**XX-Large**
Florence	404	612	1,326	1,289	1,622	2,709	0	0	5	0	0	14	0%	0%	0%	0%	0%	1%
Dunes City	3	6	43	6	11	109	0	0	0	0	0	0	0%	0%	0%	0%	0%	0%
Siltcoos	2	2	2	516	516	516	0	0	0	43	47	115	1%	1%	11%	8%	9%	22%
Other[4]	141	286	495	232	454	841	0	1	45	0	1	117	0%	0%	9%	0%	0%	14%
Lane County Total	550	906	1,866	2,043	2,604	4,175	0	1	50	43	49	246	0%	0%	5%	2%	2%	9%
Reedsport	553	954	1,115	384	497	635	0	0	0	0	0	0	0%	0%	0%	0%	0%	0%
Winchester Bay	121	222	222	1,527	1,873	1,873	5	8	19	1,138	1,143	1,244	4%	3%	9%	74%	61%	66%
Umpqua South Jetty	41	41	43	301	301	301	2	2	8	56	57	166	5%	5%	18%	19%	19%	55%
Other[4]	339	409	594	90	560	644	0	3	6	0	0	10	0%	1%	1%	0%	0%	2%
Douglas County Total	1,054	1,626	1,974	2,303	3,231	3,454	7	13	34	1,194	1,200	1,420	2%	2%	7%	23%	20%	31%
Lakeside	0	4	108	0	4	68	0	0	0	0	0	0		0%	0%		0%	0%
Coos Bay	448	1,022	2,517	545	1,054	1,630	0	0	9	0	0	9	0%	0%	0%	0%	0%	1%
North Bend	58	469	1,255	169	209	1,000	0	0	0	0	0	0	0%	0%	0%	0%	0%	0%
Barview	147	464	2,286	779	965	1,690	1	4	669	52	66	604	1%	1%	29%	7%	7%	36%
Charleston	61	62	98	475	476	487	6	10	32	195	261	377	10%	16%	33%	41%	55%	78%
Sunset Bay State Park	0	0	0	425	425	425	0	0	0	144	291	422				34%	68%	99%
Bullards Beach	5	5	5	284	664	664	0	1	5	32	111	324	2%	14%	91%	11%	17%	49%
Bandon	310	465	2,182	338	766	2,706	13	141	1,307	18	59	1,652	4%	30%	60%	5%	8%	61%
Other[4]	300	838	1,892	626	994	1,833	33	111	640	122	366	962	11%	13%	34%	19%	37%	52%
Coos County Total	1,328	3,329	10,343	3,642	5,557	10,503	52	267	2,662	561	1,152	4,350	4%	9%	22%	15%	21%	42%

Notes:

[1] Assumes 100% occupancy of second homes, vacation rentals, condominium units, bed and breakfast facilities, hotels, motels, and campgrounds.

[2] Casualties expressed as percentage of those injured or killed in the tsunami zone relative to the total number of community-wide permanent residents.

[3] Casualties expressed as percentage of those injured or killed in the tsunami zone relative to the total number of community-wide temporary residents, assuming 100% occupancy.

[4] Denotes all other areas impacted by a Cascadia earthquake and tsunami.

Table 3-7. Injury and fatality estimates for an XXL1 tsunami for two median departure times.

Community Zone	Number of Permanent Residents	Total Number of Residents (Permanent + Temporary[1])	10-Minute Departure				15-Minute Departure			
			Injuries	Fatalities	Total	Injuries Ratio[2]	Injuries	Fatalities	Total	Injuries Ratio[2]
Florence	10,291	16,669	1	18	19	7%	41	375	416	10%
Dunes City	1,208	2,555	0	0	0	26%	0	3	3	8%
Siltcoos	2	518	26	89	115	23%	28	290	318	9%
Other[3]	5,871	9,796	58	103	162	36%	70	341	411	17%
Lane County Total	17,372	29,538	86	210	296	23%	139	1,008	1,148	11%
Reedsport	3,932	5,241	0	0	0	49%	24	54	78	31%
Winchester Bay	227	2,107	55	1,208	1,264	4%	62	1,517	1,579	4%
Umpqua South Jetty	83	389	15	159	174	9%	12	242	254	5%
Other[3]	1,654	2,612	7	9	16	46%	30	138	168	18%
Douglas County Total	5,896	10,350	78	1,376	1,454	27%	129	1,950	2,079	15%
Lakeside	1,709	2,386	0	0	0	42%	1	3	4	18%
Coos Bay	15,652	19,483	7	11	18	37%	51	288	339	15%
North Bend	9,592	12,123	0	0	0	40%	12	60	73	17%
Barview	3,122	5,022	297	975	1,273	23%	318	1,999	2,317	14%
Charleston	190	724	55	354	409	14%	32	454	487	7%
Sunset Bay State Park	0	425	30	392	422	7%	17	406	423	4%
Bullards Beach	5	669	57	272	329	17%	38	472	510	7%
Bandon	3,227	6,748	1,047	1,913	2,960	35%	846	2,931	3,777	22%
Other[3]	26,327	36,291	229	1,373	1,602	14%	208	1,725	1,933	11%
Lincoln County Total	59,824	83,872	1,722	5,291	7,012	26%	1,523	8,338	9,861	13%

Notes:

[1] Assumes 100% occupancy of second homes, vacation rentals, condominium units, bed and breakfast facilities, hotels, motels, and campgrounds.

[2] Tsunami Injuries ratio is the number of tsunami injuries divided by total number of tsunami casualties (injuries plus fatalities).

[3] Denotes all other areas impacted by a Cascadia earthquake and tsunami.

Figure 3-5. Left: Estimated casualty numbers by community for M1, L1, and XXL1 tsunami events, assuming various visitor occupancy levels. Right: Estimates of the displaced population in each community, assuming various occupancy levels.

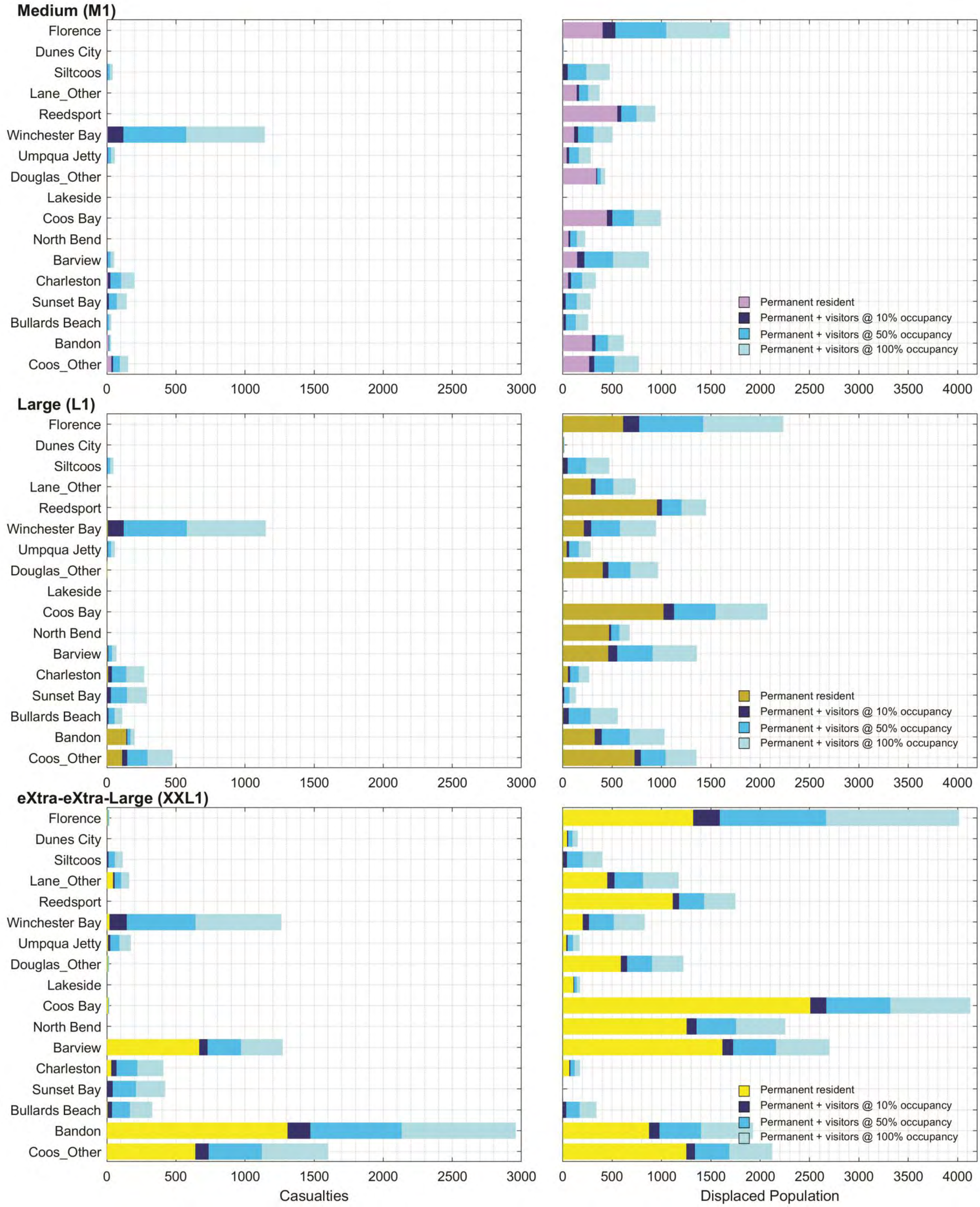


Table 3-8. Displaced population by tsunami zone.

Community Zone	Displaced Population[1] by Tsunami Scenario M1	L1	XXL1
Florence	1,692	2,234	4,017
Dunes City	9	17	152
Siltcoos River Campgrounds	497	475	429
Other[2]	373	739	1,233
Lane County Total	2,571	3,465	5,831
Reedsport	937	1,451	1,750
Winchester Bay	1,074	977	886
Umpqua South Jetty	308	286	186
Other[2]	429	967	1,229
Douglas County Total	2,748	3,681	4,052
Lakeside	0	8	176
Coos Bay	993	2,075	4,136
North Bend	227	678	2,256
Barview	884	1,371	3,001
Charleston	433	307	231
Sunset Bay State Park	292	174	33
Bullards Beach State Park	272	593	397
Bandon	627	1,103	2,975
Other[2]	808	1,506	2,352
Coos County Total	4,535	7,816	15,556

Notes:

[1] Permanent plus temporary population. For the temporary population we assume 100% occupancy of second homes, vacation rentals, condominium units, bed and breakfast facilities, hotels, motels, and campgrounds.

[2] Denotes all other areas impacted by a Cascadia earthquake and tsunami.

3.5 Essential Facilities and Key Infrastructure

Table 3-9 provides a summary list of critical facilities and key infrastructure located in the M1, L1, and XXL1 tsunami hazard zones in Lane, Douglas, and Coos counties.

Table 3-9. Critical facilities and key infrastructure in coastal Lane, Douglas, and Coos county tsunami inundation zones.

County	Community	Description	Category	Tsunami Zone		
				M1	L1	XXL1
Lane	Florence	Water Treatment Plant	water treatment	x	x	x
		Siuslaw Valley F & R - Station 2	fire department	—	—	x
Douglas	Reedsport	Douglas County Sheriff's Office	police department	—	x	x
		Public Works - City Shop	public works	—	—	x
		Reedsport Water Treatment Plant	water treatment	—	—	x
		Reedsport Police Dept	police department	x	x	x
		Reedsport Fire Dept Station 1	fire department	x	x	x
		Reedsport Public Works	public works	—	x	x
Douglas	Winchester Bay	U.S. Coast Guard Umpqua River Station	U.S. Coast Guard Station	x	x	x
		Winchester Bay RFPD	fire department	x	x	x
		Water Treatment Plant	water treatment			
Douglas	Other	Communication Structure	communications	x	x	x
		Gardiner RFPD	fire department	x	x	x
Coos	Lakeside	Water Treatment Plant	water treatment	—	—	x
Coos	Coos Bay	Coos Bay Police Dept	police department	x	x	x
		Coos Bay Water Treatment Plant No. 1	water treatment	—	x	x
		Coos Bay Water Treatment Plant No. 2, Empire	water treatment	x	x	x
		Communication Structure	communications	x	x	x
		South Coast Head Start School	school	x	x	x
		U.S. Coast Guard Cutter Orcas	U.S. Coast Guard Station	x	x	x
Coos	North Bend	Bangor Elementary School	school	—	—	x
		North Bend Water Treatment Plant	water treatment	x	x	x
		North Bend Fire Dept Station 2	fire department	—	x	x
		Southwest Oregon Regional Airport	airport	—	x	x
		U.S. Coast Guard Air Station North Bend	U.S. Coast Guard Station	—	x	x
		Waterfall Medical Clinic	hospital	—	—	x
Coos	Barview	Charleston RFPD Station 1	fire department	—	—	x
Coos	Charleston	Charleston RFPD - Station 3	fire department	x	x	x
		U.S. Coast Guard Navigation Team Coos Bay	U.S. Coast Guard Station	x	x	x
		U.S. Coast Guard Station Coos Bay	U.S. Coast Guard Station	x	x	x

County	Community	Description	Category	Tsunami Zone		
				M1	L1	XXL1
Coos	Bandon	Bandon Police Dept	police department	—	—	x
		Bandon Water Treatment Plant	water treatment	x	x	x
		Bandon Fire Dept	fire department	—	x	x
		North Bend Medical Center	hospital	—	—	x
		Ocean Crest Elementary School	school	—	—	x
		U.S. Coast Guard Station Coquille River	U.S. Coast Guard Station	x	x	x
Coos	other	Communication Structure	communications	x	x	x
		Millington RFPD 5 Station 1	fire department	—	—	x

Notes:
"x" denotes present in the inundation zone.

3.6 Social Characteristics

We used American Community Survey (ACS) social characteristic data to identify some societal characteristics for each community throughout the three counties. Of specific interest are the distribution of Spanish-speaking households and individuals with disabilities. Both datasets are important because they have a direct bearing on tsunami outreach and education (e.g., providing translated informational materials or identifying individuals with disabilities who may need additional assistance with developing evacuation plans or actual evacuation). As noted previously, a limitation of these data is that they span the entire community and are not at a resolution that would allow us to better define these statistics by tsunami zone. Additional information relating to the use of ACS data may be found in Appendix A of Bauer and others (2020).

Table 3-10 identifies the number of Spanish-speaking households (and those speaking other languages) in coastal Lane, Douglas, and Coos counties. Overall, Spanish-speaking households are the most prevalent in the "other" Coos Bay category (~4%), North Bend (~3%), and Reedsport (~3%). Reedsport has the largest group of Spanish-speaking households that speak limited English (~2%).

Table 3-11 presents information on the percentages of people with disabilities throughout the three coastal counties. Overall, these results indicate the proportion of the local population with disabilities ranges from a low of ~19% in North Bend to highs of 32% in Florence and ~25% in Barview. Of particular concern is the relatively large number of individuals with vision, cognitive, or ambulatory disabilities. These include:

- ~12% of people in Barview have indicated vision challenges.
- Individuals with cognitive challenges make up ~22% of residents in Winchester Bay and ~12% of residents in Florence.
- Individuals with ambulatory needs make up sizable portions of Florence (~20%), Barview (~16%), Lakeside (~16%), and Coos Bay (~12%).

These results point to the need to better understand the distribution and needs of those with disabilities in the tsunami zone, as many of these people will almost certainly need help evacuating. Because the ACS data are not sufficiently detailed, not all of these individuals necessarily reside in the tsunami zone. Local emergency managers may wish to assess specific community needs.

Table 3-10. Household spoken language statistics.

Community	Number of Households Speaking Spanish	Percent of Households Speaking Spanish with MoE[1]	Number of Limited English-Speaking, Spanish Households	Percent of Households Speaking Spanish and with Limited English	Number of Limited English-Speaking, Other Language Households
Florence	29	0.7% ± 0.6%	—	—	10
Dunes City	4	0.7% ± 1.0%	—	—	—
Lane County	7,613	5.1% ± 0.3%	1,047	0.7% ± 1.0%	2,147
Reedsport	53	2.9% ± 2.1%	31	1.7% ± 1.6%	31
Winchester Bay	—	—	—	—	—
Douglas County	1,076	2.4% ± 0.4%	194	0.4% ± 0.2%	256
Lakeside	20	2.2% ± 3.5%	—	—	—
Coos Bay	255	3.8% ± 1.5%	41	0.6% ± 0.5%	41
North Bend	122	3.2% ± 1.9%	26	0.7% ± 1.1%	34
Barview	7	0.8% ± 1.4%	—	—	—
Charleston	—	—	—	—	—
Bandon	26	1.7% ± 2.7%	—	—	—
Coos County	838	3.2% ± 0.7%	120	0.5% ± 0.4%	141

Note:

Data taken from American Community Survey 2013–2017 five-year estimates.

[1]MoE denotes margin of error.

Table 3-11. Number of individuals with disabilities (by type) for coastal Lane, Douglas, and Coos counties.

Community	Total Number of Individuals*	Number of Individuals* with a Disability	Percent of Individuals with a Disability	Hearing	Vision	Cognitive	Ambulatory	Self-Care	Independent Living
Florence	8,646	2,798	32.4% ± 3.6%	11.4% ± 2.4%	6.0% ± 1.9%	12.4% ± 2.7%	20.3% ± 3.7%	7.0% ± 1.7%	12.2% ± 2.5%
Dunes City	1,304	252	19.3% ± 3.8%	6.9% ± 2.4%	1.5% ± 1.4%	8.0% ± 3.3%	9.6% ± 3.3%	3.7% ± 2.6%	10.1% ± 3.4%
Lane County	361,882	60,677	16.8% ± 0.5%	5.3% ± 0.3%	2.8% ± 0.2%	7.5% ± 0.4%	8.7% ± 0.3%	3.1% ± 0.2%	7.1% ± 0.3%
Reedsport	4,037	824	20.4% ± 3.4%	7.3% ± 2.4%	5.0% ± 2.0%	6.1% ± 2.4%	11.2% ± 3.2%	4.5% ± 2.0%	7.2% ± 2.7%
Winchester Bay	376	81	21.5% ± 15.0%	0.0% ± 8.3%	0.0% ± 8.3%	21.5% ± 15.0%	6.4% ± 11.4%	6.4% ± 11.4%	7.3% ± 12.5%
Douglas County	106,896	22,467	21.0% ± 0.8%	8.1% ± 0.5%	3.4% ± 0.4%	7.8% ± 0.7%	10.6% ± 0.6%	2.9% ± 0.3%	6.7% ± 0.6%
Lakeside	1,874	452	24.1% ± 6.9%	9.4% ± 3.8%	3.2% ± 2.3%	10.2% ± 4.2%	16.0% ± 5.4%	7.2% ± 3.4%	10.6% ± 4.1%
Coos Bay	15,888	3,518	22.1% ± 2.6%	4.8% ± 1.1%	3.9% ± 1.4%	11.1% ± 2.1%	12.3% ± 1.9%	5.1% ± 2.0%	12.0% ± 2.4%
North Bend	9,468	1,798	19.0% ± 3.1%	6.6% ± 1.6%	4.3% ± 1.7%	8.5% ± 1.9%	10.0% ± 2.5%	3.9% ± 1.4%	9.9% ± 2.4%
Barview	2,021	510	25.2% ± 6.7%	11.9% ± 4.5%	6.7% ± 3.7%	6.7% ± 3.6%	16.3% ± 6.2%	3.4% ± 2.2%	9.7% ± 4.0%
Charleston	—	—	—	—	—	—	—	—	—
Bandon	2,995	575	19.2% ± 5.6%	6.1% ± 3.2%	4.3% ± 3.2%	7.6% ± 3.6%	13.5% ± 4.6%	5.4% ± 2.9%	7.8% ± 3.8%
Coos County	62,058	14,509	23.4% ± 1.5%	7.6% ± 0.7%	4.1% ± 0.7%	9.9% ± 1.1%	13.8% ± 1.1%	5.2% ± 0.8%	10.5% ± 1.0%

Notes:

Data taken from ACS 2013–2017 five-year estimates.

An individual with a disability may have more than one difficulty.

* Permanent residents as defined from ACS.

4.0 DISCUSSION

This study extends the original work undertaken by Bauer and others (2020) and Allan and others (2020a,b, 2021) by implementing the 2017 FEMA Hazus methods on a countywide basis in order to estimate building damage, losses, and casualties from a CSZ earthquake and tsunami. The approach adopted here has been guided by the best available information on a CSZ earthquake (Mw 9.0; Madin and others, 2021; Wirth and others, 2020) and M1, L1 and XXL1 tsunami inundation scenarios (Priest and others, 2013e), together with a detailed building database and a population model that accounts for both permanent and temporary residents (2 AM occupancy). Although previous studies evaluated statewide casualty estimates for permanent residents (OSSPAC, 2013), our study significantly expands on this initial work by evaluating in greater detail the expected impacts of three different tsunami inundation scenarios that could impact coastal Lane, Douglas, and Coos counties. In particular, the present study extends the population model to include new information that helps us evaluate the temporary visitor population, types of housing that permanent and temporary residents occupy, and their relative distances to high ground and hence safety. Such information is critically important because communities on the Oregon Coast presently do not have adequate information on the likely socioeconomic effects of a CSZ earthquake and accompanying tsunami. Accordingly, we hope that the information presented in this report may be used to assist with community pre- and post-disaster planning, including addressing such needs as the development of tsunami evacuation wayfinding signage plans, mass-care planning, debris removal plans, vertical evacuation structure plans, and individual community tsunami evacuation facilities' improvement plans[10].

Building damage: Our analyses reveal that the earthquake alone accounts for significant community-wide building losses that range from a few tens of thousands of dollars in Dunes City to ~$1.06 billion in Coos Bay (**Table 3-4**). An estimated $832 million in damage is expected for the City of Florence. These variations reflect differences in the type and age of building construction, the size and purpose of the community, the density of buildings (e.g., a state park versus a town), and the number of buildings established in terrain that may be subject to landslides or liquefaction. Countywide losses in coastal Lane, Douglas, and Coos counties caused by a CSZ earthquake are projected to reach ~$6.08 billion, most of which will occur in Coos Bay, Florence, North Bend, and areas outside of the Coos County community boundaries ("other").

Damage to buildings from the tsunami is expected to be catastrophic — the smallest amount of earthquake/tsunami destruction this analysis predicts is ~10% of buildings lost for the M1 scenario at Dunes City campground. The greatest losses (>80%) are in the communities of Florence, Reedsport, Winchester Bay, Barview, Charleston, and Bandon in an XXL1 event. Siltcoos River Campground, Umpqua South Jetty, Sunset Bay State Park, and Bullards Beach State Park are effectively wiped out as well. Much of this destruction can be attributed to the magnitude of the tsunami hydraulic forces and the prevalence of light-frame (mainly wood) construction, which is vulnerable to tsunami damage. In addition, except for a few inland areas such as Lakeside and Dunes City, most of the communities and campgrounds are built on low-lying coastal plains or estuary deposits that are inundated in an XXL1 event.

[10] https://www.oregon.gov/LCD/Publications/TsunamiLandUseGuide_2015.pdf

Combined earthquake and tsunami damage indicate the following losses:

	M1	L1	XXL1
Lane	$1.25 billion	$1.27 billion	$1.36 billion
Douglas	$440 million	$464 million	$530 million
Coos	$4.52 billion	$4.62 billion	$5.14 billion

Note that these estimates are approximate and exclude building content losses, such that these are minimum estimates.

Building debris: Debris generated from the destruction of these of buildings will be scattered throughout the tsunami zone. Planners should consider that buoyant debris within the tsunami zone will be redistributed and may accumulate around low points, which often include key transportation routes (Park and Cox, 2019), within ports and harbors, and in navigation channels. Jetties such as those built at the mouth of the Siuslaw, Umpqua, and Coos estuaries are expected to be severely damaged or completely destroyed. Such effects are likely to compromise marine traffic access into the estuaries and thus the ports of Siuslaw, Winchester Bay, and Coos. Our analyses indicate that the approximate weight of debris produced from building damage could reflect the following:

	M1 (tons)	L1 (tons)	XXL1 (tons)
Lane	40,000	50,500	108,000
Douglas	71,200	106,000	149,000
Coos	190,300	358,000	785,000

This equates to ~4,000 dump trucks for M1 event in Lane County and as much as 78,500 dump trucks for an XXL1 event in Coos County. These estimates are almost certainly on the low end, as they do not include debris associated with content from buildings (personal items, business equipment, etc.), road rip-ups, vehicles, and vegetation. Nonetheless, the amount of debris listed here provides a starting point for communities as they begin the process of developing earthquake/tsunami debris plans.

Injuries and fatalities: Our analyses indicate that the permanent resident population present in each of the three counties is:

	M1	L1	XXL1
Lane	550	910	1,870
Douglas	1,050	1,630	1,970
Coos	1,330	3,330	10,340

Including the temporary (visitor) population visiting the coast in the calculation increases the overall coastal population substantially. Our Hazus analyses presented in **Table 3-1** suggest that the temporary visitor population could potentially reflect the following:

	M1	L1	XXL1
Lane	2,040	2,600	4,180
Douglas	2,300	3,230	3,450
Coos	3,640	5,560	10,500

These results highlight the tremendous burden that each community could potentially face following a CSZ earthquake and tsunami. However, it should be recognized that these totals are conservative since they assume every lodging facility is fully booked and in use at the time of the event. Although 100% occupancy is an unlikely scenario, the point remains that there is a high probability that significant number of displaced visitors will be on the coast, in addition to the displaced permanent residents, who will need emergency care and support following a Cascadia event. Further refinements to these numbers are therefore critical for communities to develop short-term mass-care plans and for state and federal agencies to develop their long-term plans.

Our Hazus casualty results estimate the number of people killed in the tsunami zones in each county could reflect the following:

	M1	L1	XXL1
Lane	20	50	210
Douglas	610	1,180	1,380
Coos	440	1,070	5,290

Estimates provided in the Oregon Resilience Plan suggest that fatalities could range from ~600 to ~5,000 for the entire coast (OSSPAC, 2013). Of note, the results from OSSPAC were based on an M1 event that accounts for 79% of the expected inundation scenarios. Thus, the M1 results presented here are more consistent with the same size earthquake event used in the OSSPAC assessment. Combining results for the M1 scenario modeled in Lane, Douglas, and Coos counties with those from our Clatsop (Allan and others 2020a), Tillamook (Allan and others 2020b), and Lincoln County studies (Allan and O'Brien, 2021), we estimate ~4,100 permanent resident casualties, increasing to ~14,800 when factoring in the temporary visitor populations (assuming 100% occupancy). Accordingly, it is apparent that coast-wide tsunami fatality estimates for even an M1 tsunami could be substantial for the Oregon Coast, potentially approaching levels observed in the 2011 Tōhoku, Japan, event.

To assist the public, considerable hazard related information has been developed over the past decade to enable coastal communities and visitors to make informed decisions. These include detailed evacuation maps for every coastal community, which are available in print and online (e.g., http://nvs.nanoos.org/TsunamiEvac). In addition, recent tsunami evacuation modeling undertaken by DOGAMI has helped clarify where people need to evacuate to and how fast they need to travel to reach safety. These efforts demonstrate the simple fact that for every community:

Casualties attributed to a CSZ tsunami can be substantially reduced if people undertake the following simple steps:

1. ***Practice their evacuation routes.***
2. ***Evacuate as soon as possible after the earthquake.***
3. ***Travel as fast as possible (e.g., a fast walk, jog, or run) to safety.***

Building a culture of tsunami awareness on the Oregon Coast that reduces the potential injury and fatality rate can be accomplished through concerted education/outreach campaigns, developing school curricula on tsunami hazards, improving signage, and implementing frequent evacuation drills reminding people of where they need to go. Oregon Emergency Management has developed a guidance document for how to organize and hold a tsunami evacuation drill (OEM, 2017), providing a valuable starting point for coastal communities intending to pursue this option.

We quantified impacts to both temporary and permanent populations in our injury and fatality estimates for two reasons. First, planners can apply their own judgment to their community's population at offpeak times, such as assuming that wintertime temporary population is 10%–50% of peak summertime (e.g., **Figure 3-5**). Second, tsunami preparation and education awareness levels of permanent residents versus temporary populations are likely to differ. For example, temporary populations generally have little to no knowledge of the hazard, evacuation procedures, or optimal routes to safety and are more likely to engage in counterproductive milling (delay) behaviors that will lead to greater risk of death. In contrast, we hypothesize that permanent residents are generally better prepared (are aware of the hazard and their evacuation routes) and are less likely to delay their departure following an earthquake. Again, planners can apply their own judgment on the level of preparedness, including departure times and evacuation speeds, between the groups, to better refine the estimates of injuries and fatalities that may occur in their community.

Depending on the community, the temporary population on average may be closer to the ocean — thus farther away from safety — compared with the permanent resident population. Market forces often drive such housing arrangements (Raskin and Wang, 2017). This is certainly the case for several Oregon coastal communities, including Seaside and Cannon Beach in Clatsop County, and Rockaway Beach in Tillamook County, where hotels, motels, and rental homes are located closest to the beach. This sets up a problematic situation where a presumed less-informed group is farther away from safety and may take longer to depart, with resultant higher proportion of fatalities compared to the permanent residents. Although some hotel/motels in Lane, Douglas, and Coos counties are similarly located next to the ocean, high ground is generally closer to these facilities when compared with similar establishments in the northern counties. In other locations such as inside the Coos and Umpqua estuaries, although hotel/motels may be close to the water, they are generally located further up the estuary and hence have a little more time to reach high ground.

However, even with permanent residents, our assumptions of individuals' preparation and awareness may not match actual preparedness. For example, we assume a 10-minute departure time after the earthquake begins. Grumbly and others (2019) noted that permanent residents in a Washington coastal town underestimated the distance to tsunami safety and were often not aware of the optimal route to safety at different locations in their community. The City of Seaside survey data gathered by Buylova (2018) pointed to a pressing need for continued education on the tsunami threat. That study targeted primary and secondary homeowners but did not sample vacationers. Regarding the initiation of evacuation, 29.6% of survey respondents indicated that they would likely wait for confirmation of a tsunami prior to evacuation (i.e. phone notification or hearing a siren). However, about half the population indicated they were unlikely or very unlikely to wait for tsunami confirmation (24.3% and 22.8%, respectively). Many of the respondents (78 out of 207, or 38%) indicated they would attempt to evacuate by driving, which would be problematic given Seaside's constrained road evacuation network. Oregon state and county emergency management officials strongly discourage vehicular travel following an earthquake and instead emphasize travel on foot. The top three behaviors respondents said they would very likely carry out after a major earthquake are evacuating to higher ground immediately following the earthquake (51%), contacting loved ones (49.5%), and checking social media and television (40.3%).

The underlying field survey data used in Buylova (2018) provided further insights into education challenges. Among the 209 respondents, 17% did not correctly identify their home as being in or out of the tsunami zone; many incorrectly identified their house as being outside the tsunami zone. Only a small portion of the respondents identified themselves as secondary homeowners (5% respondents), and no significant difference was observed in perceptions or in plans between primary and secondary homeowner groups. Continued tsunami education and outreach are critically important for local residents as well as visitors in order to build the necessary culture of awareness needed to survive such a disaster. Education and outreach can be achieved through awareness programs at local, state, and federal levels.

Displaced population: Given the near-complete destruction of buildings within the tsunami zone (**Table 3-8**), planners should assume that all people who were in the area impacted by the tsunami and who successfully evacuated will need short-term (days to weeks) and perhaps even longer-term shelter (weeks to months for permanent residents who previously resided in the tsunami zone). The large influx of temporary visitors in the summertime will increase demands on mass care facilities, placing even greater strain on local, state, and federal emergency managers. A major concern identified for all three counties is the potentially large number of people outside of community boundaries who will also be impacted by the earthquake and tsunami. Given how spread out many of these people are, a major challenge for emergency managers will be figuring out how to get supplies to people, while also evacuating many of these people to centralized locations where emergency shelters are established. Key to this process is to ensure that these people are well prepared and hence are "two-week" ready to ensure they can survive until help arrives.

5.0 CONCLUSION AND RECOMMENDATIONS

This study has evaluated the degree of impact associated with three CSZ tsunami scenarios in order to document potential building losses, debris weight, fatalities, injuries, and displaced populations throughout coastal Lane, Douglas, and Coos counties. The overarching goal of this work is to assist communities in their overall hazard preparation by identifying some of the expected challenges that will occur when the next great earthquake occurs on the CSZ and a tsunami is triggered. Great care has been taken as part of this study to address the needs of local communities. Discussions with local community planners, undertaken by Bauer and others (2020), helped frame the overall study approach and assumptions applied in our latest countywide Hazus modeling.

Education

Our analyses have improved estimates of fatalities and identified the presence of potentially very large temporary visitor populations, variations in the spatial concentration of both population groups within each community, and potential challenges facing those with physical or mental disabilities. Addressing these factors will be an important part of education and outreach at both the local and state level.

Our community-based information on the types of lodging visitors may occupy (e.g., motels, vacation rentals, second homes, or tents) and where these lodgings are predominantly located provide insights about the potential challenges that may face a community. Such information may help local communities better target their tsunami education/outreach activities and messaging to address the lack of hazard awareness by visitors, while also meeting the unique needs of the residential community. For example, ~82% of people visiting Winchester Bay are likely to stay at the campground near the port dock. Although high ground is close by, the evacuation route is over a bridge that is likely to fail, compromising safe evacuation. The only alternative is evacuation up a steep bluff immediately behind the campground or toward the Umpqua lighthouse, both of which require the evacuees to run toward the incoming tsunami. The data in this report provides local governments with the necessary information needed to evaluate various options, such as the construction of a vertical evacuation structure or hardening a bridge, that may ultimately best serve residents and visitors.

Besides vacation homes, our analyses demonstrate that a number of the coastal communities have significant numbers of hotels/motels located in the tsunami zone (especially XXL1). Those that do include Coos Bay, North Bend, Florence, Reedsport, and Bandon, where hotels and motels account for 52%, 50%, 27%, 26%, and 23% of beds where visitors may stay, respectively. Luckily, high ground is relatively close for each of these communities such that investment in appropriate signage, education of lodging staff, and access to high-resolution "neighborhood" scale evacuation maps in every hotel/motel room may be sufficient. Thus, tsunami education and outreach targeting each of these lodging groups become essential in order to mitigate against the potentially large loss of life likely to occur without such measures.

Two key approaches are in place to begin to address such needs:

1) The first is the development by Oregon Emergency Management of the "Tsunami Safe" program (*Hospitality Begins With Safety*). This effort focuses on increasing tsunami awareness among hospitality industry employees, including providing key tsunami and safety instructions that may be disseminated to hotel/motel guests. Trained hospitality staff can provide accurate messaging to the public before and during an event and, importantly, are able to help guide people out of the inundation zone. Evacuation guidance assumes that hospitality staff at every establishment know exactly where their nearest point of high ground is located.
2) To address evacuation information needs, DOGAMI staff, in partnership with the Northwest Association of Networked Ocean Observing Systems (NANOOS), developed a "print-your-own-tsunami-brochure" tool that is integrated in the NANOOS Visualization System (NVS) tsunami evacuation portal (http://nvs.nanoos.org/TsunamiEvac). This tool allows individuals or businesses to develop their own custom evacuation brochures for any location on the Oregon Coast. More recently, DOGAMI has initiated the development of higher-resolution tsunami evacuation neighborhood maps[11] that can be printed with conventional printers. It is thus conceivable that hotel/motel rooms could display tsunami evacuation maps in a manner similar to the fire escape exit maps required in every room. Increasing local awareness of these tools should thus be integrated in any future planned outreach activity.

Finally, building a culture of awareness is needed to survive the next CSZ tsunami. Such an effort could include funds to post and maintain tsunami wayfinding signage of sufficient density along core evacuation routes and to establish and support tsunami coordinators in every county. Tsunami coordinators could assist with identifying locations of people with disabilities, work with the local hotel/motel industry to develop appropriate evacuation map products, lead the planning of evacuation drills, and perform needed outreach at the grassroots level.

Mitigation

Tsunami evacuation modeling throughout coastal Lane, Douglas, and Coos counties demonstrates that improving existing evacuation trails for unimpeded passage — along with increased saturation of tsunami wayfinding signage — will help save lives. Of particular importance is having a sufficiently dense network of signs (posted and/or on road/path surfaces) that direct people along core routes to areas outside the tsunami zone. Such efforts, guided by our evacuation modeling results, are now being implemented in multiple communities on the northern Oregon Coast, including Seaside, Cannon Beach, Manzanita, and Newport. In each of these communities, a "beach to safety" plan has been developed for core evacuation routes, and signage consisting of posted signs as well as thermoplastic signage on roads and paths is being implemented. Signs of this nature need to be spaced sufficiently close together and illuminated at night so that the signage may be easily seen at all times.

Consideration should also be directed at barriers that may impede rapid evacuation. For example, downed power lines could pose a significant barrier to safe evacuation if the wires remain live following the earthquake. Communities could initiate conversations with local utility districts to assess if power can be immediately shut down during a major earthquake or if new power lines could be buried underground and existing ones relocated.

We recommend and encourage local communities to practice periodic tsunami evacuation drills, ideally on at least an annual basis, to instill a culture of tsunami-hazard awareness for residents and visitors. Studying an evacuation map is not the same as actually walking an evacuation route. Although we recognize that such an approach may be disruptive to the local economy and difficult to organize,

[11] https://www.oregongeology.org/tsuclearinghouse/pubs-evacbro_neighborhoods.htm

holding periodic drills will save lives. Such a culture is in practice in Japan and likely helped save many thousands of lives during the catastrophic tsunami event on March 11, 2011 (e.g., Nakaya and others, 2018; Sun and Yamori, 2018).

Mitigation options to improve evacuation may also include facility improvements such as seismic retrofits of key bridges or the construction of vertical evacuation structures. Although seismically retrofitting bridges will be critically important for post-disaster recovery (e.g., the Umpqua bridge by Reedsport or the Megler Bridge in Coos Bay), the only community we identified as having a dependency on bridges for evacuation purposes was Winchester Bay. Construction of vertical evacuation towers in a few key locations could potentially save lives. Of the communities examined here, the community of Barview is particularly exposed to the tsunami hazard (Gabel and others 2019b).

In many communities, people reside in older manufactured housing. Manufactured homes installed prior to 2003 are susceptible to slipping off their foundations during earthquake shaking (OBCD, 2010; SPA Risk LLC, 2014; Maison and Cobeen, 2016; EERI, 2014), potentially blocking or compromising egress. Even if a manufactured house is relatively close to high ground, compromised egress may hinder timely evacuation. Seismic upgrades of such structures to current building standards may be cost-prohibitive. FEMA (2012b, Section D) advises having large crowbars and sledgehammers stored near potentially compromised primary doors to facilitate emergency exiting. Such tools may provide manufactured housing occupants with a low-cost solution for rapidly exiting their structure in the critical time interval between earthquake cessation and tsunami arrival.

Response

Our analyses demonstrate that destruction of buildings in the tsunami zone will be virtually complete, whether the scenario is M1 or XXL1. Accordingly, all Oregon coastal communities will need to be prepared to shelter large numbers of people who escape the tsunami. The need for shelter is likely to last many weeks until tsunami evacuees can be relocated out of the disaster area. This will be especially challenging for communities with potentially large numbers of temporary residents, all of whom are unlikely to be able to return to their permanent homes for at least several weeks, given the anticipated disruption to the regional transportation network and fuel supply (ODOT, 2014; ODOE, 2017). As demonstrated here, depending on the time of year, the number of displaced persons could range from a few tens (e.g., Dunes City) to potentially many thousands (e.g., Coos Bay, Florence, North Bend, Barview, and Bandon, in a worst-case summer scenario with every vacancy filled).

Mass casualties will vary significantly from community to community due to exposure and access to high ground. Overall, injuries caused by the tsunami alone were found to be low, averaging about 4% to 15% across the coastal communities, depending on the scenario. This finding is not unexpected because most people who are unable to evacuate in time and are caught by the tsunami are killed. Combined earthquake and tsunami related injuries presented here reflect the following:

	M1	L1	XXL1
Lane	750	730	810
Douglas	750	200	240
Coos	1,980	2,150	3,520

Given that there are about 483 licensed beds at the 11 coastal hospitals (OSSPAC, 2013), these facilities can be expected to be quickly overwhelmed. Because of this capacity issue, Wang (2018) examined approaches for coastal hospitals to better prepare for a Cascadia event, including improving building seismic resiliency, establishing a resilience network where knowledge and training could be shared, and evaluating and planning for fuel and water needs. In addition to these suggestions, mass care planning is necessary to prepare coastal hospitals for a potential surge in injuries and illness. To that end, further work is required to better refine these casualty numbers.

Recovery

A CSZ earthquake and tsunami will be catastrophic to both the state and local economies. At the local level, these impacts will vary substantially. Quantifying such economic impacts is well beyond the scope of this investigation. Nevertheless, we can speculate on several likely scenarios. Overall, building destruction in coastal Lane, Douglas, and Coos counties could yield an estimated ~302,000 tons of debris in the M1 scenario, increasing to ~515,000 tons for L1, and over one million tons in an XXL1 event. These estimates are almost certainly on the low end, as they exclude the content volume within buildings (e.g., personal and business-related items), vehicles, and other forms of debris. Utilizing the number of households throughout the three counties (5,878 buildings), we estimate an additional 29,400 tons (assuming five tons per household) of debris could be generated from personal effects. This equates to ~3% of the total volume of debris reported in Table 3-4. The estimated building replacement cost for coastal Lane, Douglas, and Coos counties is likely to exceed $6.2 billion in an M1 event, $6.4 billion in L1, and $7.0 billion in an XXL1 earthquake and tsunami. These numbers emphasize that regardless of the size and characteristics of the next Cascadia earthquake and tsunami, the impact will be severe for the Oregon Coast.

Wood-frame construction dominates many Oregon coastal communities. The majority of such buildings in the tsunami zone will probably be completely destroyed by the tsunami. This means that for Lane, Douglas and Coos counties, there is likely to be a significant shortage of suitable housing in the months and perhaps years following the disaster. In the absence of housing, tsunami refugees will likely migrate away from such communities, further decimating the local economy. The housing situation will likely be compounded by the altered coastal landscape due to subsidence effects caused by the earthquake. For example, the earthquake deformation models used to simulate tsunami inundation estimate that the coastline could drop by the following amounts (data derived from Witter and others, 2011):

	M1	L1	XXL1
Lane	0.8 m (2.6 ft)	1.2 m (3.9 ft)	1.8 m (5.9 ft)
Douglas	1.3 m (4.1 ft)	1.8 m (5.9 ft)	2.7 m (8.9 ft)
Coos	2.1 m (6.9 ft)	3.0 m (9.8 ft)	4.7 m (15.4 ft)

Such changes will inevitably lead to accelerated rates of coastal erosion along with increased incidences of coastal flooding in low-lying areas. These changes can be expected to be significant in the weeks to months following the event, with further change progressively decreasing over time as the coastline re-equilibrates to the new sea level regime.

Finally, our analyses indicate that many buildings in the tsunami zone are outside existing coastal or riverine FEMA flood zones. As a result, owners are not required by federally backed mortgage lenders to carry flood insurance. However, flood insurance is available to all building owners in the tsunami zone through the National Flood Insurance Program, which covers building loss due to a tsunami (FEMA, 2018), and can aid in community recovery. More information on the National Flood Insurance Program can be obtained from https://www.fema.gov/flood-insurance.

Vulnerable Populations

We provided population estimates from American Community Survey (ACS) data for selected population groups that may have special challenges understanding preparedness messages or evacuating (Section 3.6). The ACS estimates are for the entire community, including people outside the tsunami zone, so the total number of individuals identified in this report is likely to be higher than those actually in the tsunami zone. Planners wanting to further understand the specific locations of vulnerable populations are encouraged to discuss the situation with their local public health preparedness coordinators. Other resources include the emPOWER database[12], which tracks electricity-dependent Medicare populations and the Centers for Disease Control and Prevention's Behavioral Risk Factor Surveillance System (BRFSS)[13], which tracks health-related risk behaviors, chronic health conditions, and use of preventive service by U.S. residents. Although our focus in this study was on quantifying casualties from a local tsunami, such information on vulnerable populations can also be useful when planning evacuation from distant-source tsunamis.

Finally, our model does not account for populations living in the tsunami zone who are currently experiencing homelessness. However, homeless encampments are likely present in the tsunami zones of many Oregon coastal communities, and outreach messaging should include this population.

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[12] https://empowermap.hhs.gov/
[13] https://www.cdc.gov/brfss/index.html

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8.0 APPENDIX A: COMMUNITY PROFILES FOR LANE, DOUGLAS AND COOS COUNTIES

Appendix A includes additional summary information specific to each community. These data include the effects of both the earthquake and accompanying tsunami (M1, L1, and XXL1) that can inform preparation, recovery, and mitigation planning.

A) Area analyzed: We summarized data when possible within the community's designated urban growth boundary (UGB). Planners consider the UGB as a more inclusive and useful aggregation unit compared to city limits. However, some data are available only at the city limits level, specifically the most current population estimates and U.S. Census Bureau American Community Survey data. For unincorporated communities, we used a geospatial layer of unincorporated community boundaries compiled by the Department of Land Conservation and Development (DLCD). The summary community profile maps highlight several datasets, including the boundary used for analysis (UGB, city limits, or DLCD outline depending on data availability), building placements and tsunami zone. In addition, the maps include the results of the evacuation modeling (path distances) based on a 1.2 mps (4 fps; walk) evacuation speed (with 10-minute delay) out of the inundation zone. We distinguish the chance of successful evacuation (green lines) versus increased likelihood of fatality (red lines). In all cases, the likelihood of successful evacuation improves significantly if individuals increase their evacuation speed or leave sooner.

B) Population demographics: These data reflect the permanent (resident) population within each respective tsunami zone (M1, L1, and XXL1), expressed as absolute numbers and as a percentage of the total community population. A conservative estimate of the number of temporary visitors is also presented, assuming 100% occupancy of vacation homes, hotel/motels, and camping areas. Additional demographic information of the permanent population distinguishes those <65 years and those over 65 years of age.

C) Distance to safety: Distance to safety plots show the number of permanent and temporary residents as a function of distance to safety. The closer a person is to safety (i.e., right side of the figure) the greater the chance of successful evacuation. The distance to safety figure includes a 1.2 mps (4 fps) threshold line (vertical dash black line). Left of this line, the model assumes people will not be able to evacuate out of the inundation zone in time, while those to the right have a greater chance of surviving. We also include a two-standard-deviation gray dash line that highlights uncertainty in the 1.2 mps (4 fps) threshold, which is a function of the wave arrival time and uncertainty in peoples' travel speed. Finally, we include a cumulative percent curve to further define the proportion of people relative to safety in the community.

D) Distance to safety and building type: This figure is similar to C), with the exception that it now defines the tendency of people (permanent and temporary) to be in particular building types. Here we distinguish between the following building types: single-family residential, manufactured housing, multifamily residential, hotel/motel, and mobile (e.g., tent, RV, etc.). These data define where people tend to be predominantly located. For example, many coastal hotel/motels tend to be located close to the ocean and are mostly used by visitors.

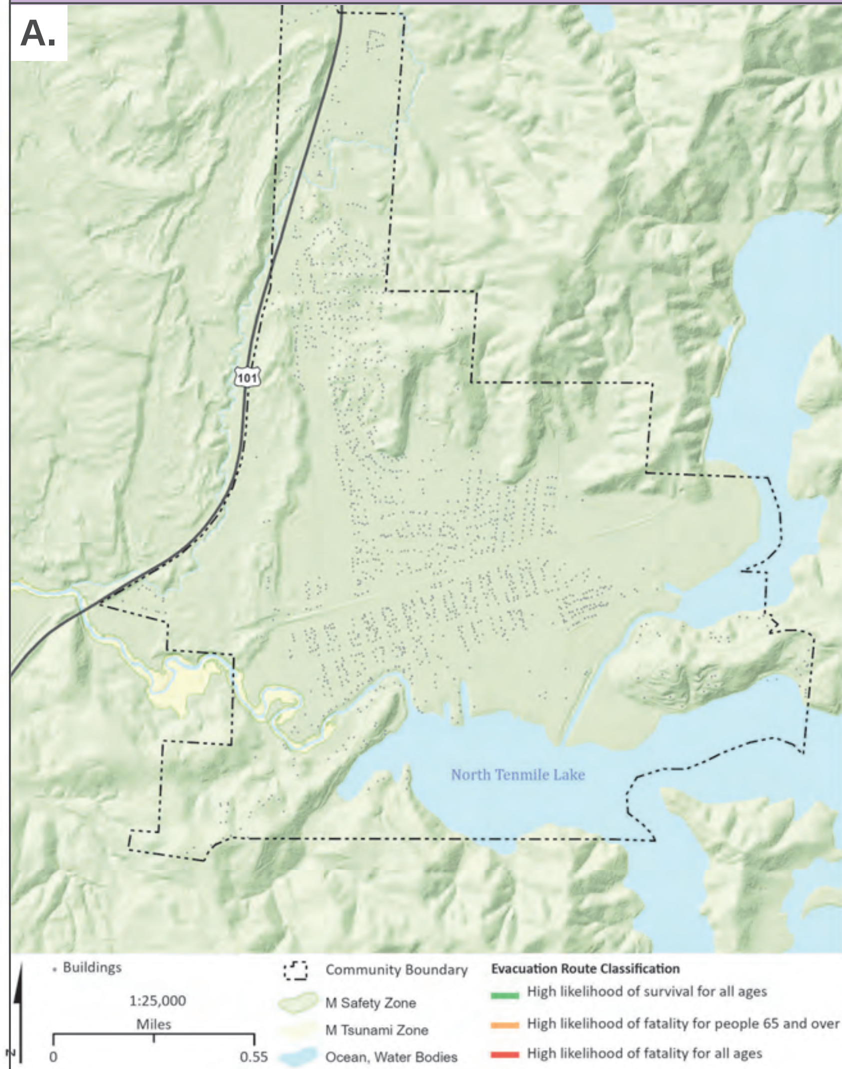
E) Building losses: The effects of a M_w 9.0 Cascadia Subduction Zone earthquake and accompanying tsunami (M1, L1, and XXL1) in terms of economic losses and debris generated are included in this figure. For each tsunami zone, we define the number of buildings in the zone and the building replacement cost. Earthquake losses are defined for the tsunami zone and as a total for the entire community. These data are then combined with the tsunami losses calculated by Hazus. Finally, the weight of debris generated by the tsunami is also presented. As a reminder, these data do not include the weight of content in buildings and therefore reflect a minimum value.

F) **Fatalities and displaced population:** To standardize tsunami injury and fatality estimation across all communities, we assume the entire population, as a group, evacuates at 4 fps (2.7 mph), which is regarded as a moderate walk. In all cases, we factor in a 10-minute evacuation delay prior to getting underway that accounts for ~3 minutes of expected earthquake shaking and up to 7 minutes for people to organize themselves, leave the building, and begin to evacuate. For each community, we provide graphical representations of the modeled fatalities, for both permanent and temporary residents. For the temporary population we assume 10%, 50%, and 100% occupancy estimates. The displaced population is defined as the difference between the local (permanent) population and the fatalities (for permanent and temporary). Planners can apply their own judgment as to the occupancy levels associated with the temporary visitors and adjust downward from the 100% occupancy estimate.

Lakeside - M1

Casualty estimates assume a MODERATE WALK travel speed (4 ft per second)

A.



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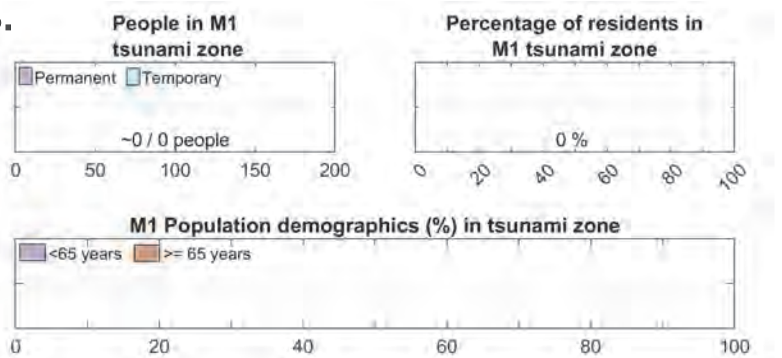

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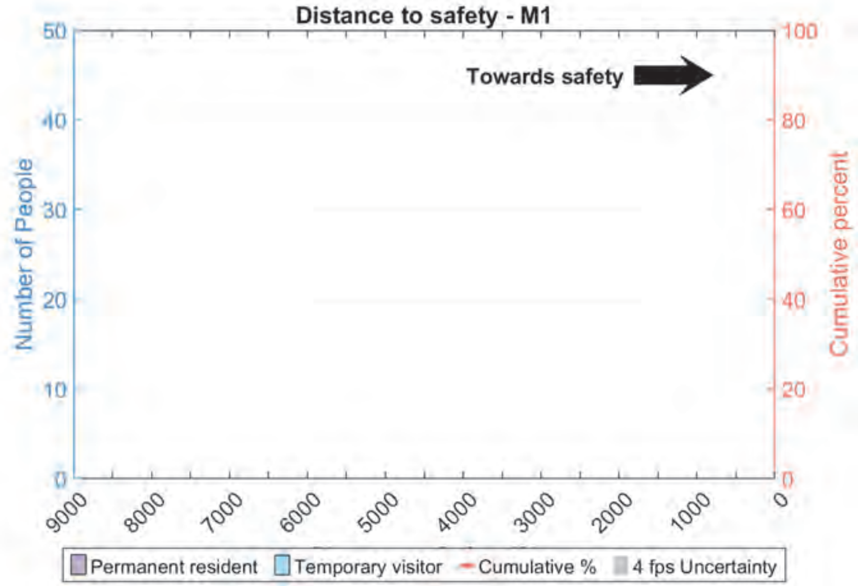

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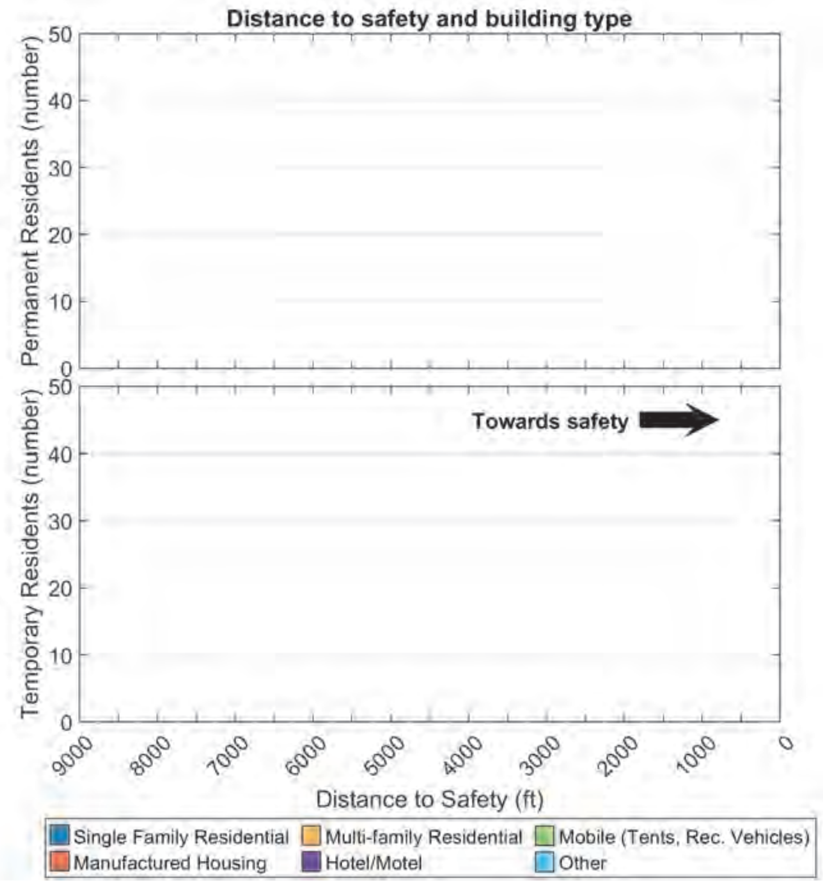

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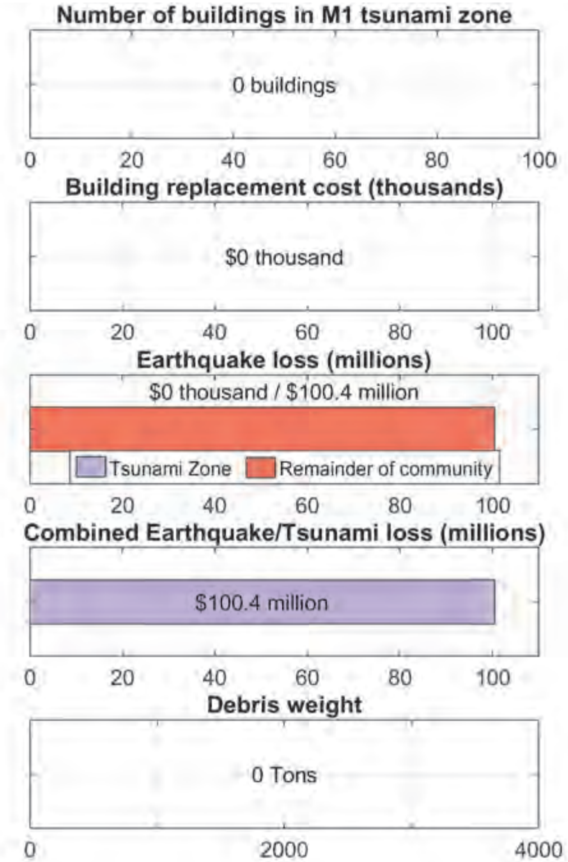

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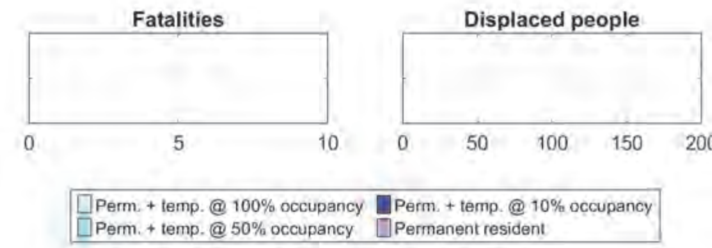
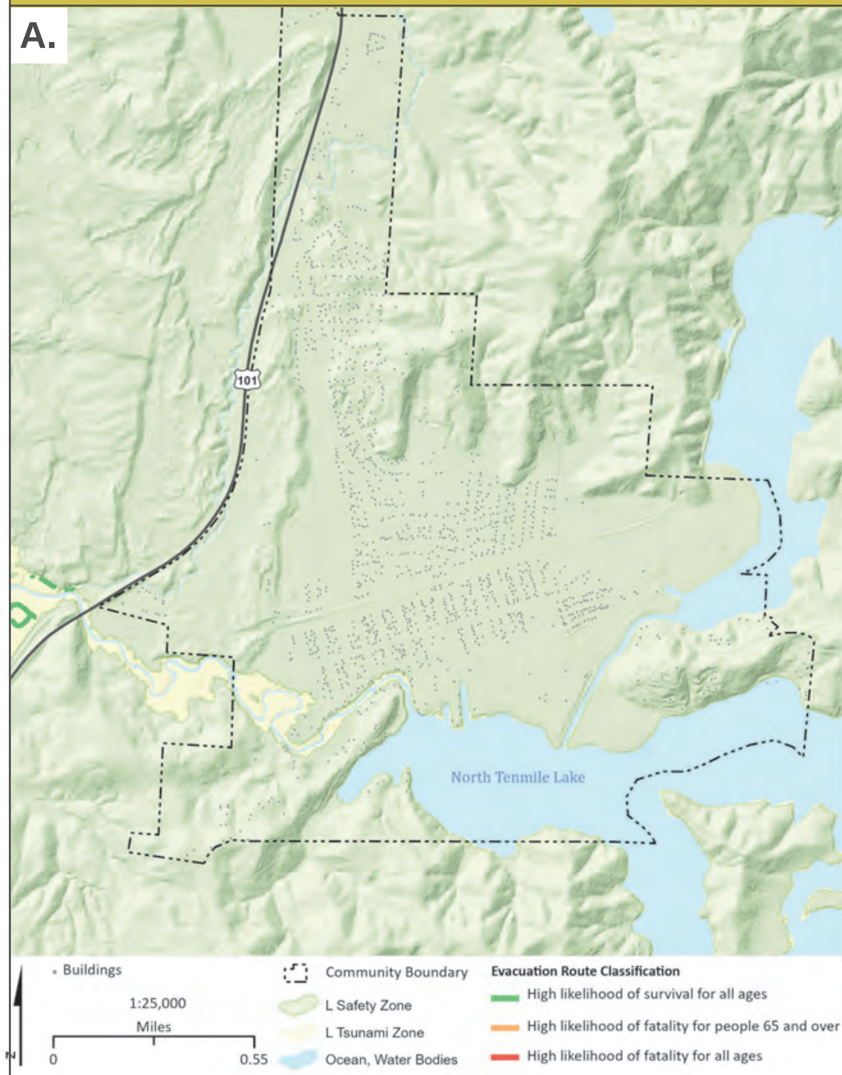
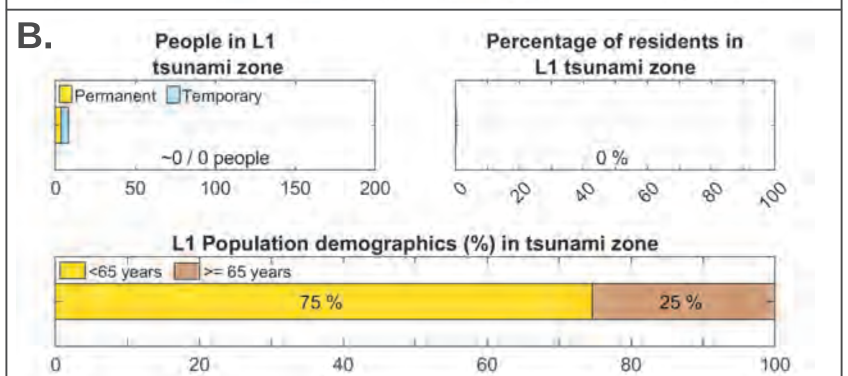


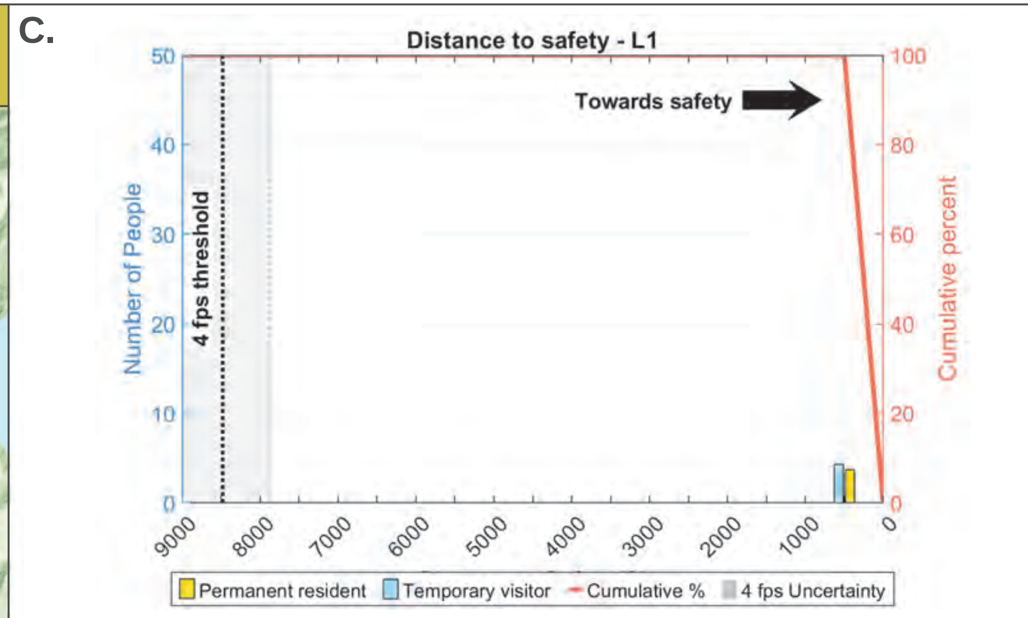
Description	Total
Earthquake Injuries (Entire Community)	76
Tsunami Injuries - Permanent + Temporary	0
Tsunami Fatalities - Permanent	0
Tsunami Fatalities - Temporary @ ~100% occupancy	0
Displaced Population - Permanent	0
Displaced Population - Permanent + Temporary	0

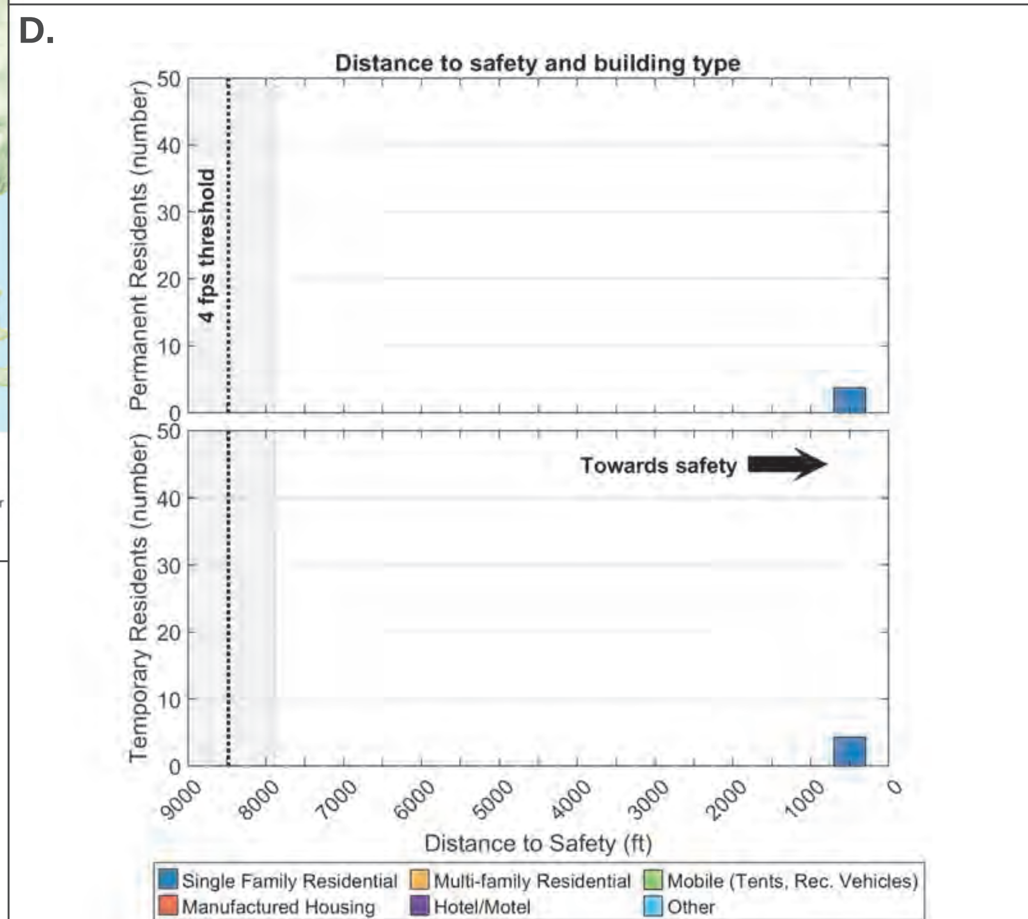
Lakeside - L1

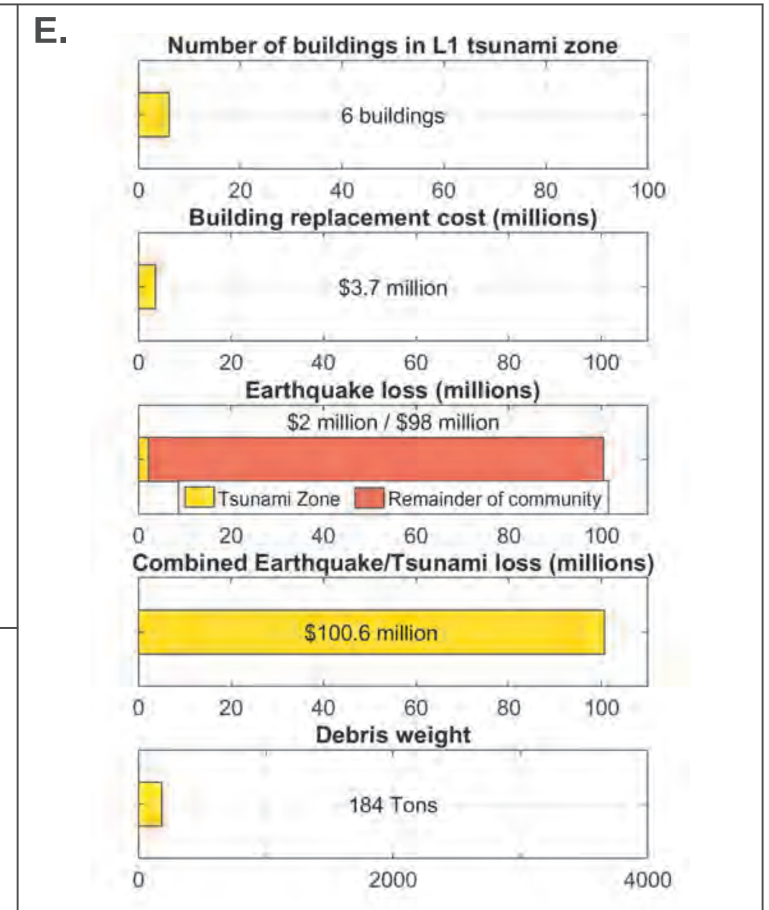
Casualty estimates assume a MODERATE WALK travel speed (4 ft per second)

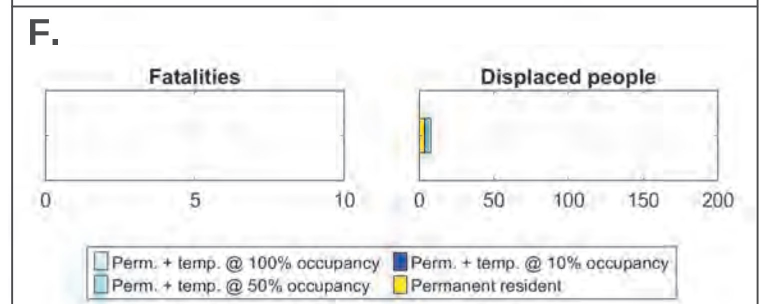












Description	Total
Earthquake Injuries (Entire Community)	76
Tsunami Injuries - Permanent + Temporary	0
Tsunami Fatalities - Permanent	0
Tsunami Fatalities - Temporary @ ~100% occupancy	0
Displaced Population - Permanent	4
Displaced Population - Permanent + Temporary	8

Lakeside - XXL1

Casualty estimates assume a MODERATE WALK travel speed (4 ft per second)

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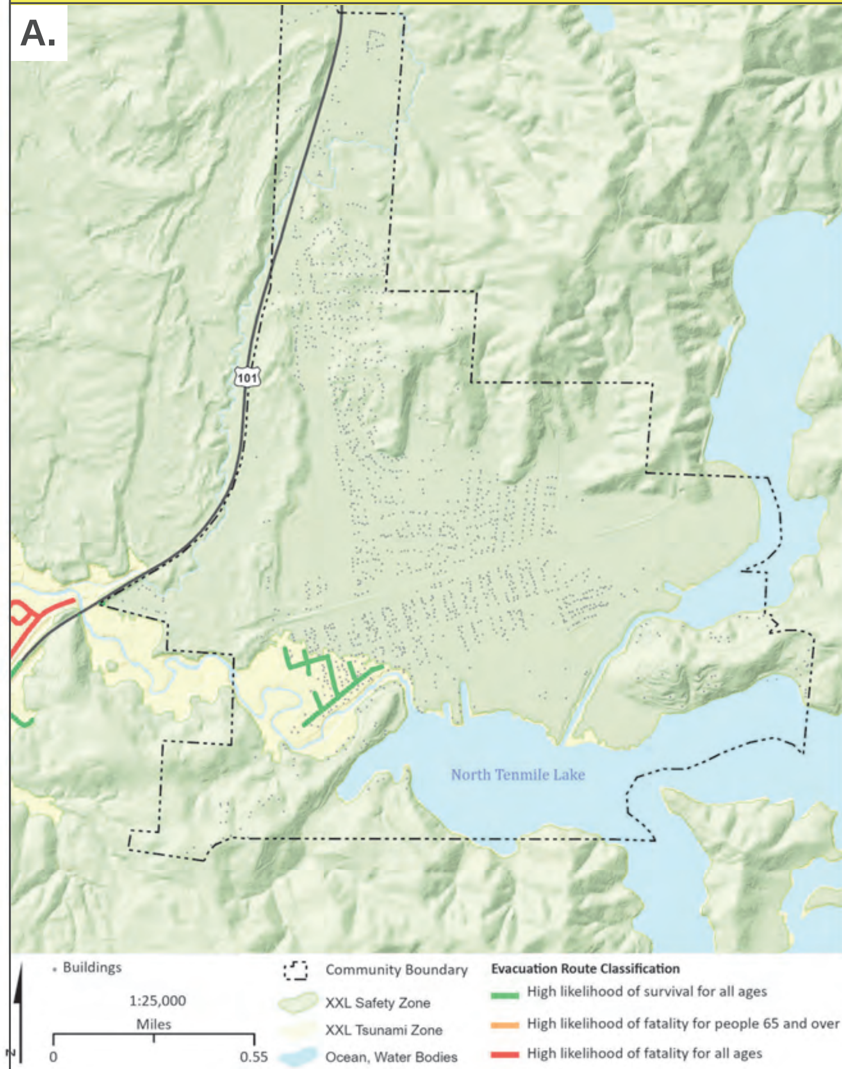

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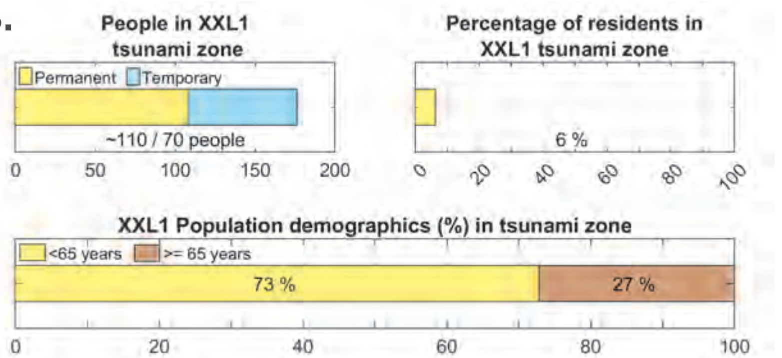

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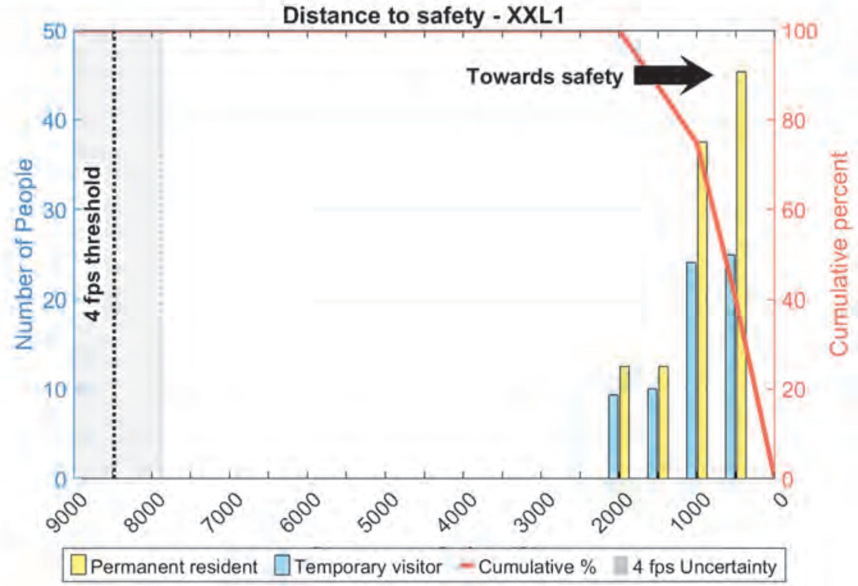

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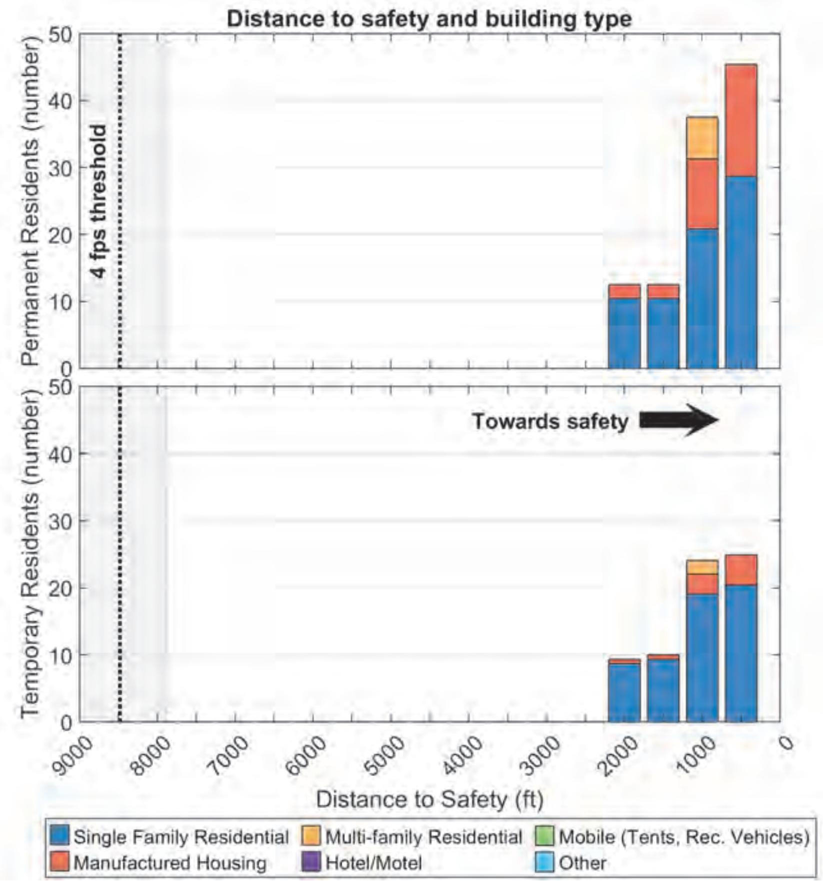

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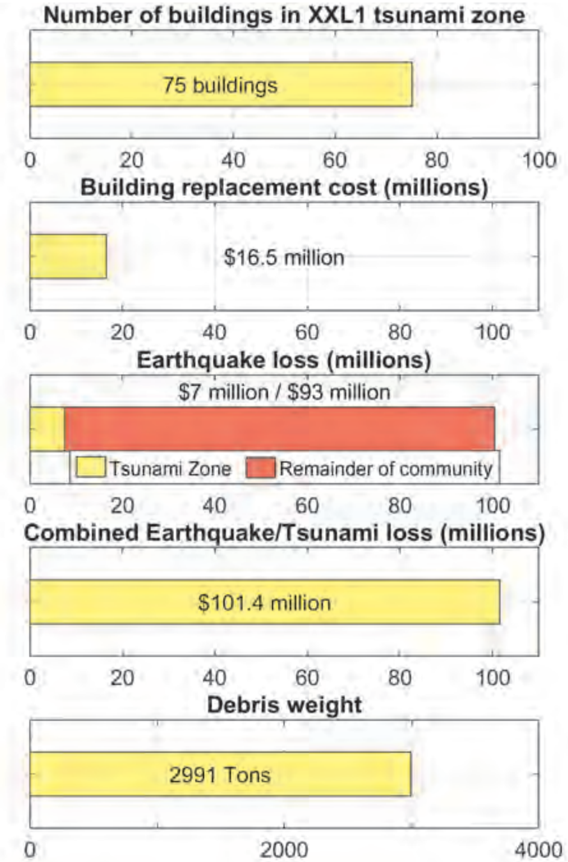

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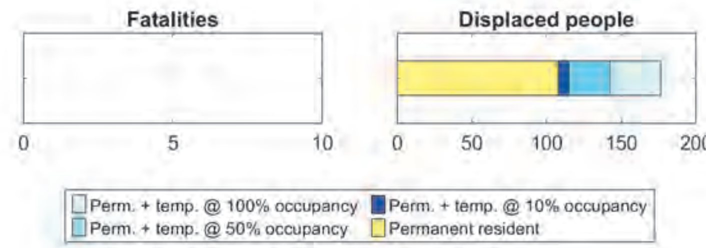
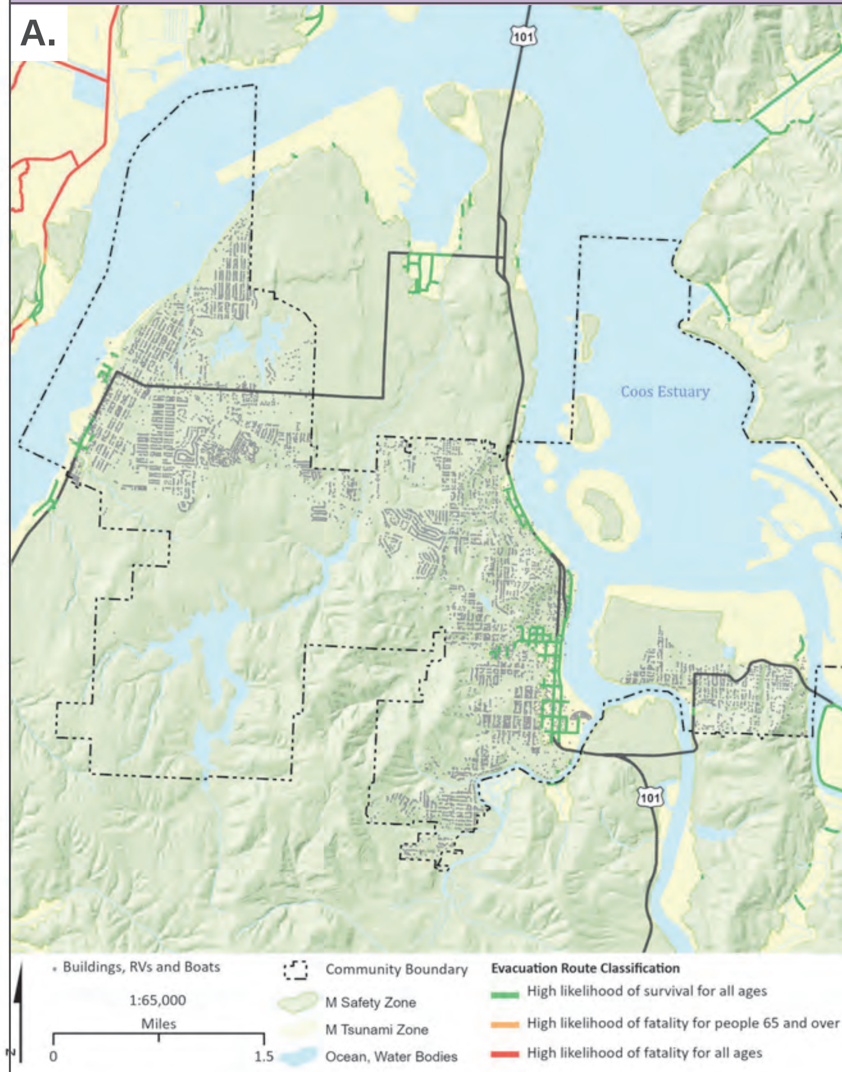


Description	Total
Earthquake Injuries (Entire Community)	76
Tsunami Injuries - Permanent + Temporary	0
Tsunami Fatalities - Permanent	0
Tsunami Fatalities - Temporary @ ~100% occupancy	0
Displaced Population - Permanent	108
Displaced Population - Permanent + Temporary	176

Coos Bay - M1

Casualty estimates assume a MODERATE WALK travel speed (4 ft per second)

A.



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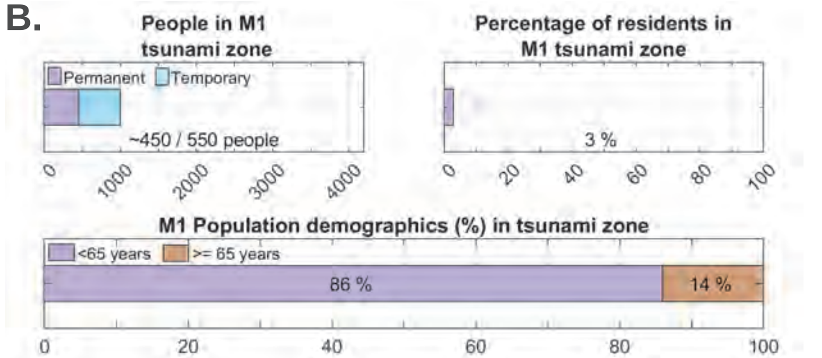

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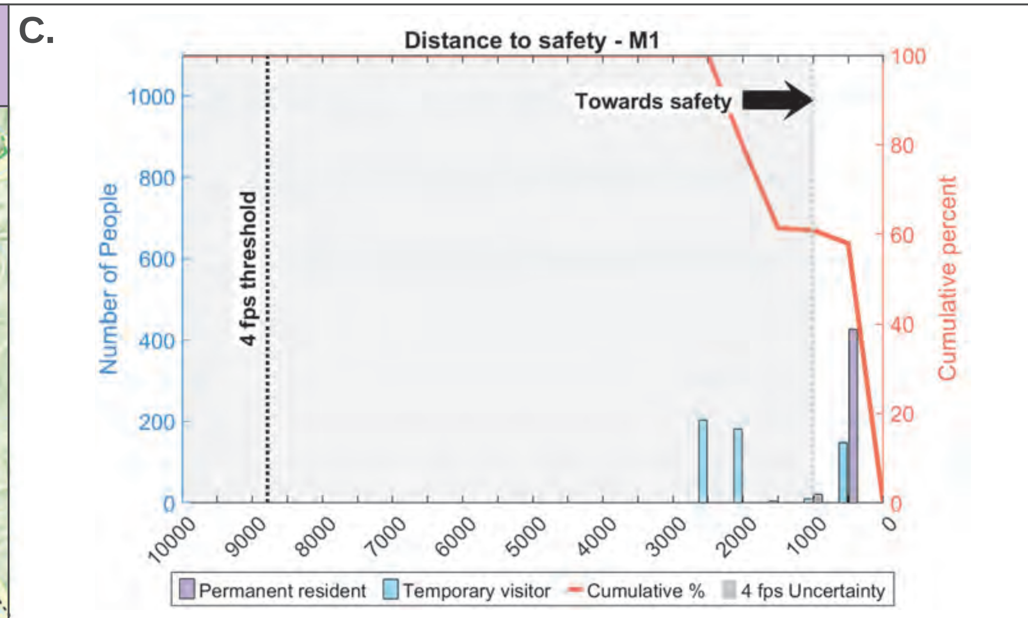

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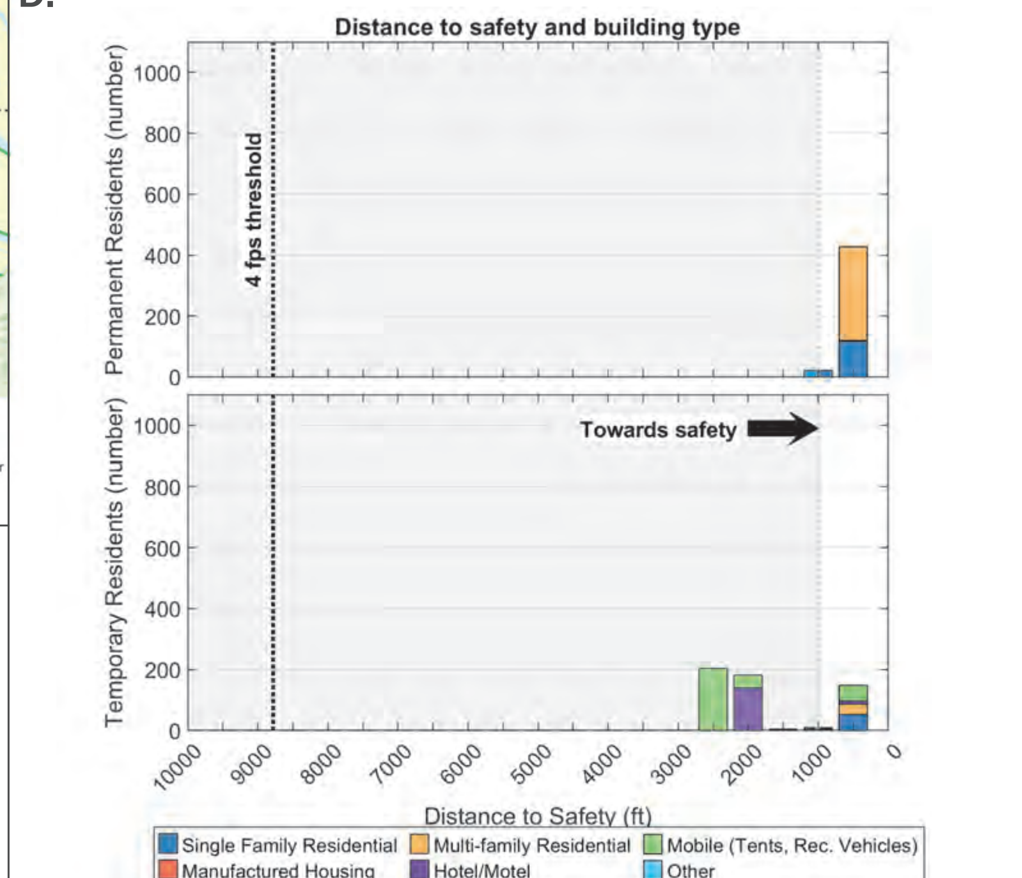

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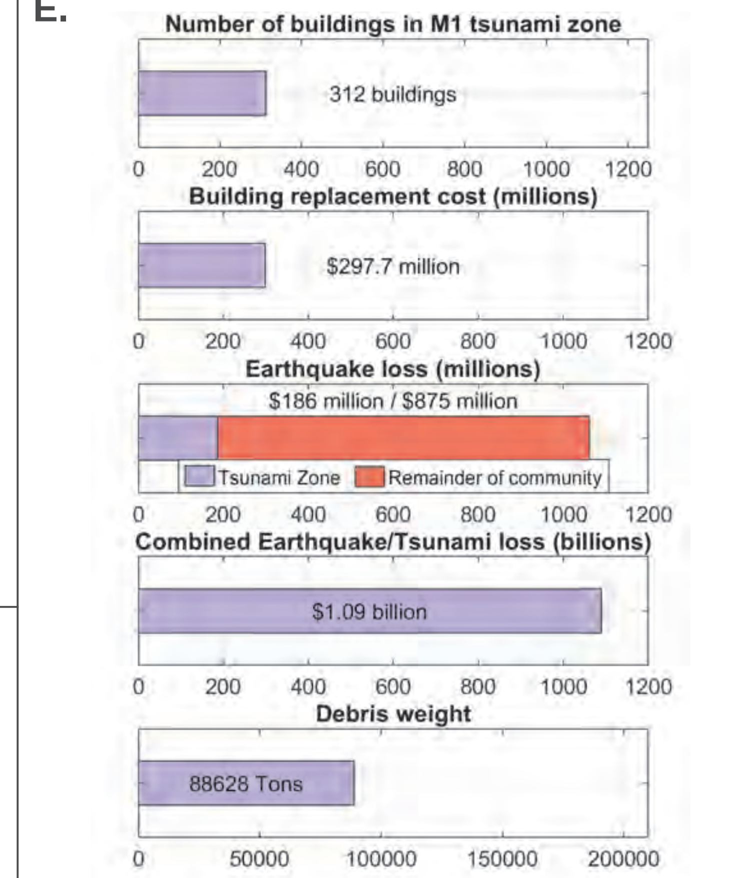

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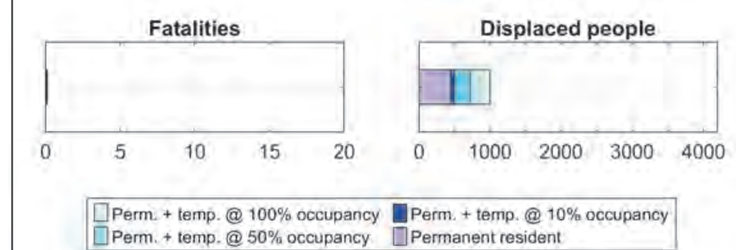
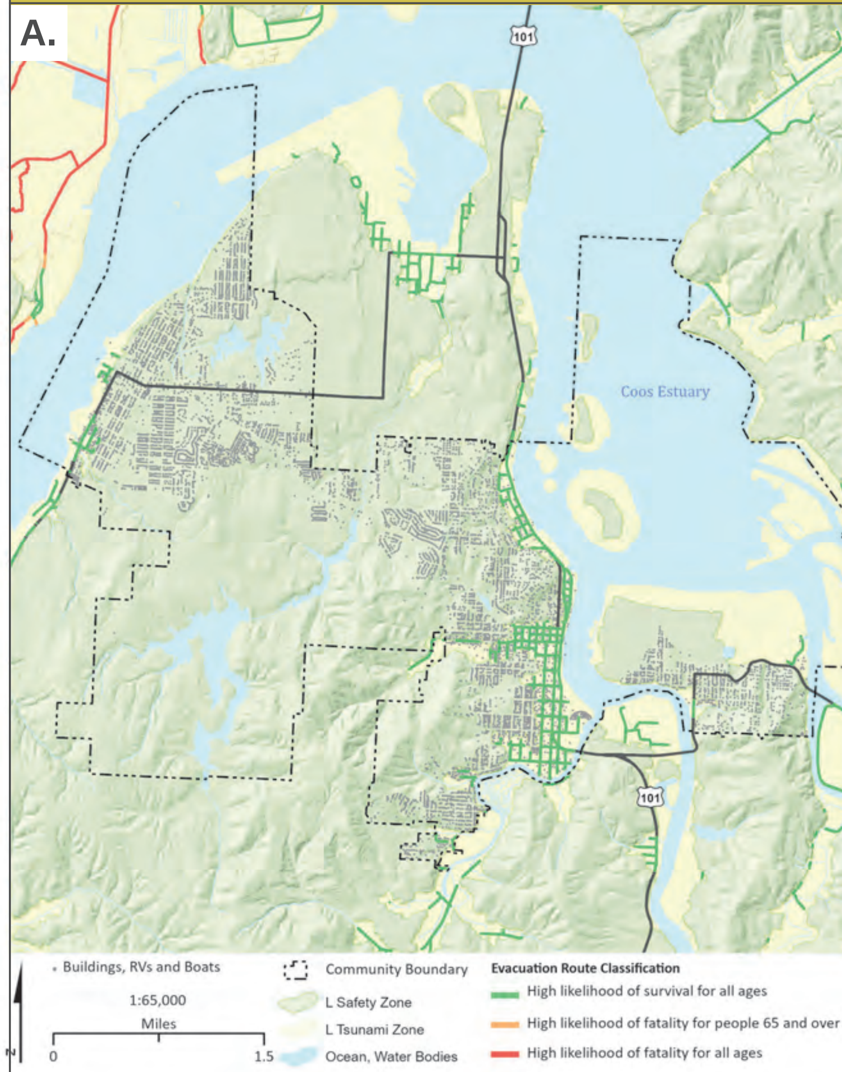
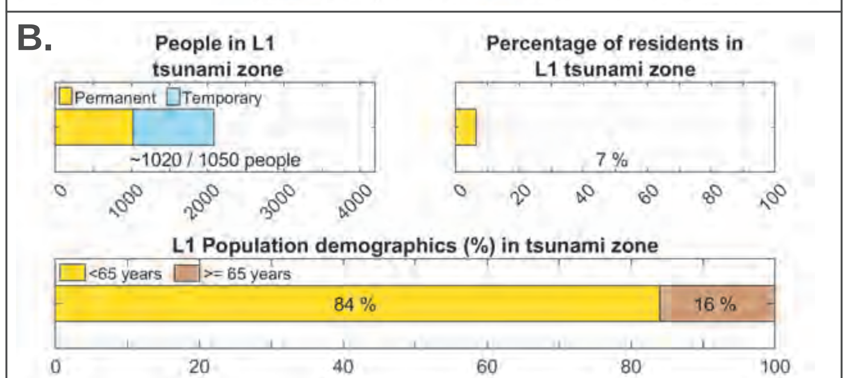


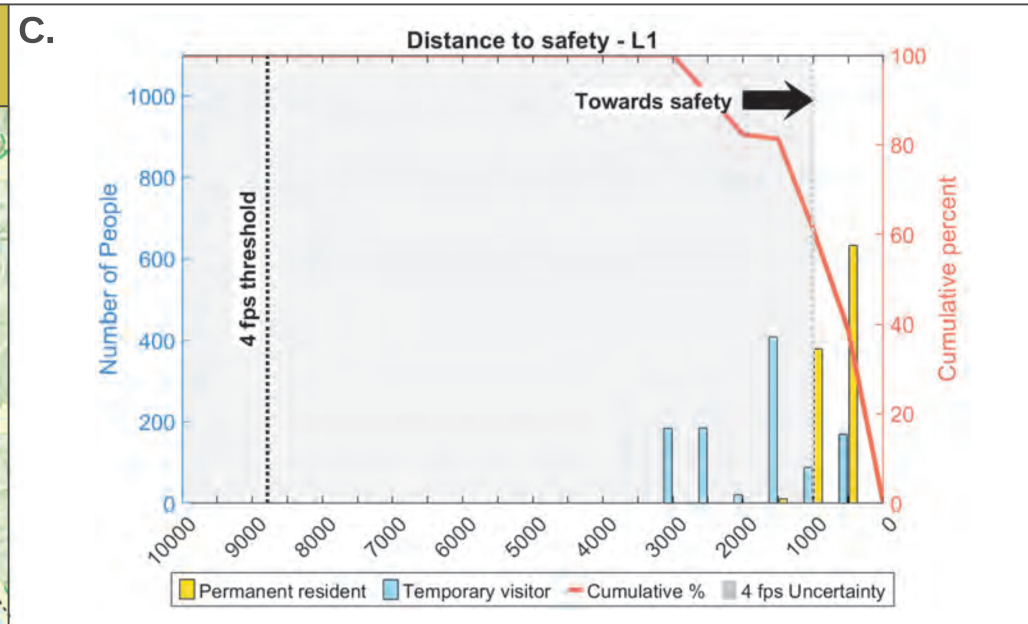
Description	Total
Earthquake Injuries (Entire Community)	441
Tsunami Injuries - Permanent + Temporary	0
Tsunami Fatalities - Permanent	0
Tsunami Fatalities - Temporary @ ~100% occupancy	0
Displaced Population - Permanent	448
Displaced Population - Permanent + Temporary	993

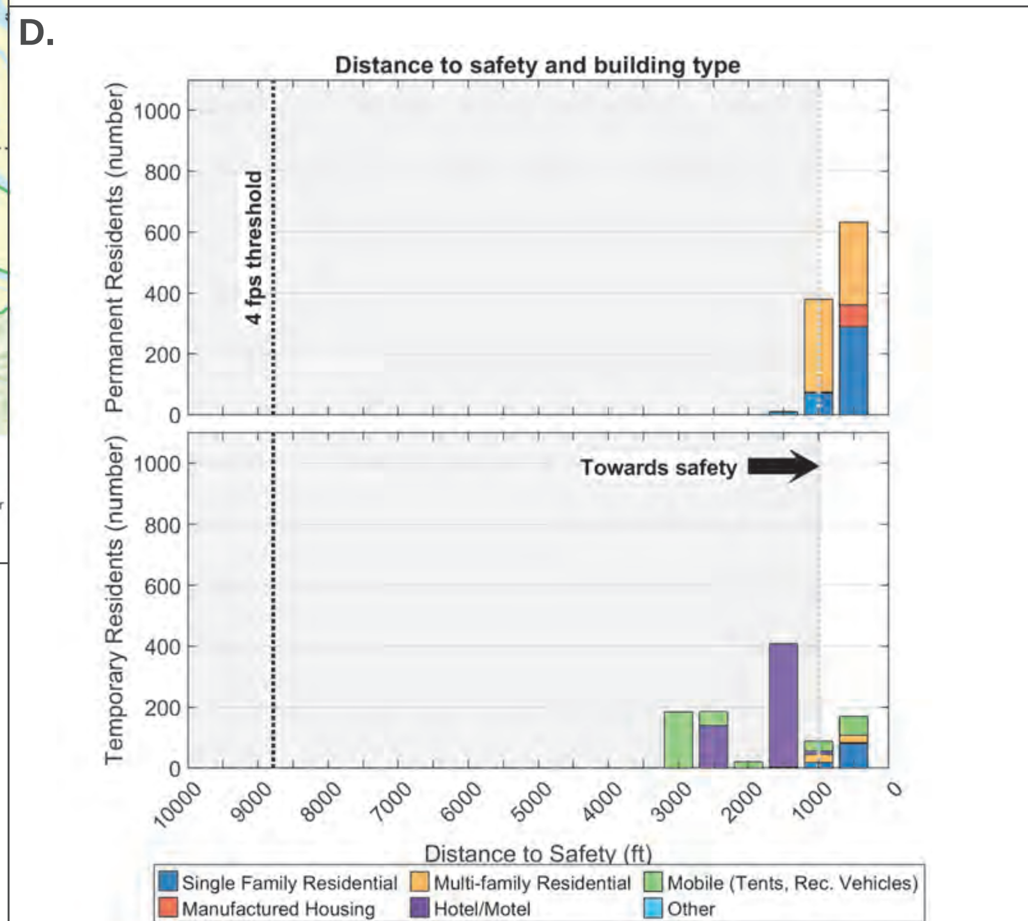
Coos Bay - L1

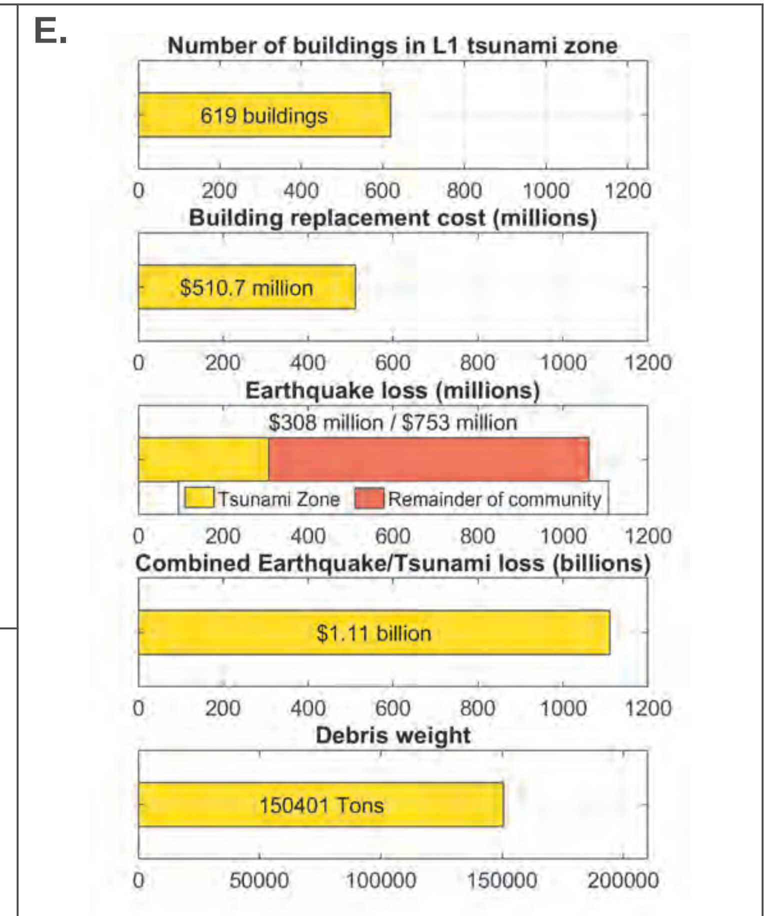
Casualty estimates assume a MODERATE WALK travel speed (4 ft per second)

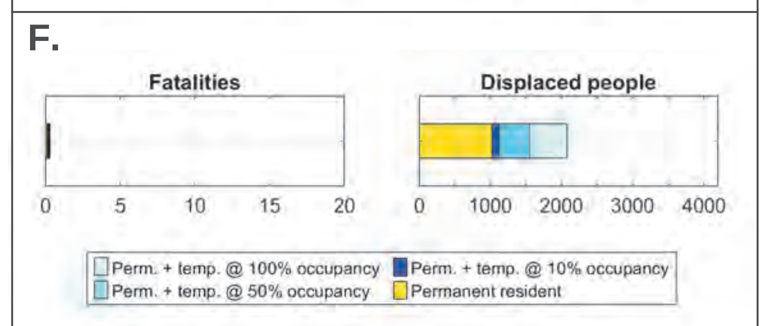








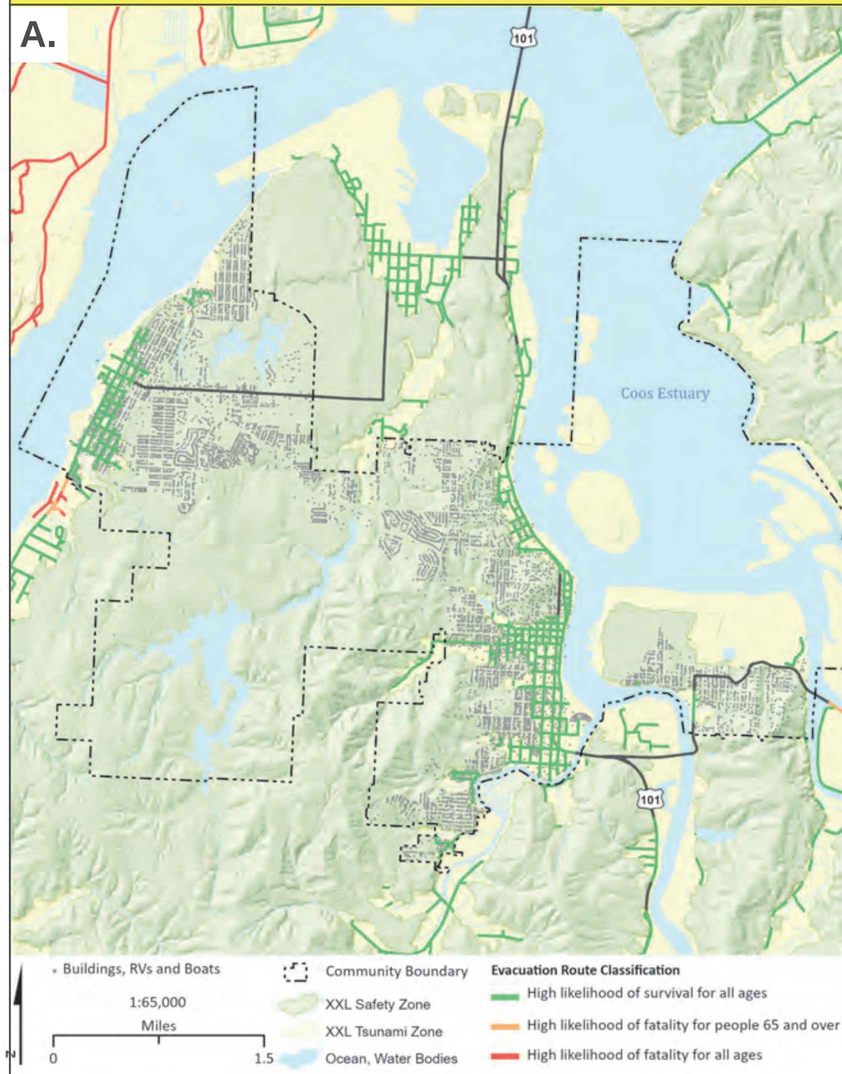


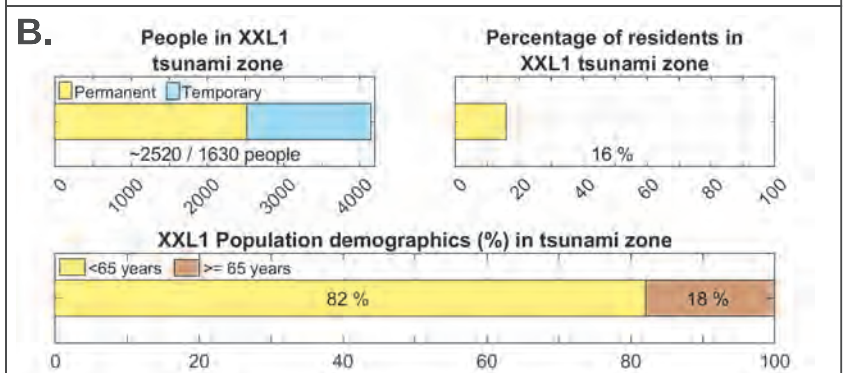


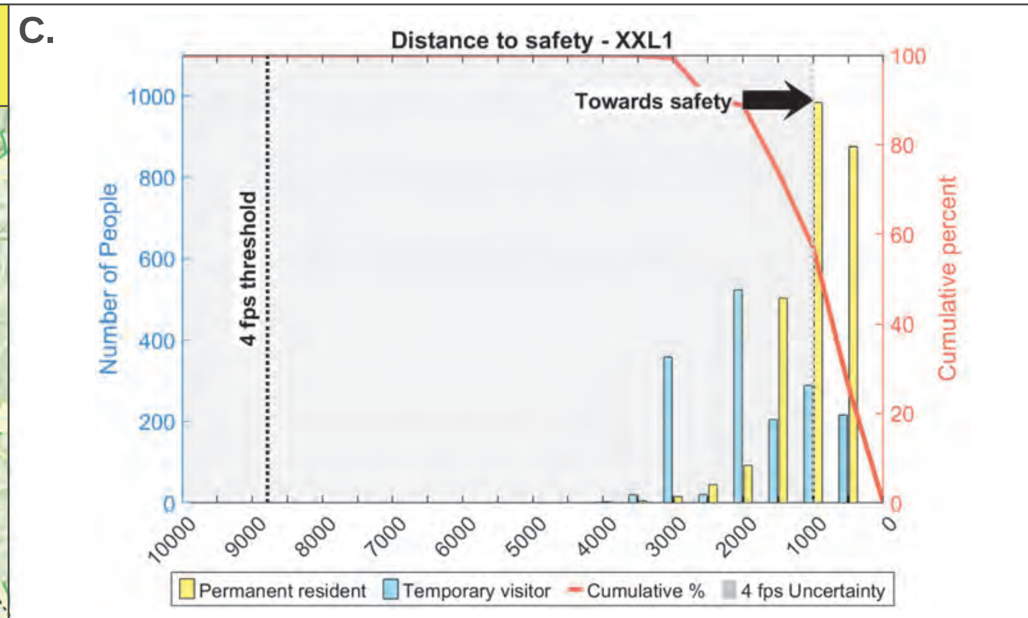
Description	Total
Earthquake Injuries (Entire Community)	441
Tsunami Injuries - Permanent + Temporary	0
Tsunami Fatalities - Permanent	0
Tsunami Fatalities - Temporary @ ~100% occupancy	0
Displaced Population - Permanent	1,021
Displaced Population - Permanent + Temporary	2,075

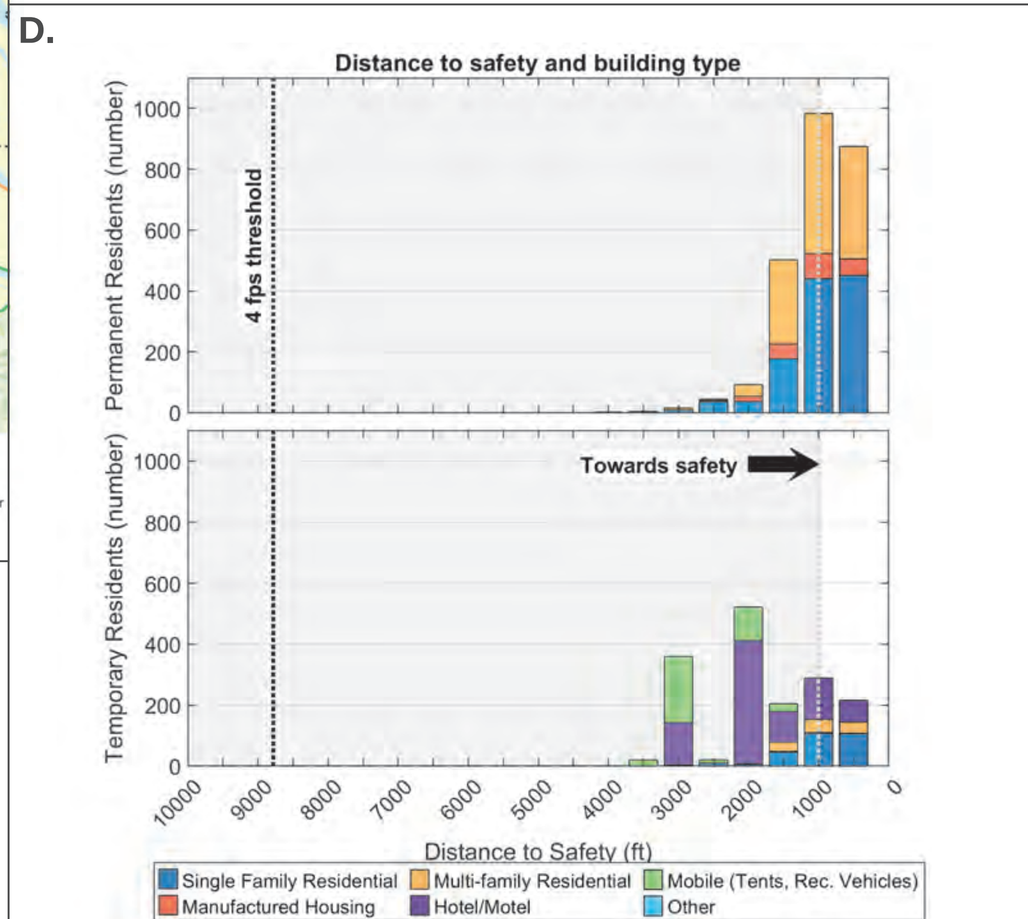
Coos Bay - XXL1

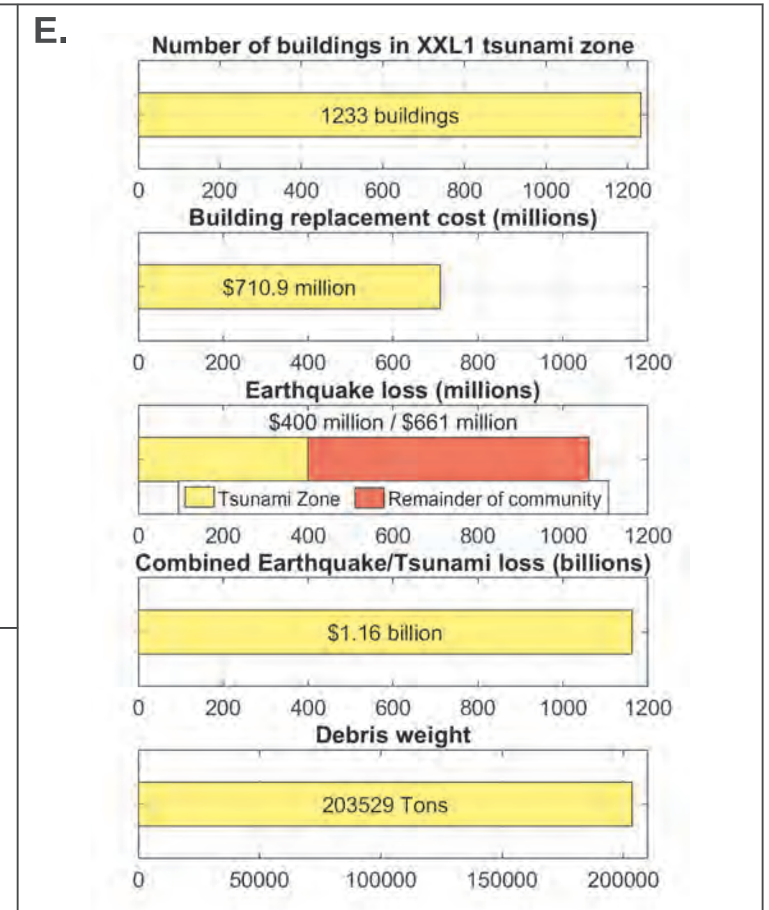
Casualty estimates assume a MODERATE WALK travel speed (4 ft per second)

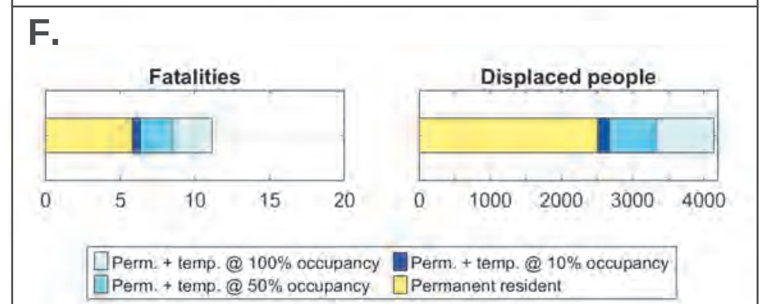










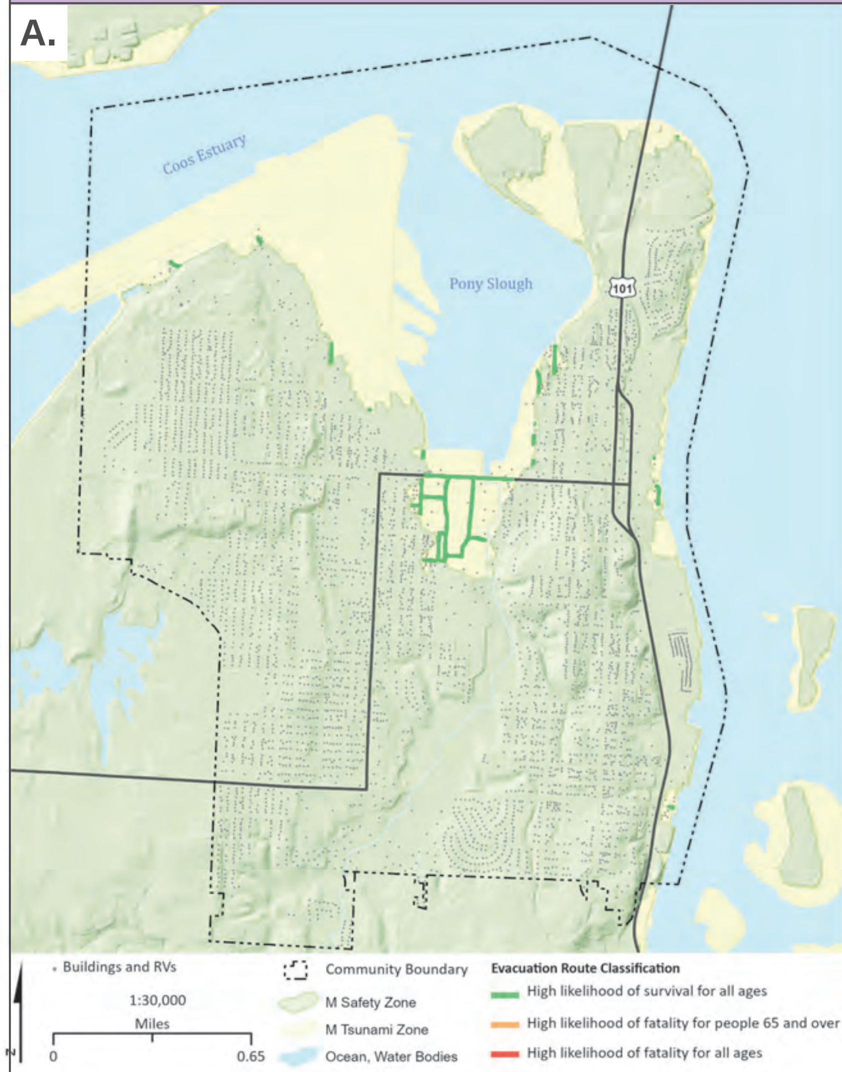


Description	Total
Earthquake Injuries (Entire Community)	441
Tsunami Injuries - Permanent + Temporary	7
Tsunami Fatalities - Permanent	6
Tsunami Fatalities - Temporary @ ~100% occupancy	5
Displaced Population - Permanent	2,511
Displaced Population - Permanent + Temporary	4,136

North Bend - M1

Casualty estimates assume a MODERATE WALK travel speed (4 ft per second)

A.



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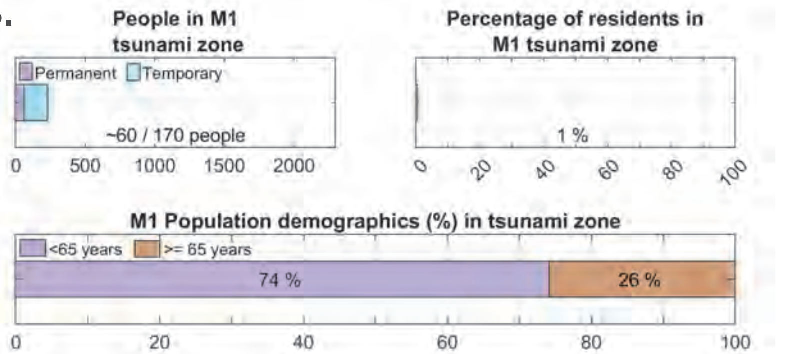

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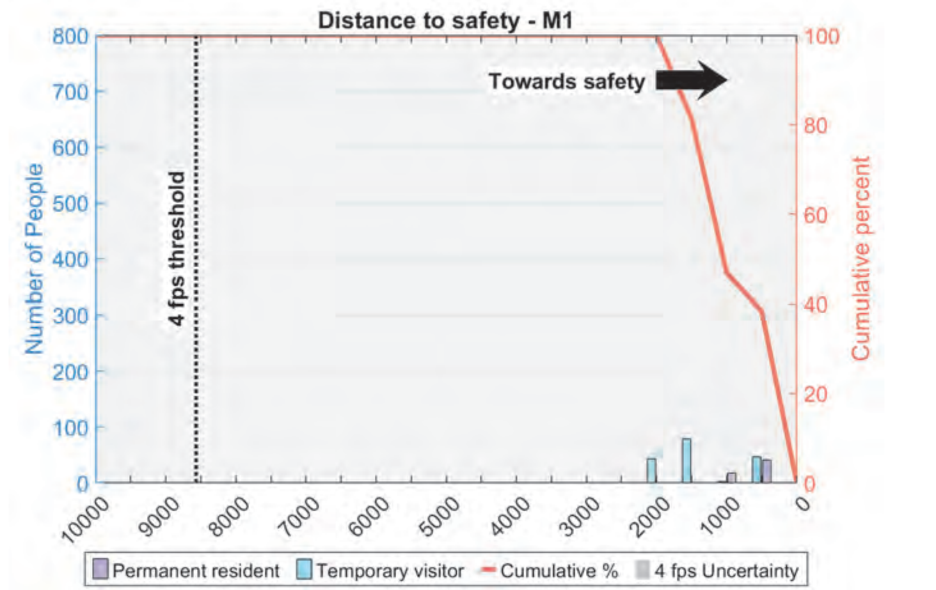
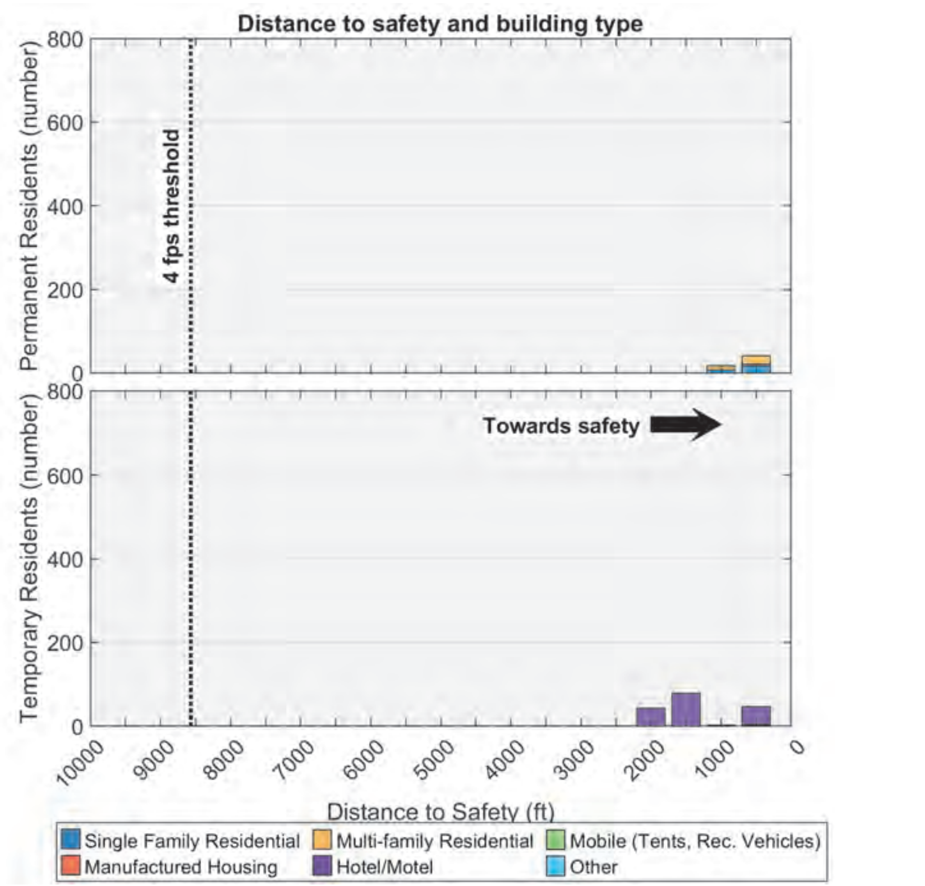
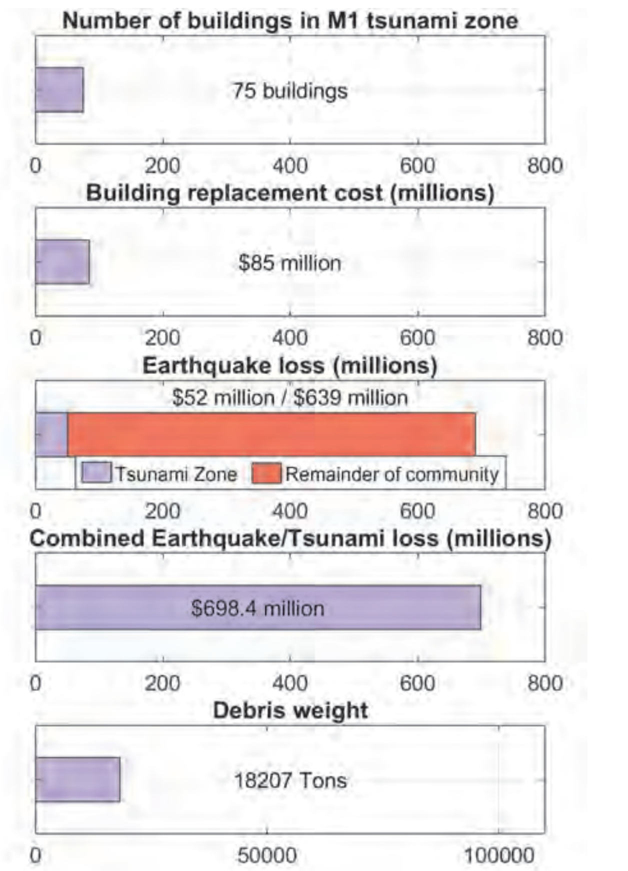


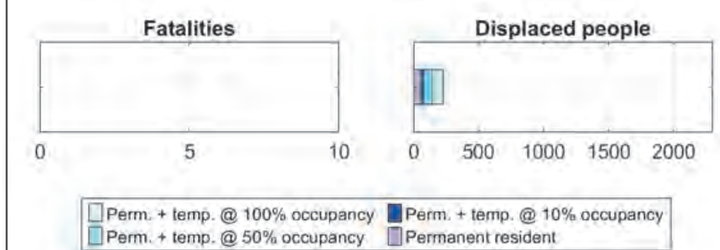
D.



E.



F.

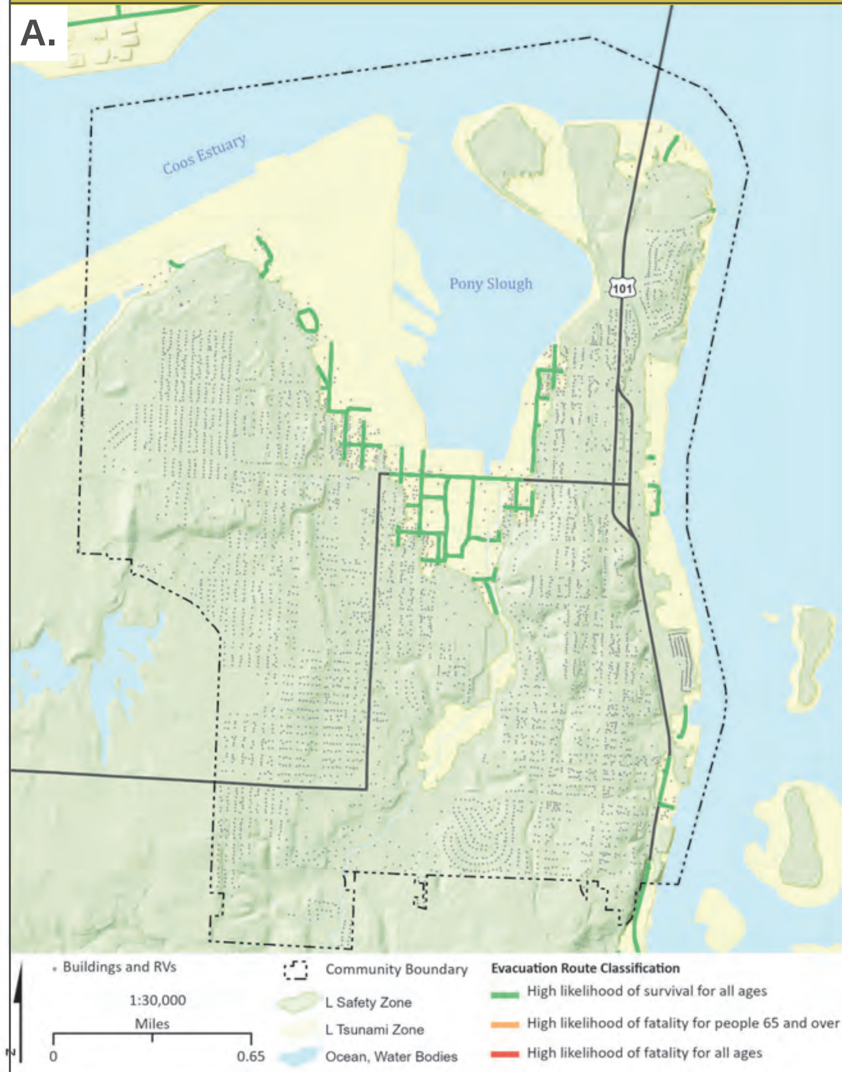


Description	Total
Earthquake Injuries (Entire Community)	267
Tsunami Injuries - Permanent + Temporary	0
Tsunami Fatalities - Permanent	0
Tsunami Fatalities - Temporary @ ~100% occupancy	0
Displaced Population - Permanent	58
Displaced Population - Permanent + Temporary	227

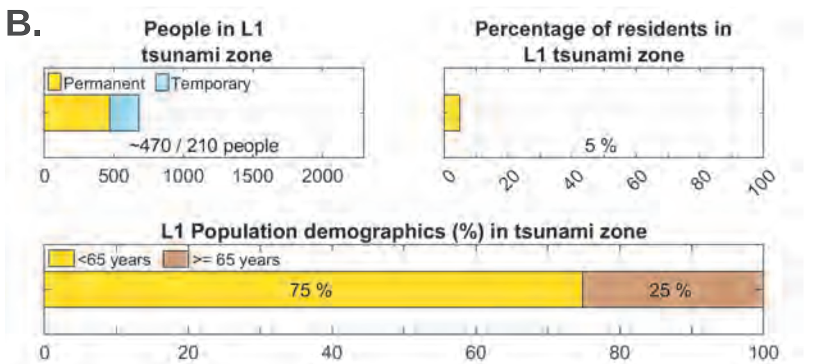
North Bend - L1

Casualty estimates assume a MODERATE WALK travel speed (4 ft per second)

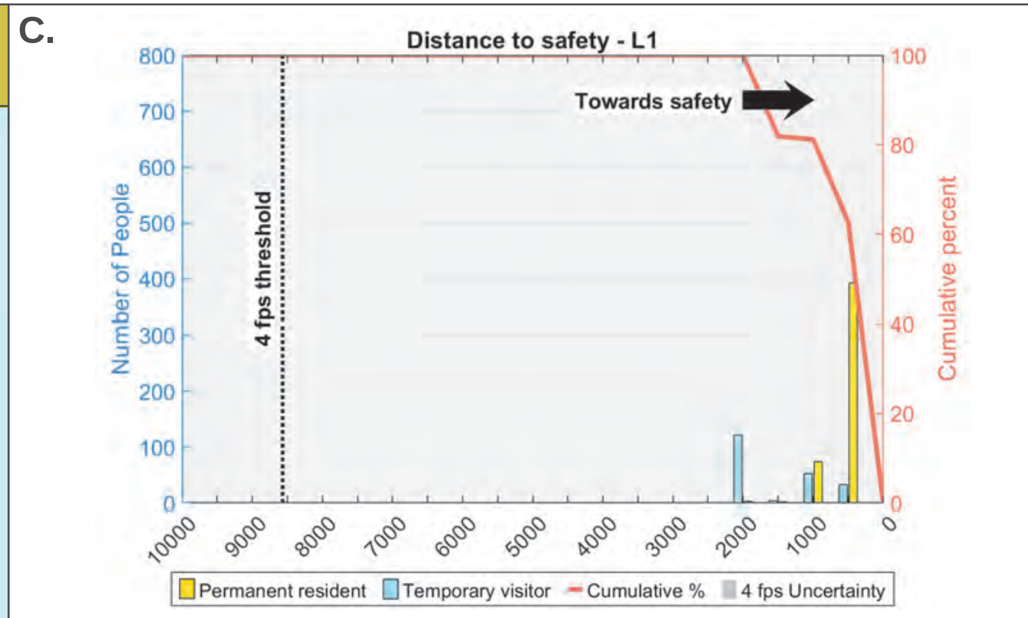
A.



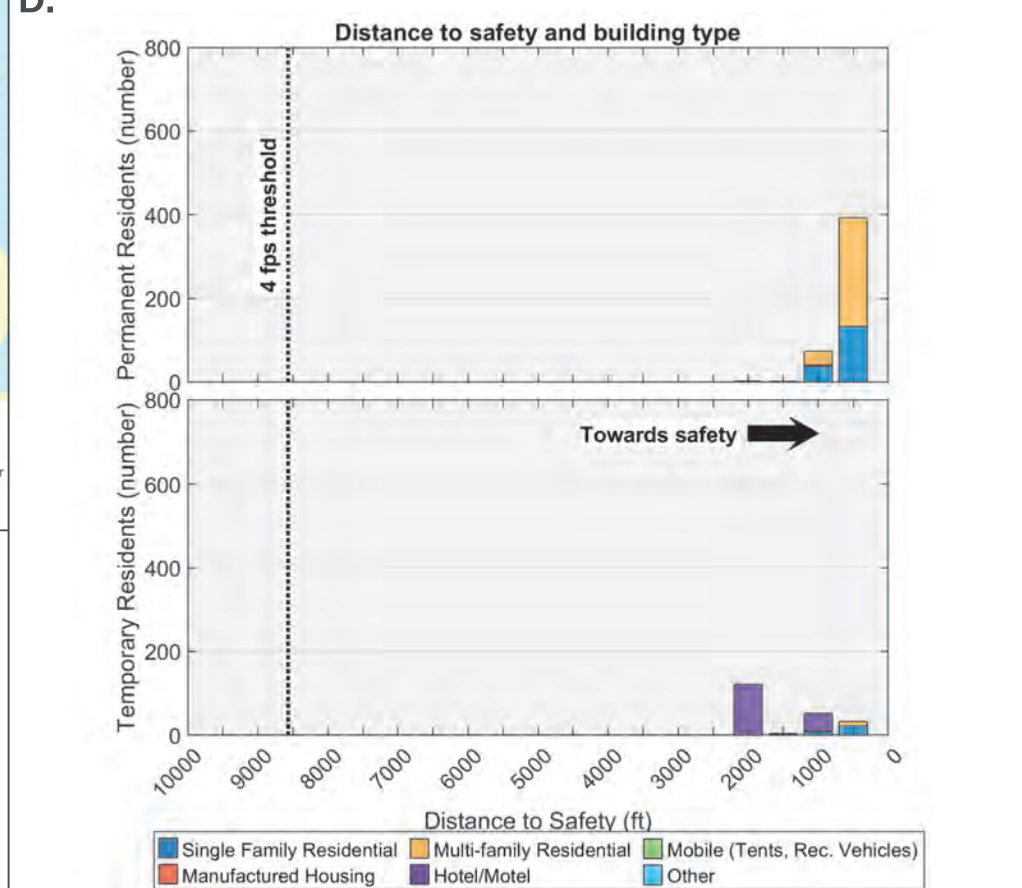
B.



C.



D.



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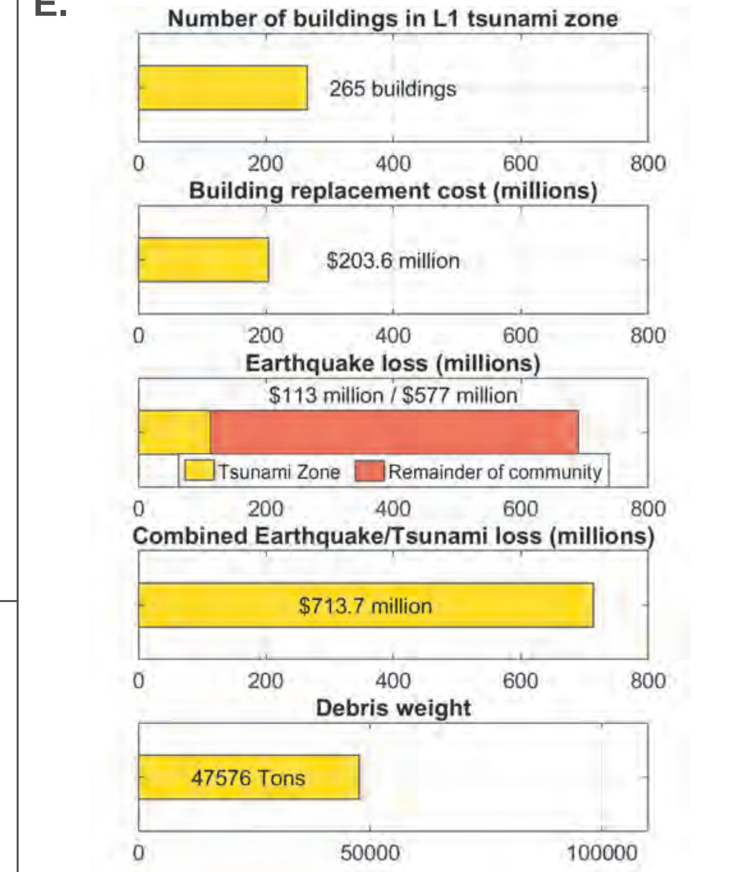
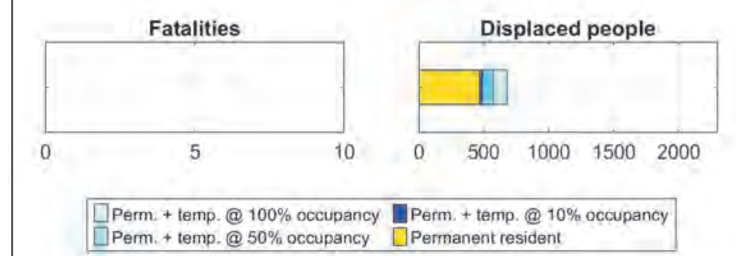


F.

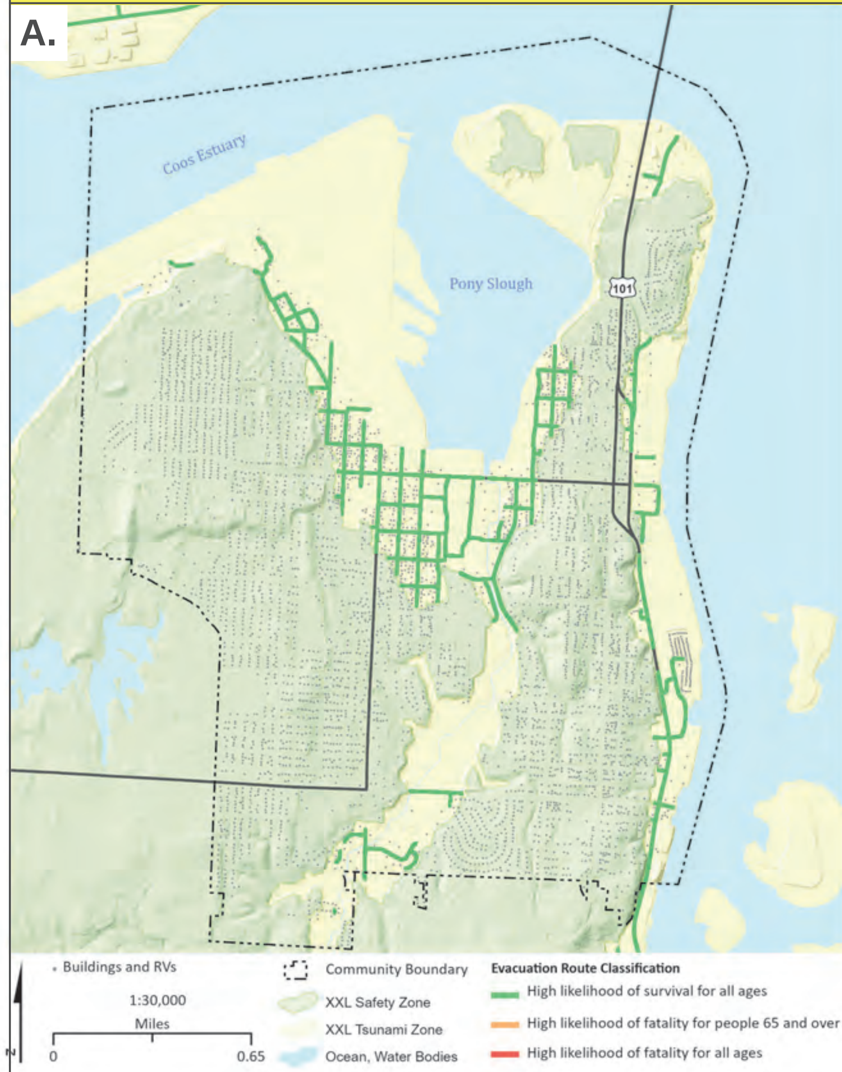


Description	Total
Earthquake Injuries (Entire Community)	267
Tsunami Injuries - Permanent + Temporary	0
Tsunami Fatalities - Permanent	0
Tsunami Fatalities - Temporary @ ~100% occupancy	0
Displaced Population - Permanent	469
Displaced Population - Permanent + Temporary	678

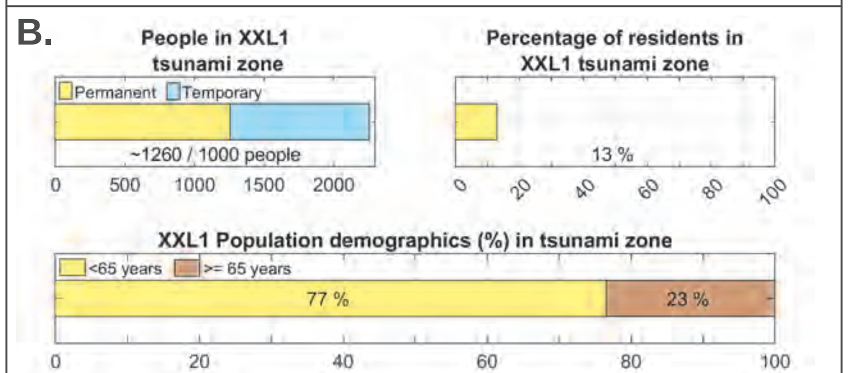
North Bend - XXL1

Casualty estimates assume a MODERATE WALK travel speed (4 ft per second)

A.



B.



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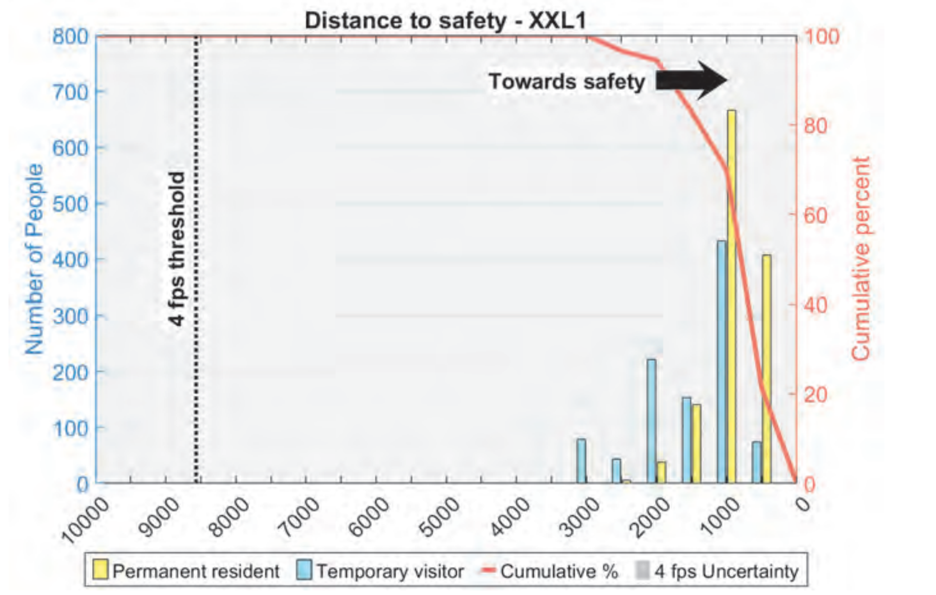

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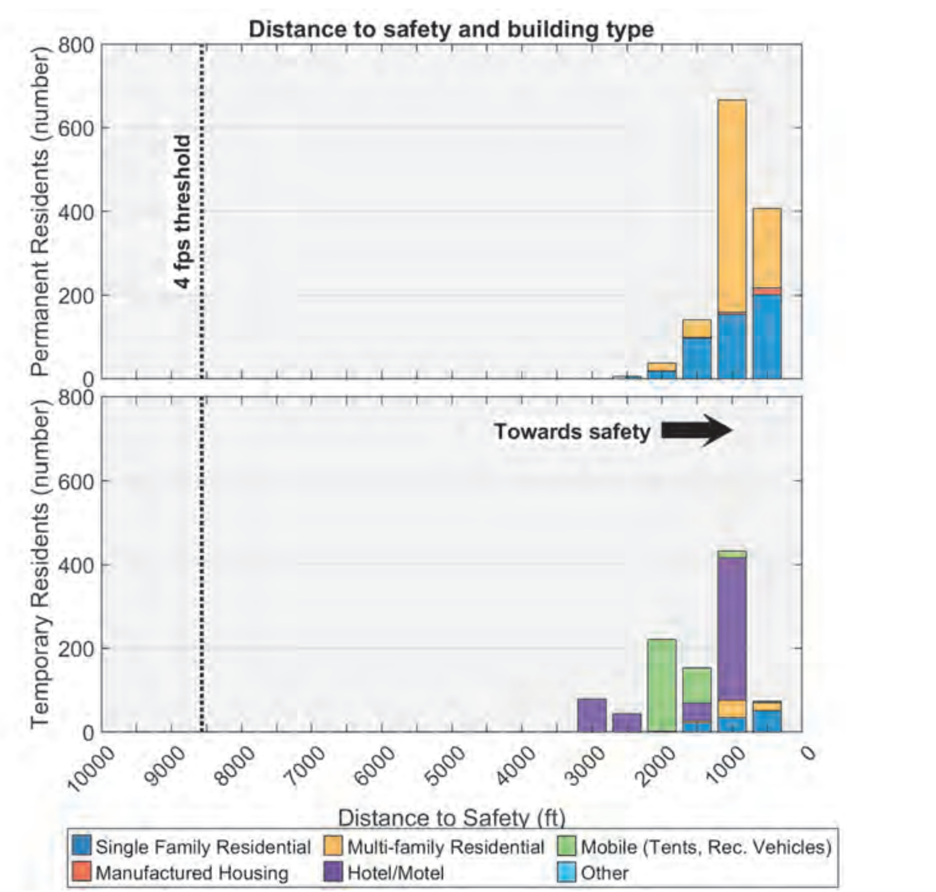

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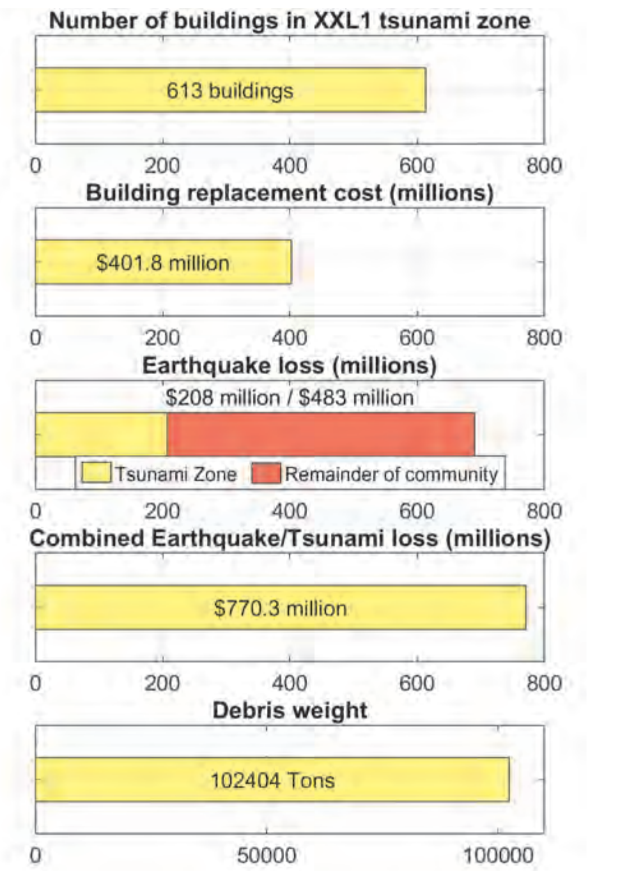

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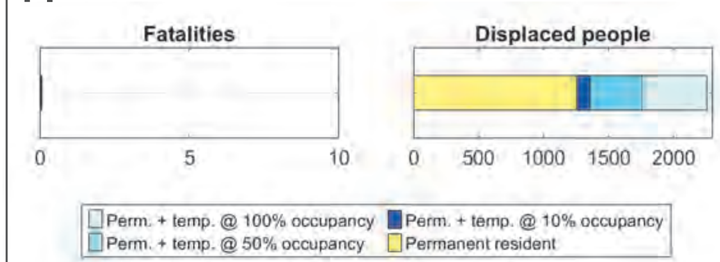


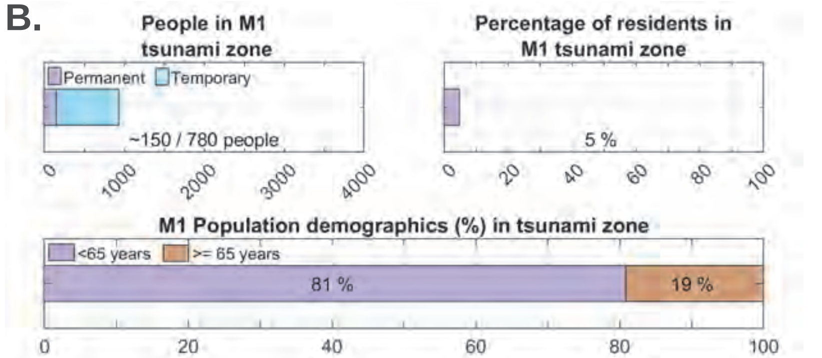
Description	Total
Earthquake Injuries (Entire Community)	267
Tsunami Injuries - Permanent + Temporary	0
Tsunami Fatalities - Permanent	0
Tsunami Fatalities - Temporary @ ~100% occupancy	0
Displaced Population - Permanent	1,255
Displaced Population - Permanent + Temporary	2,256

Barview - M1

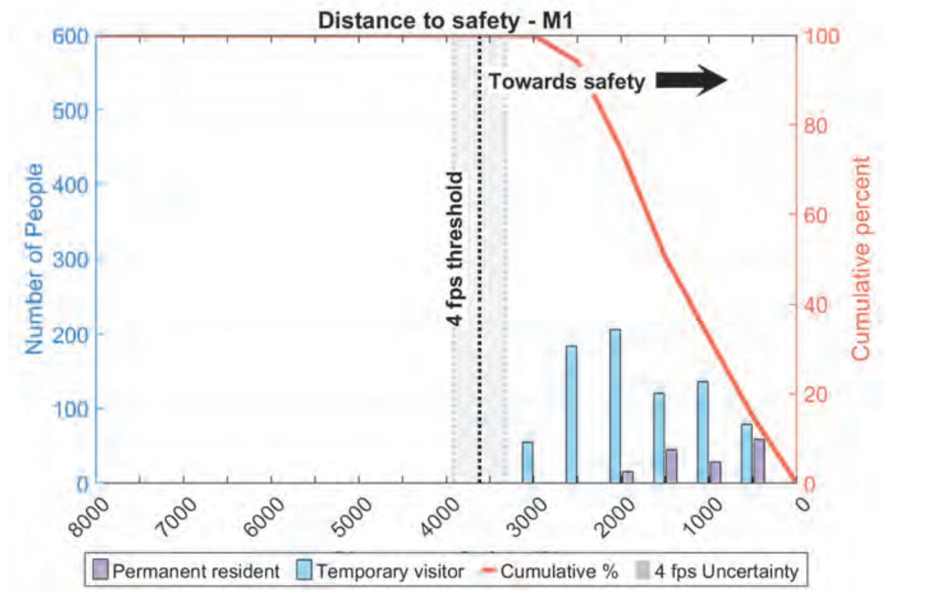
Casualty estimates assume a MODERATE WALK travel speed (4 ft per second)

A.

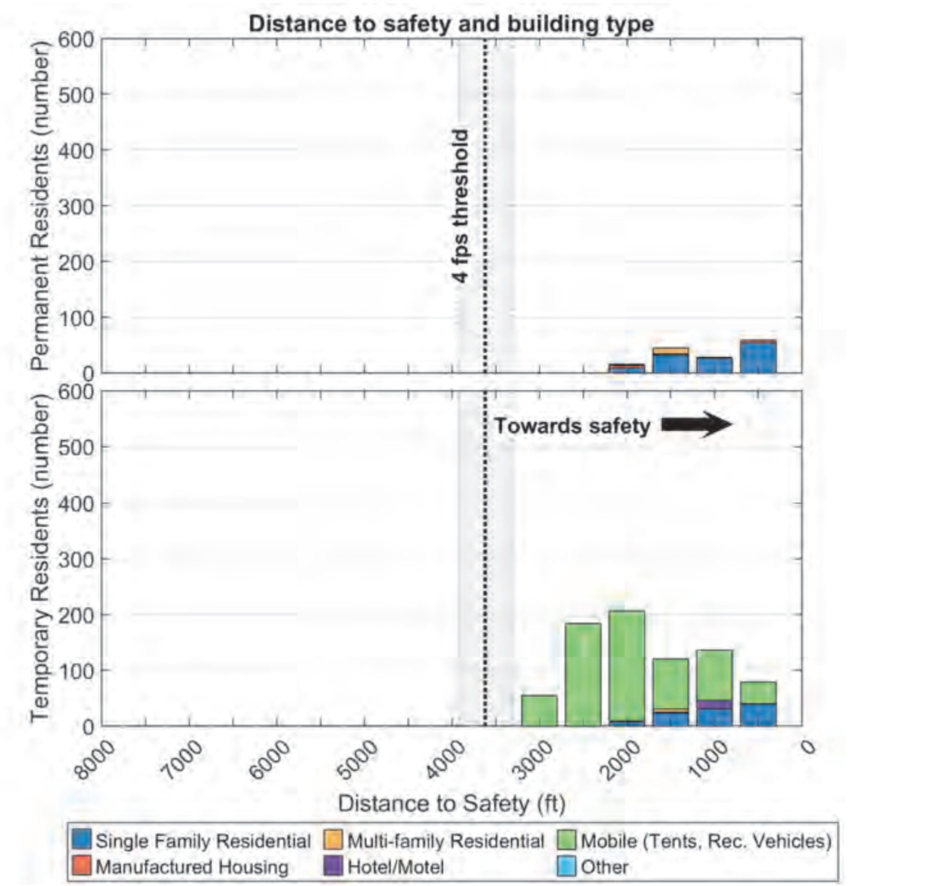
B.



C.



D.



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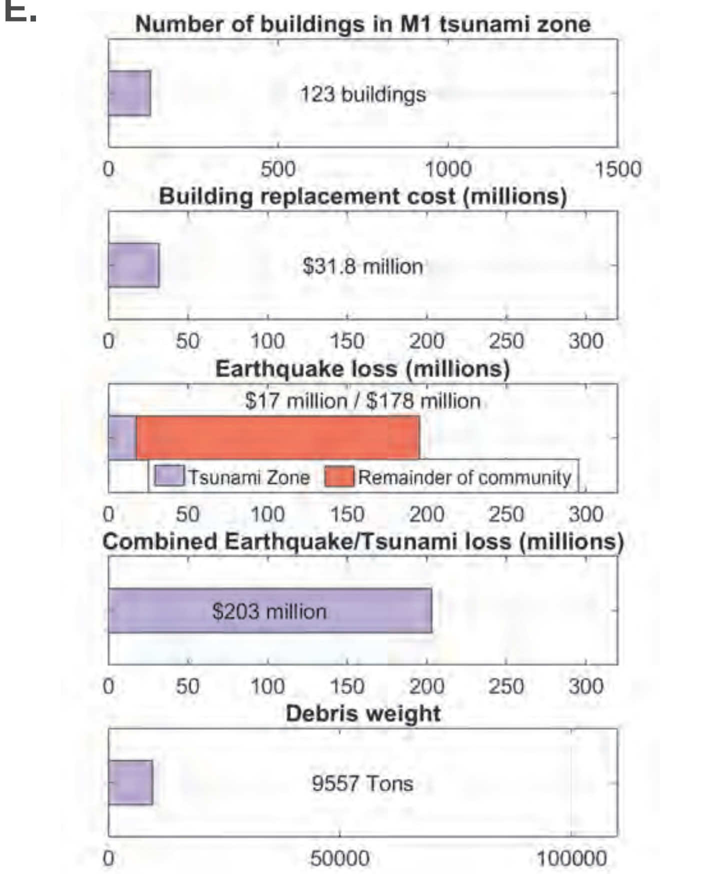

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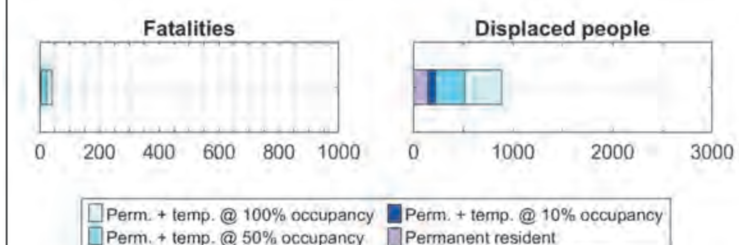


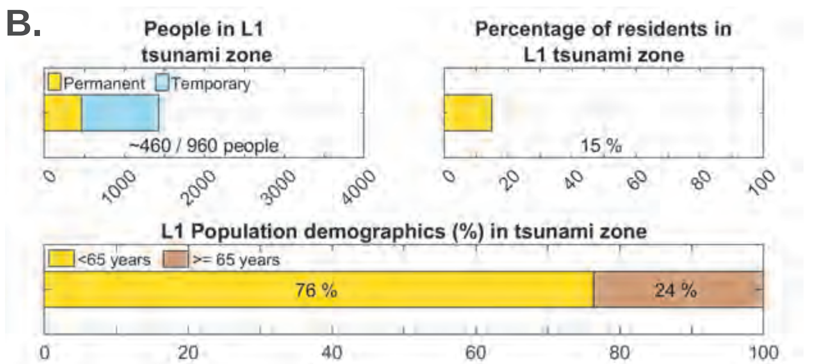
Description	Total
Earthquake Injuries (Entire Community)	130
Tsunami Injuries - Permanent + Temporary	11
Tsunami Fatalities - Permanent	1
Tsunami Fatalities - Temporary @ ~100% occupancy	41
Displaced Population - Permanent	146
Displaced Population - Permanent + Temporary	884

Barview - L1

Casualty estimates assume a MODERATE WALK travel speed (4 ft per second)

A.

B.



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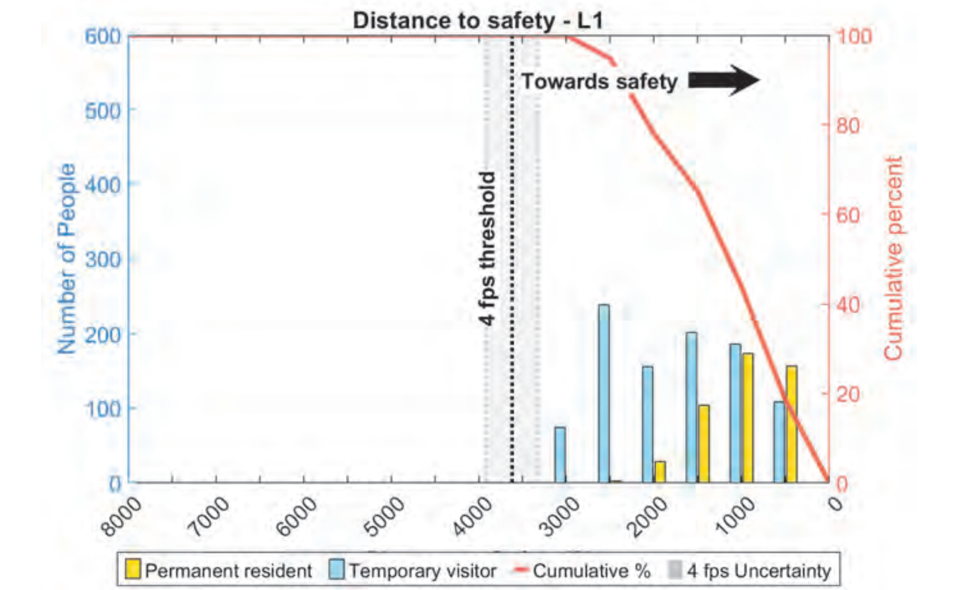

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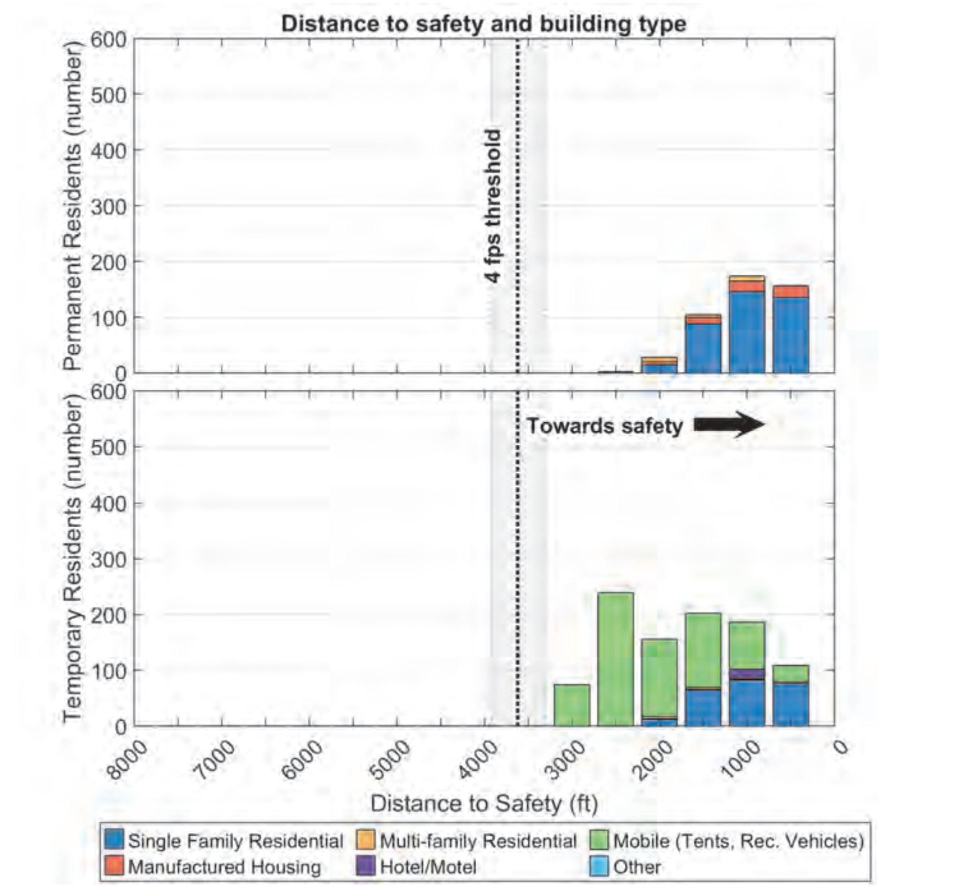

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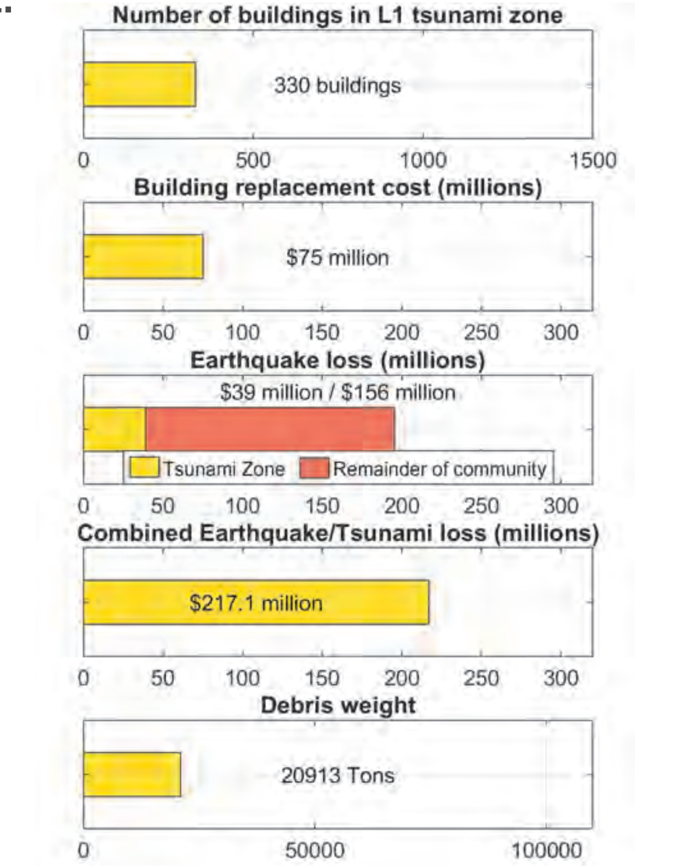

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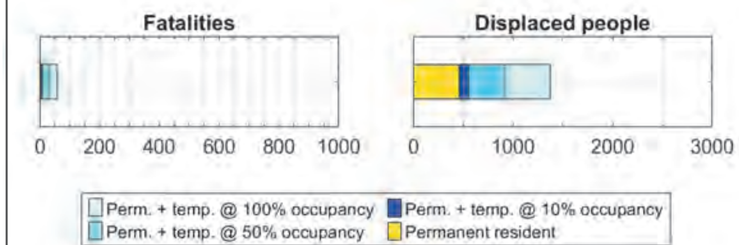
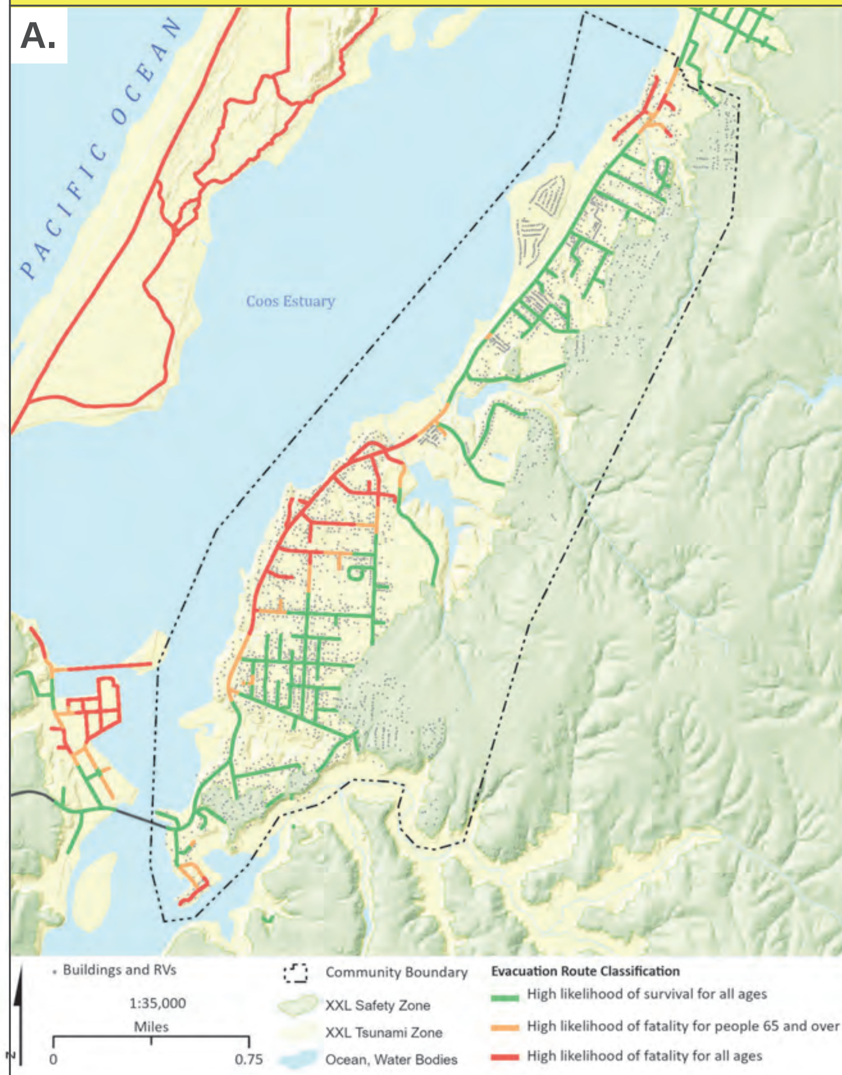
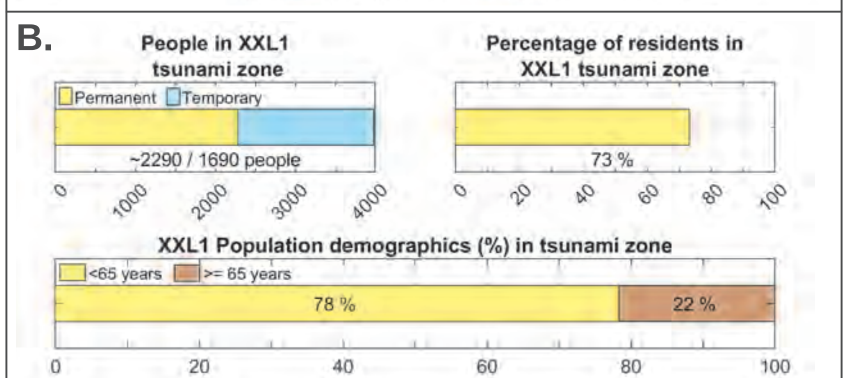


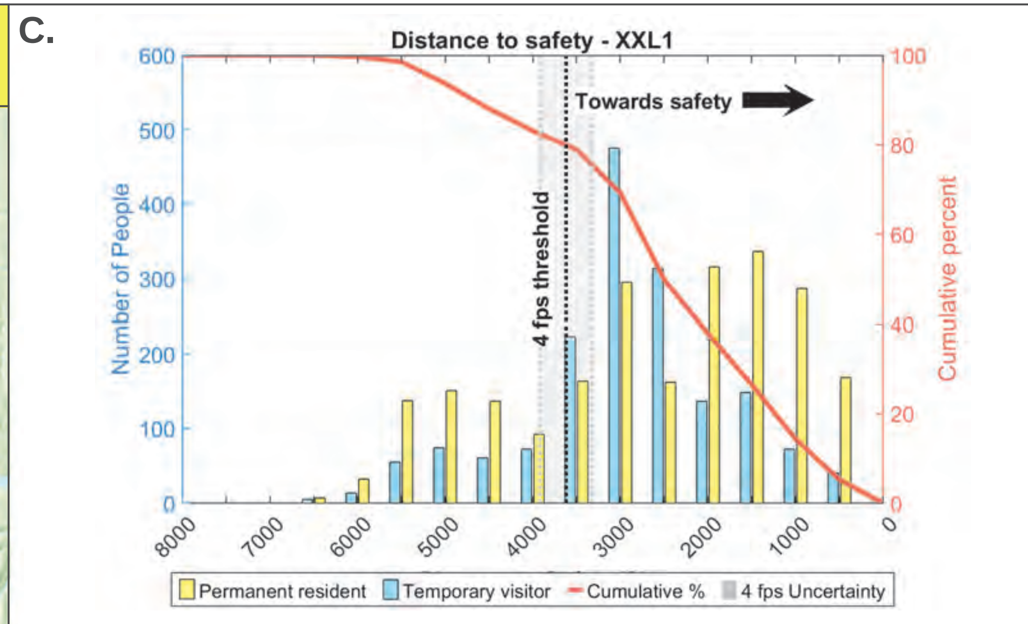
Description	Total
Earthquake Injuries (Entire Community)	130
Tsunami Injuries - Permanent + Temporary	12
Tsunami Fatalities - Permanent	3
Tsunami Fatalities - Temporary @ ~100% occupancy	55
Displaced Population - Permanent	462
Displaced Population - Permanent + Temporary	1,371

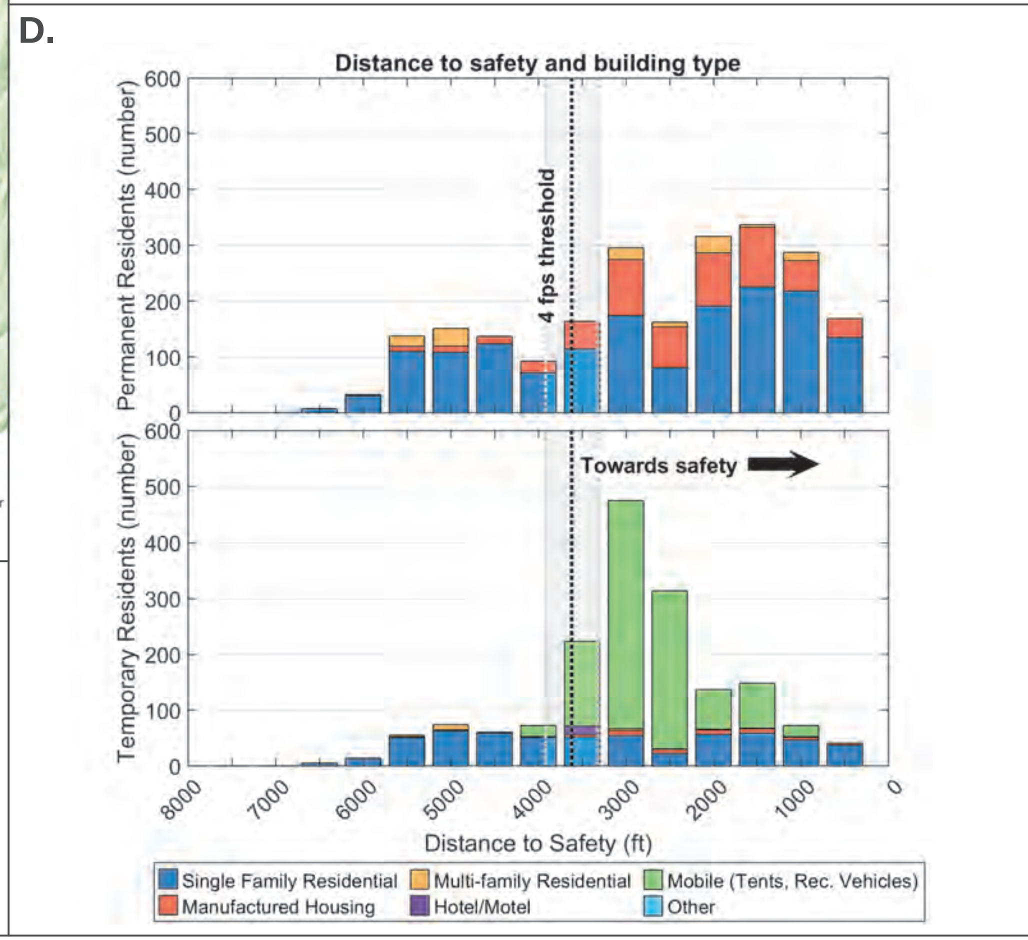
Barview - XXL1

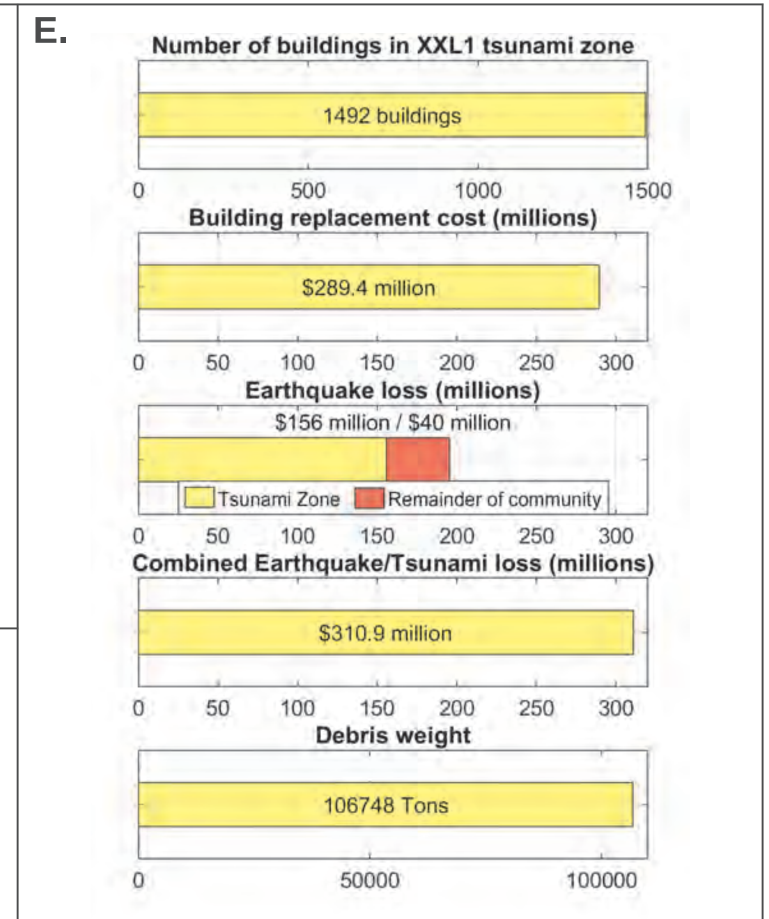
Casualty estimates assume a MODERATE WALK travel speed (4 ft per second)

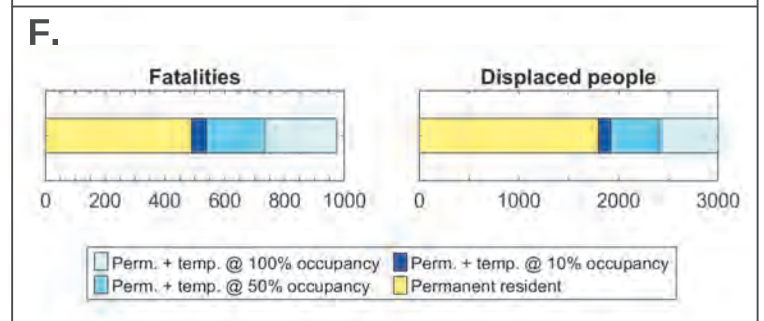








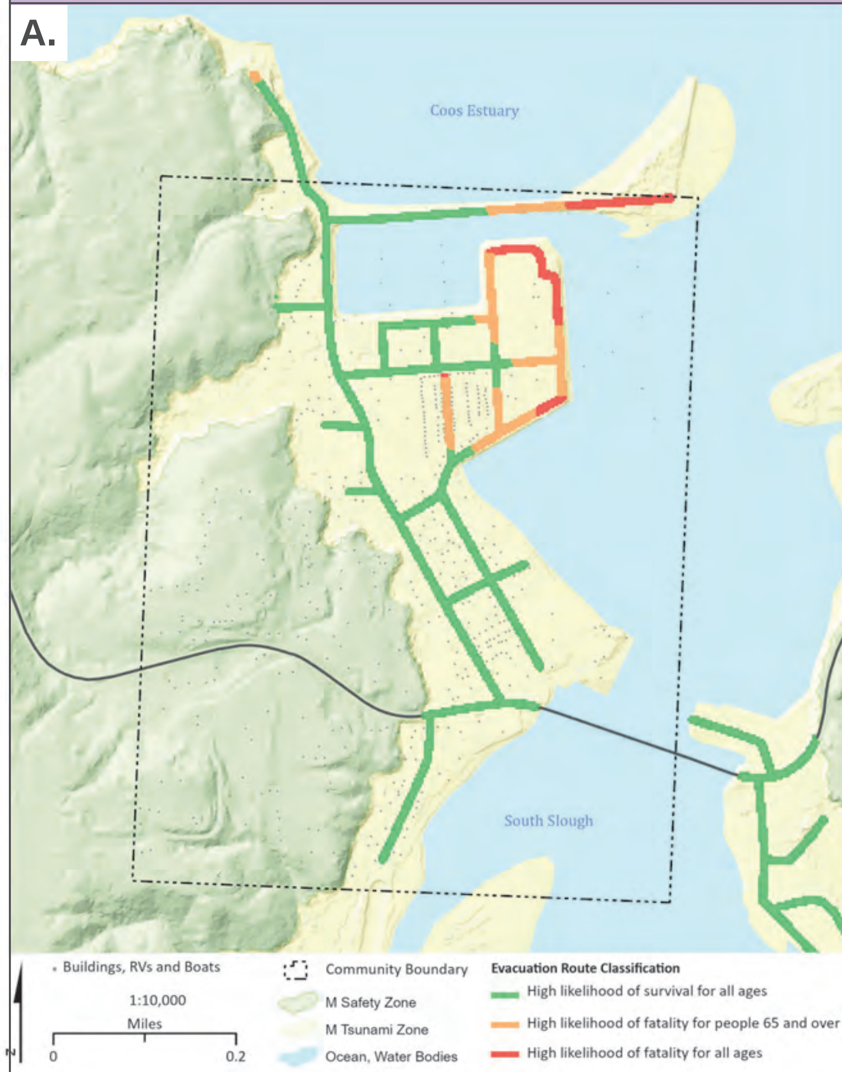


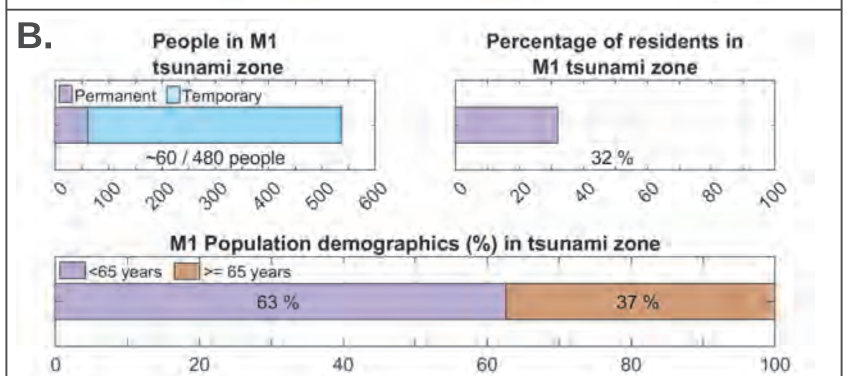


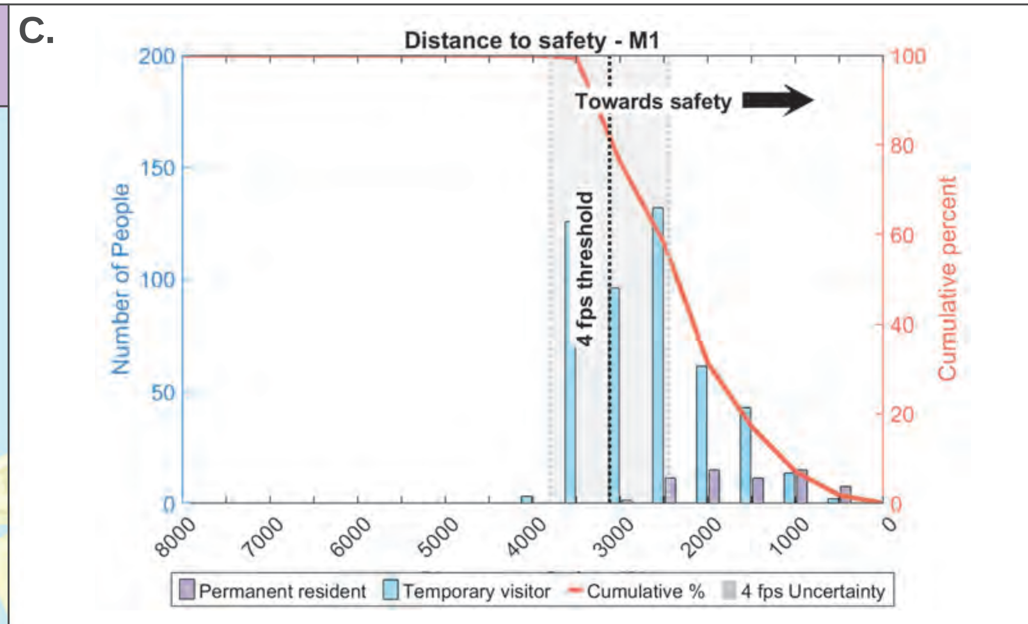
Description	Total
Earthquake Injuries (Entire Community)	130
Tsunami Injuries - Permanent + Temporary	297
Tsunami Fatalities - Permanent	488
Tsunami Fatalities - Temporary @ ~100% occupancy	487
Displaced Population - Permanent	1,798
Displaced Population - Permanent + Temporary	3,001

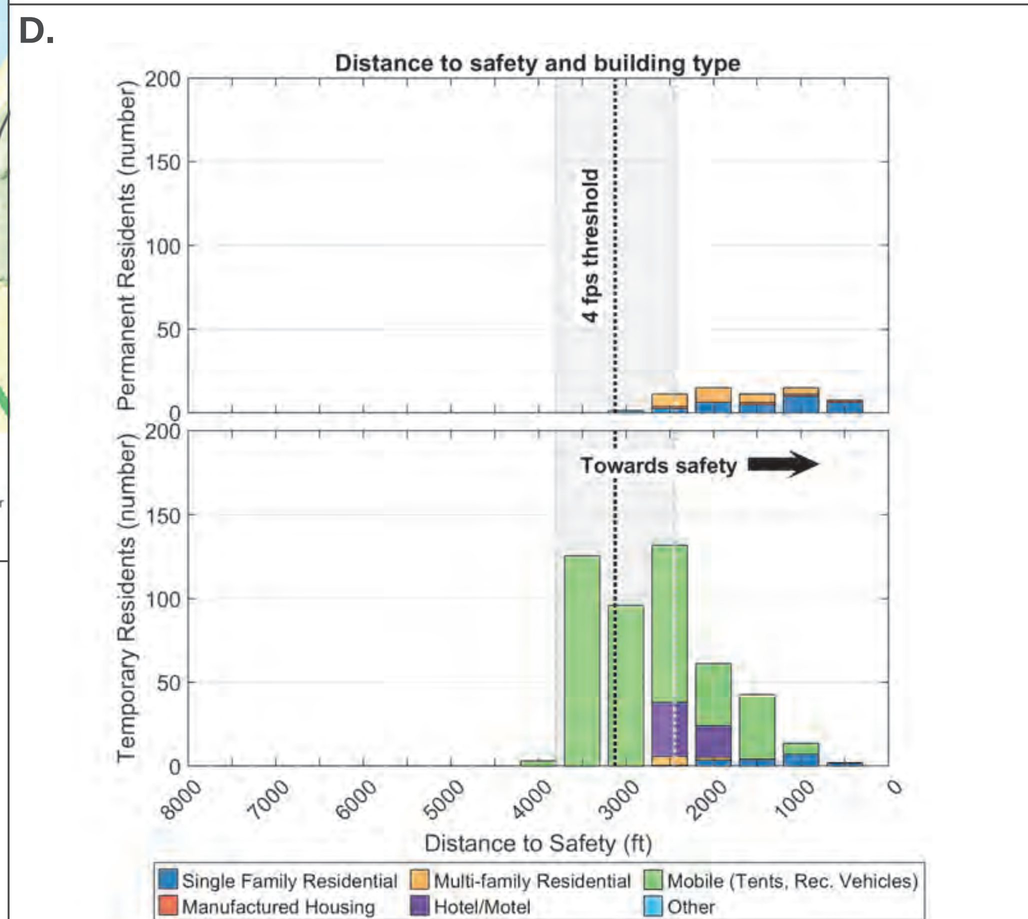
Charleston - M1

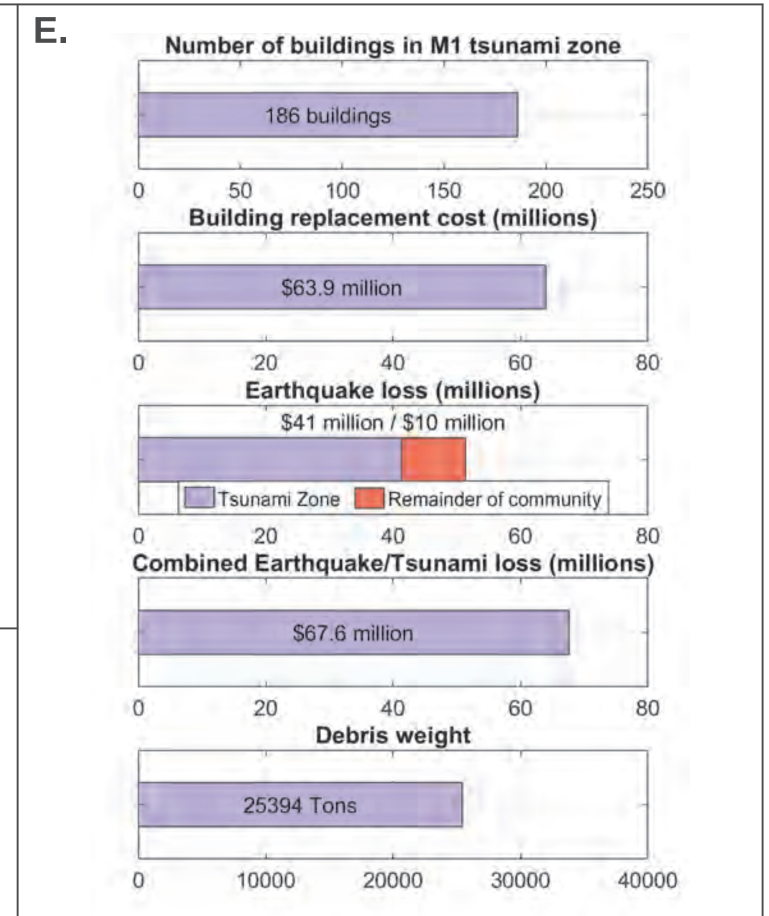
Casualty estimates assume a MODERATE WALK travel speed (4 ft per second)

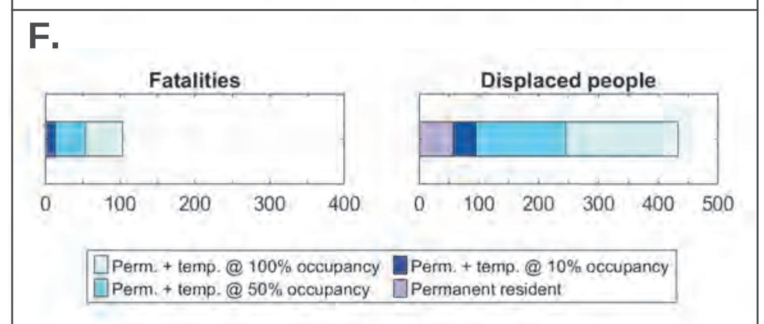










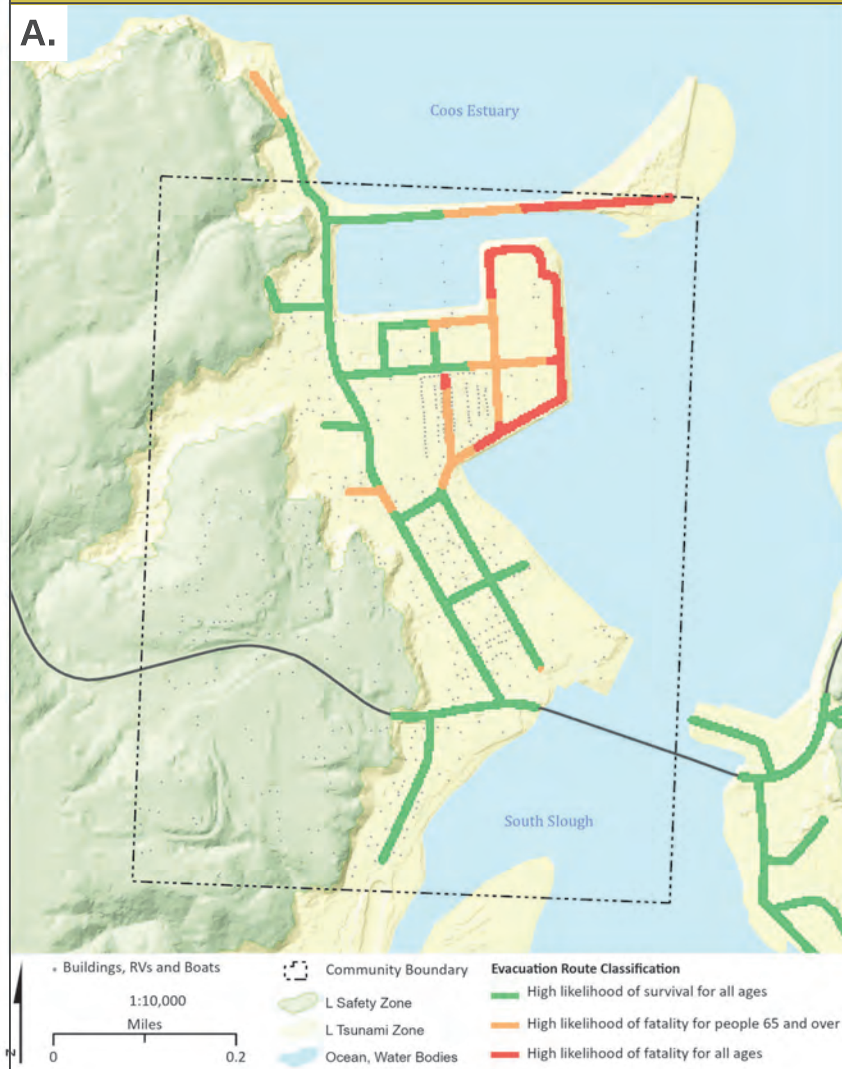


Description	Total
Earthquake Injuries (Entire Community)	14
Tsunami Injuries - Permanent + Temporary	98
Tsunami Fatalities - Permanent	3
Tsunami Fatalities - Temporary @ ~100% occupancy	100
Displaced Population - Permanent	58
Displaced Population - Permanent + Temporary	433

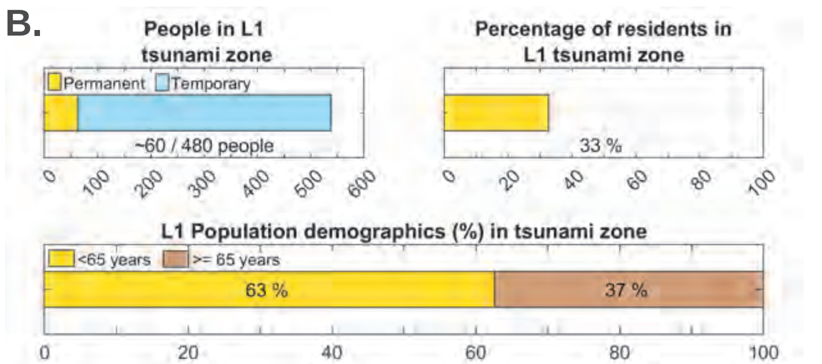
Charleston - L1

Casualty estimates assume a MODERATE WALK travel speed (4 ft per second)

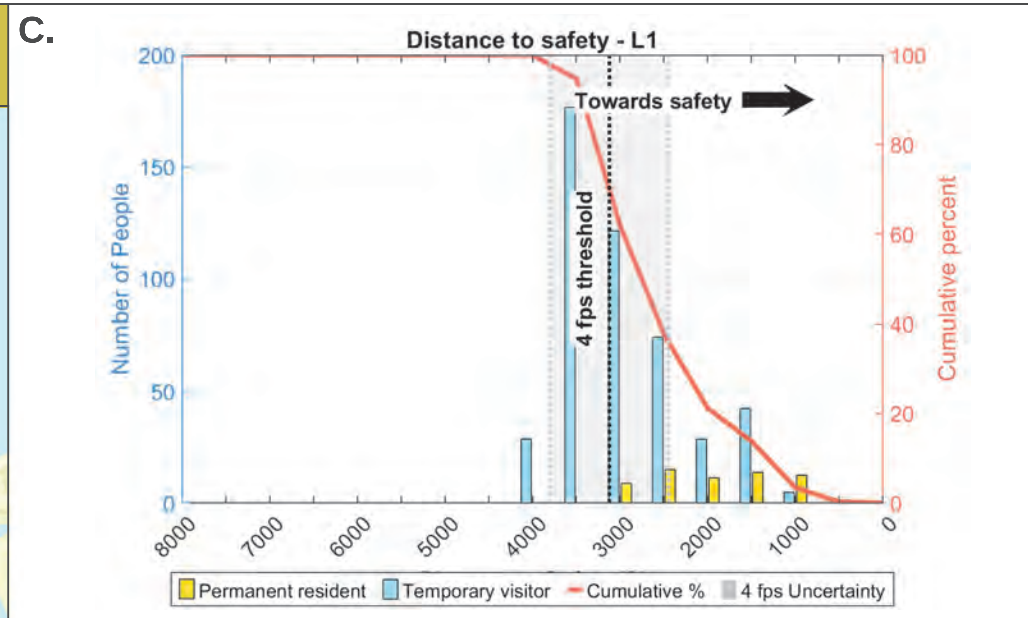
A.



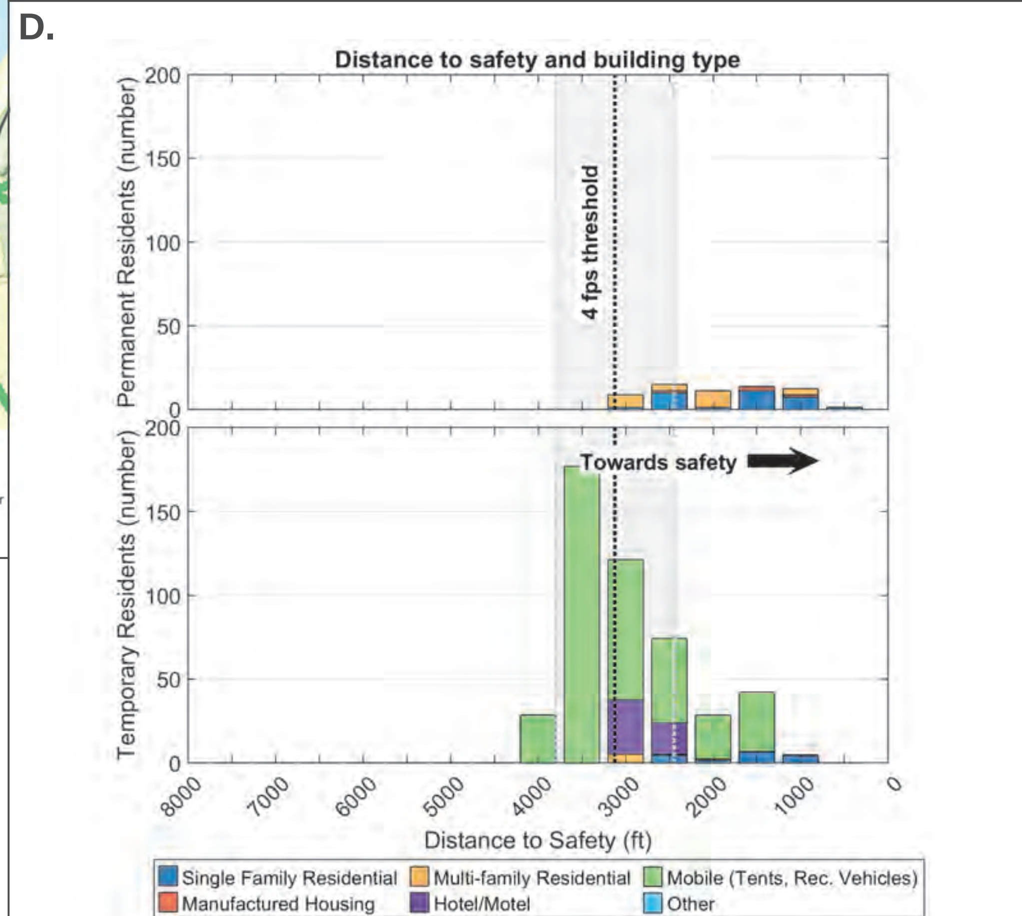
B.



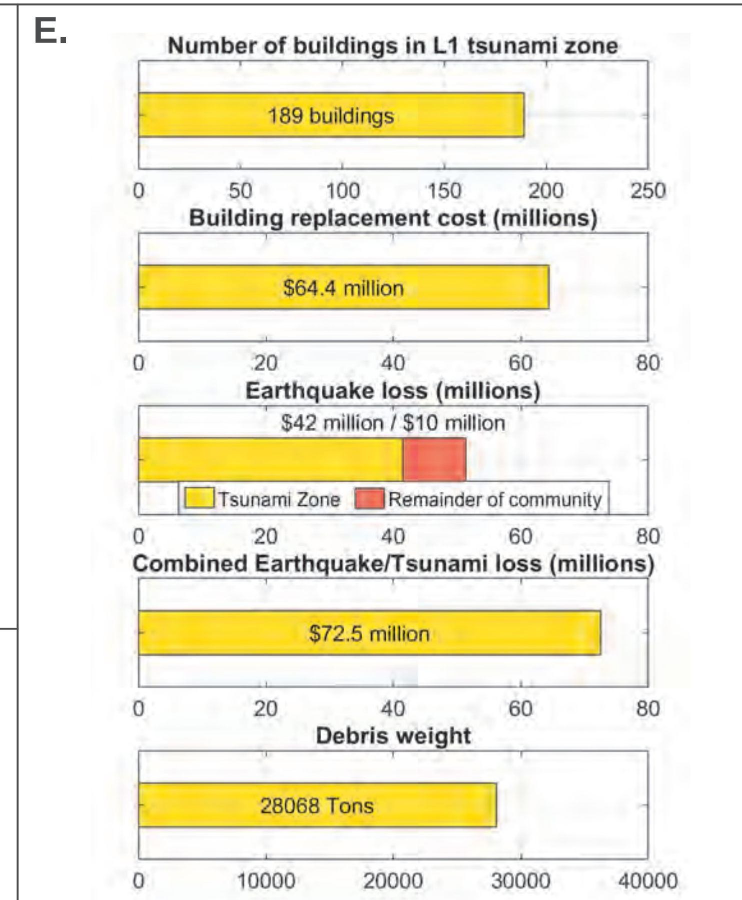
C.



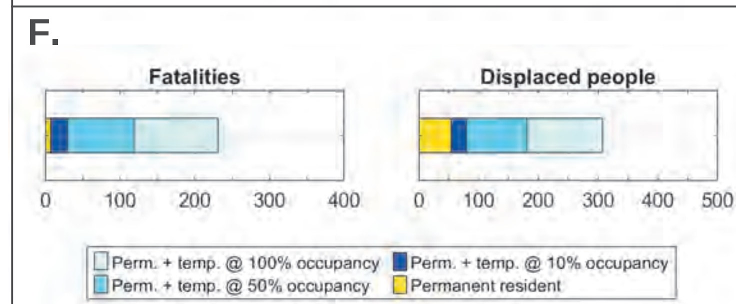
D.



E.



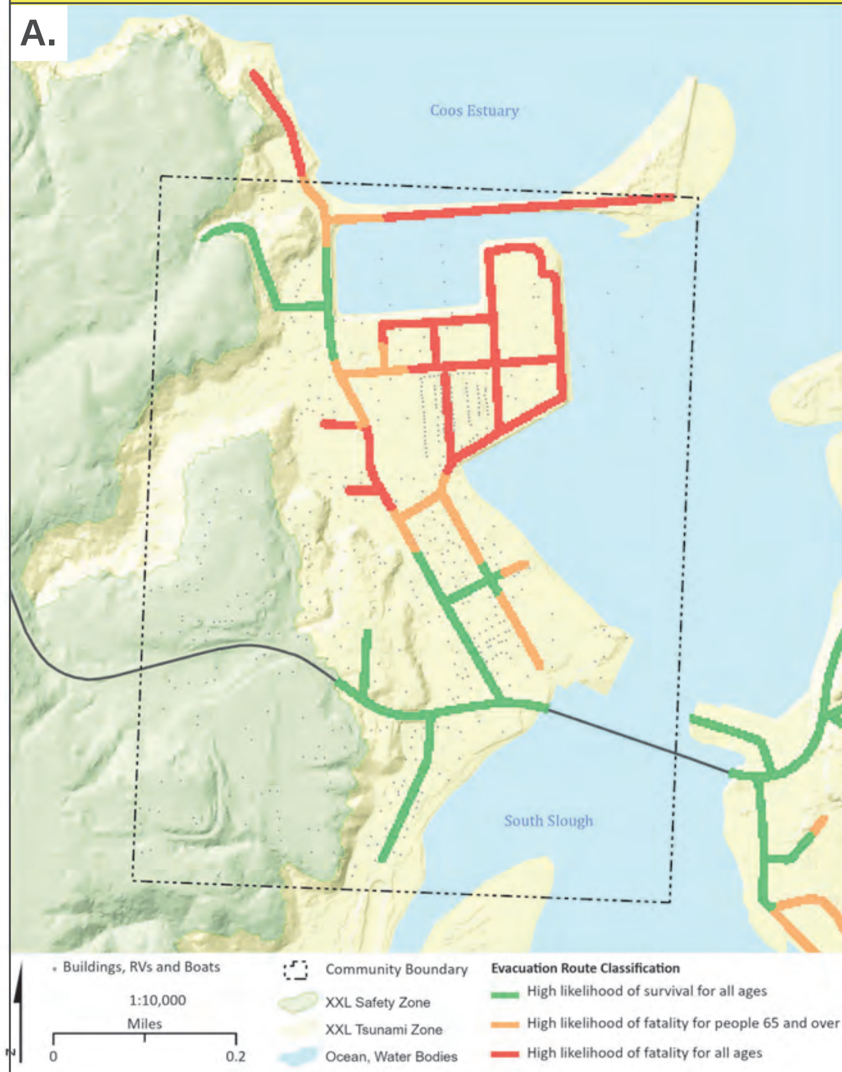
F.

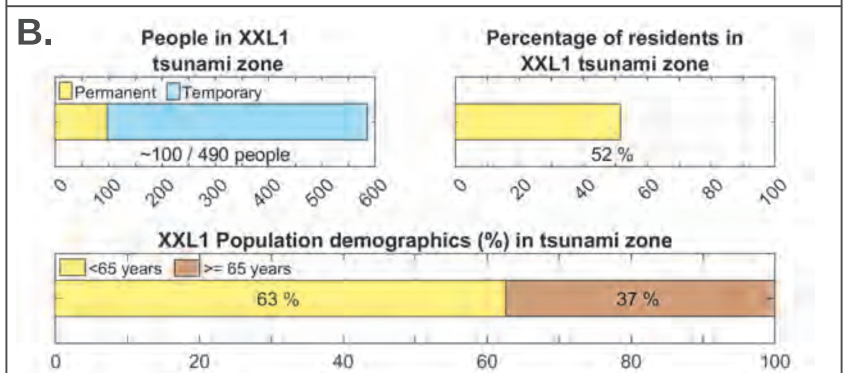


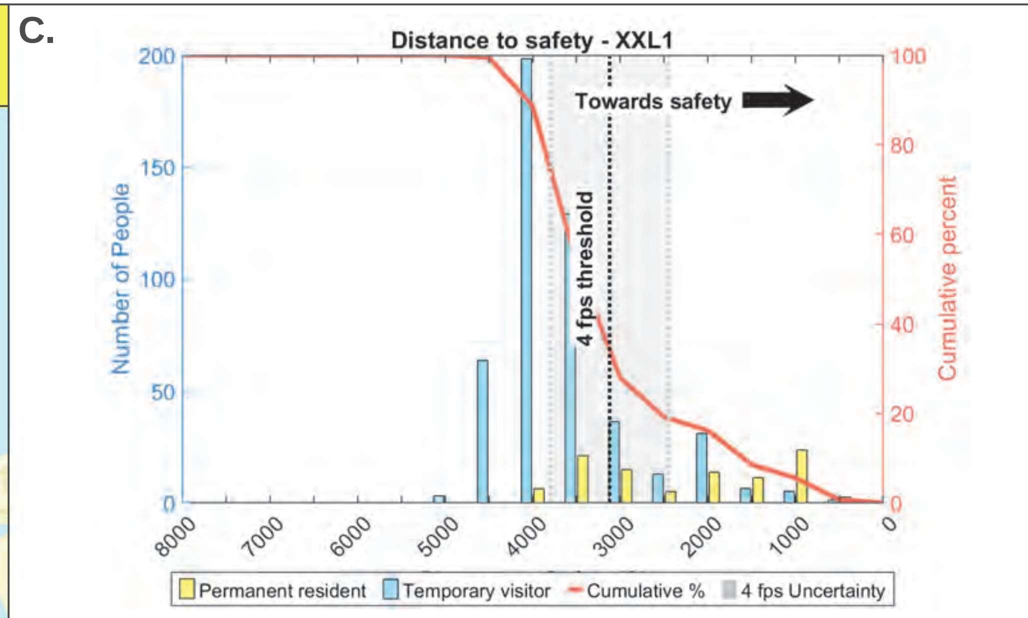
Description	Total
Earthquake Injuries (Entire Community)	14
Tsunami Injuries - Permanent + Temporary	40
Tsunami Fatalities - Permanent	7
Tsunami Fatalities - Temporary @ ~100% occupancy	223
Displaced Population - Permanent	54
Displaced Population - Permanent + Temporary	307

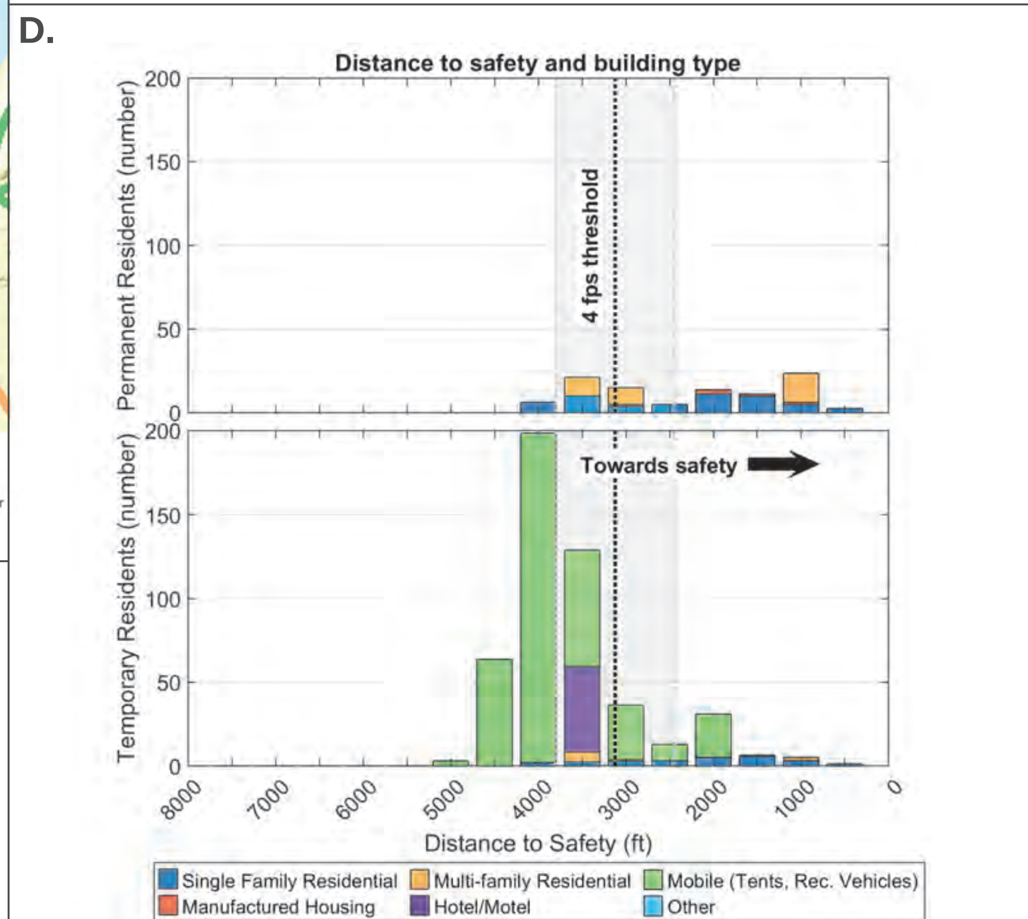
Charleston - XXL1

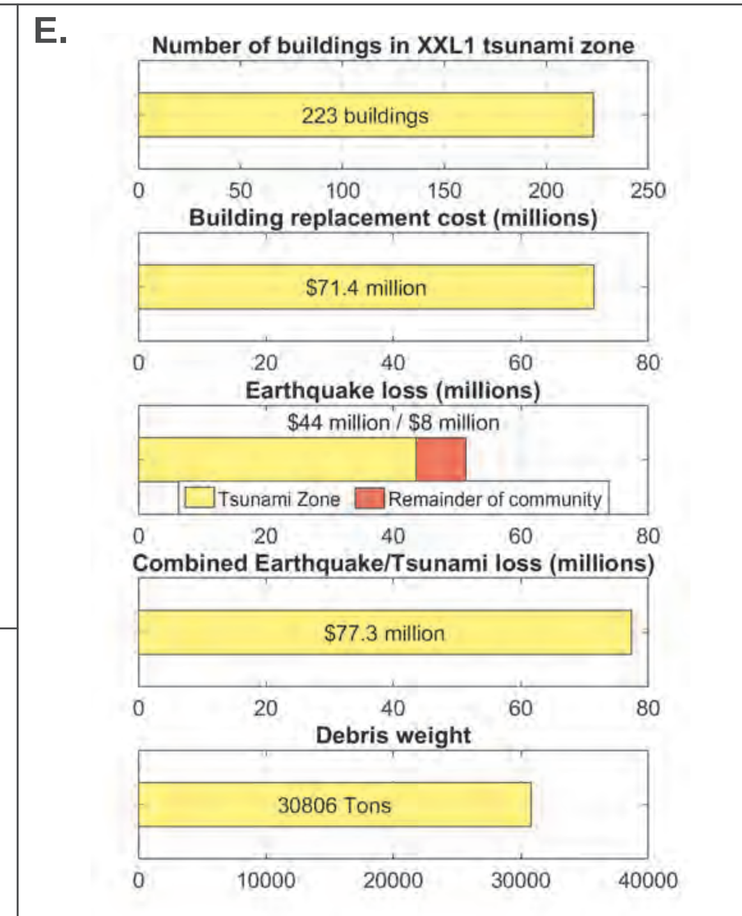
Casualty estimates assume a MODERATE WALK travel speed (4 ft per second)

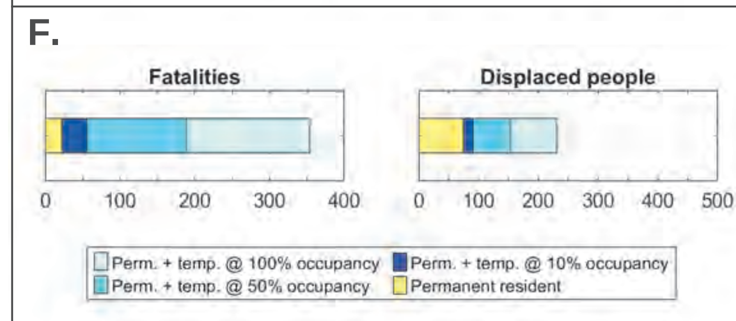








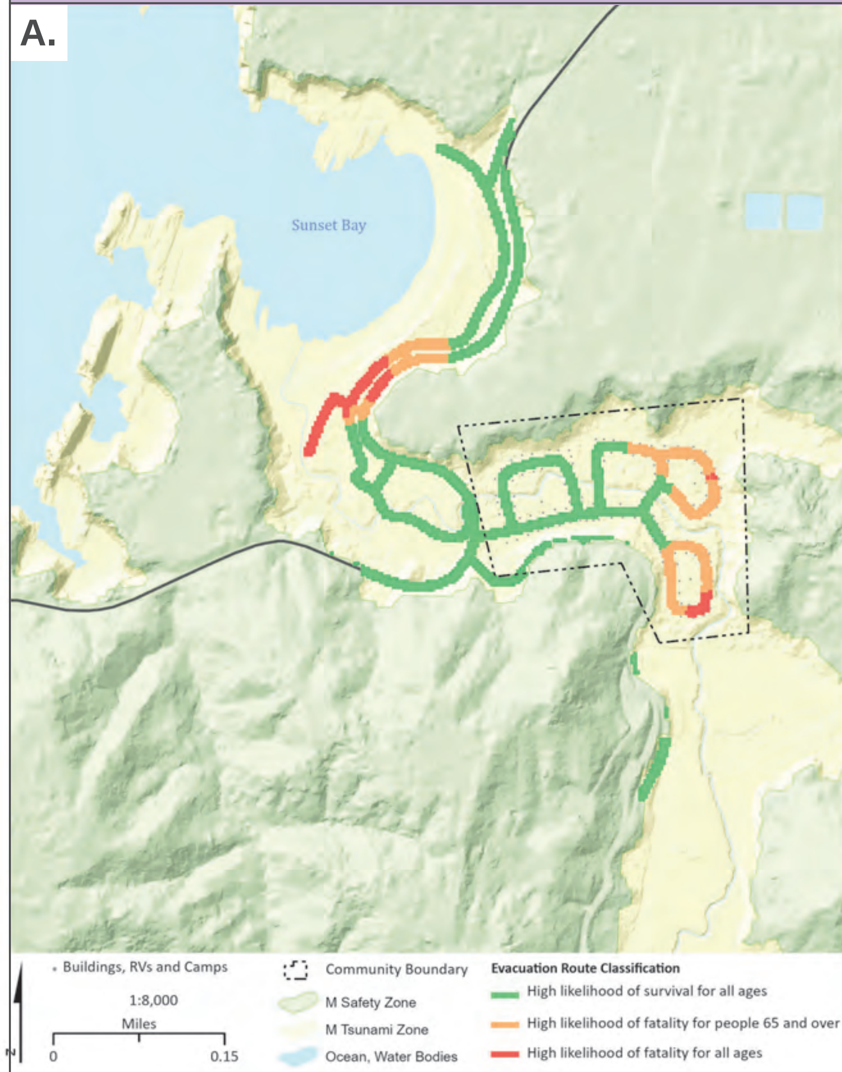


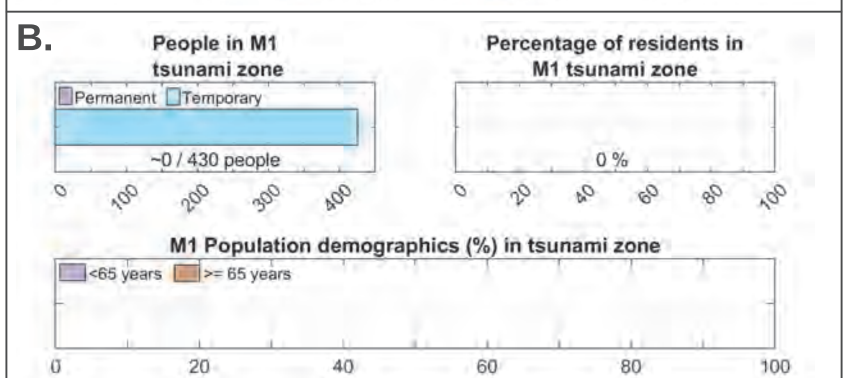


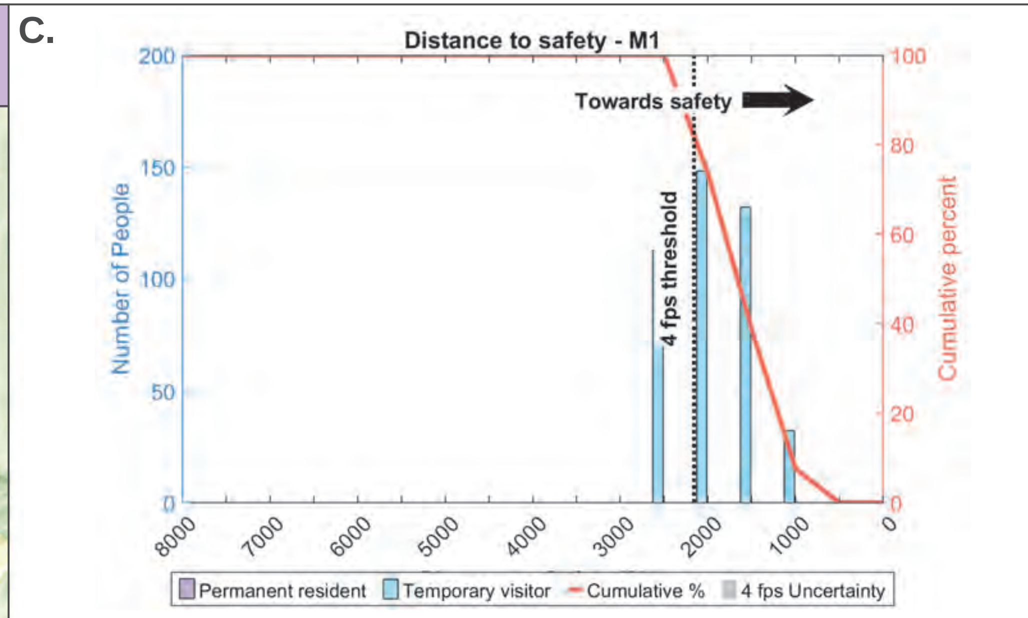
Description	Total
Earthquake Injuries (Entire Community)	14
Tsunami Injuries - Permanent + Temporary	55
Tsunami Fatalities - Permanent	23
Tsunami Fatalities - Temporary @ ~100% occupancy	331
Displaced Population - Permanent	75
Displaced Population - Permanent + Temporary	231

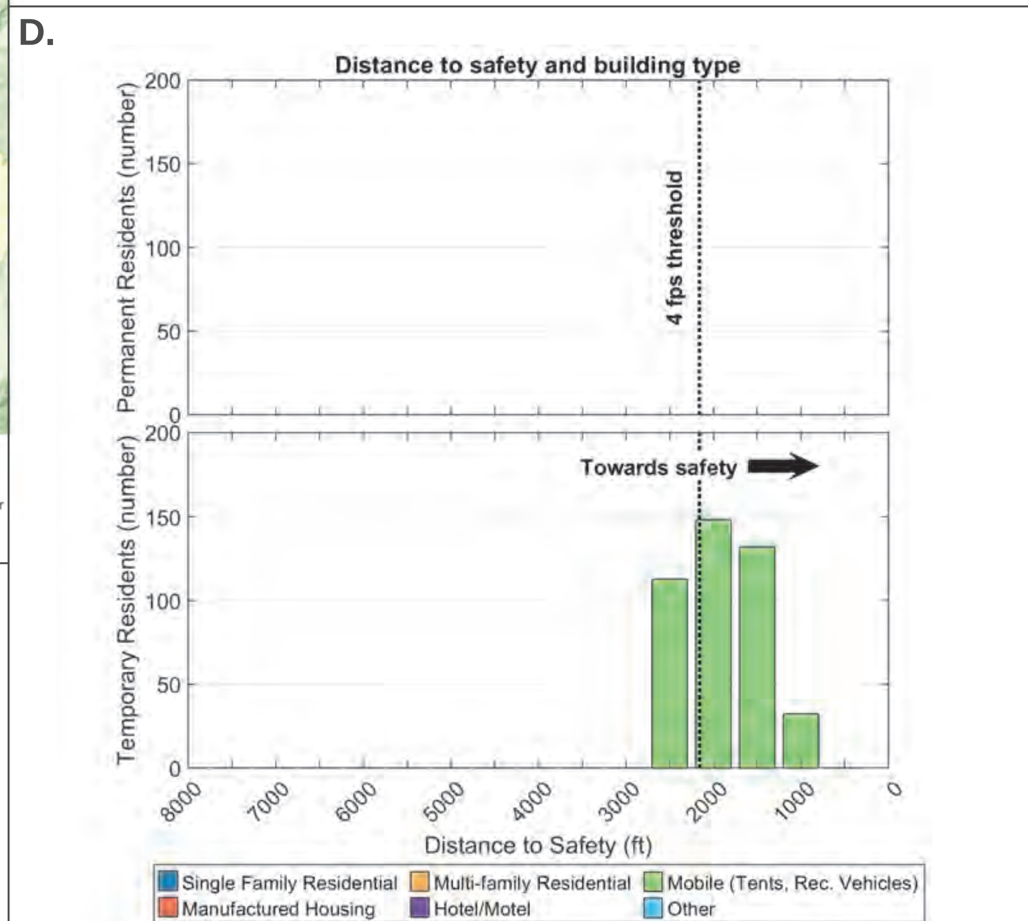
Sunset Bay State Park - M1

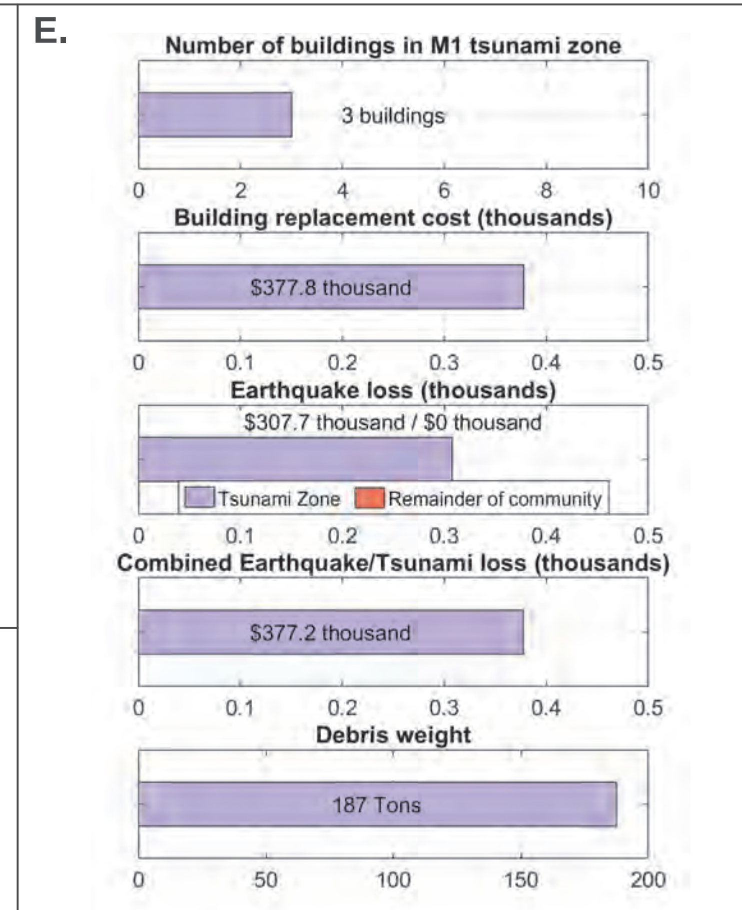
Casualty estimates assume a MODERATE WALK travel speed (4 ft per second)

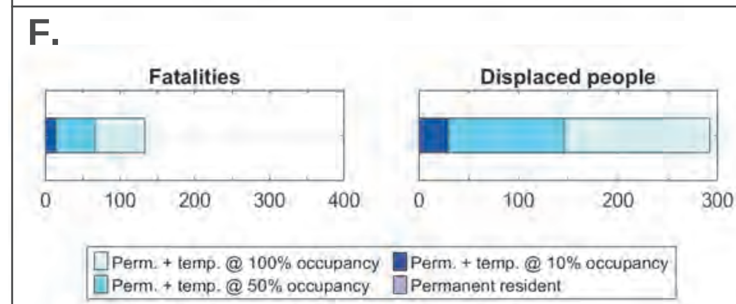










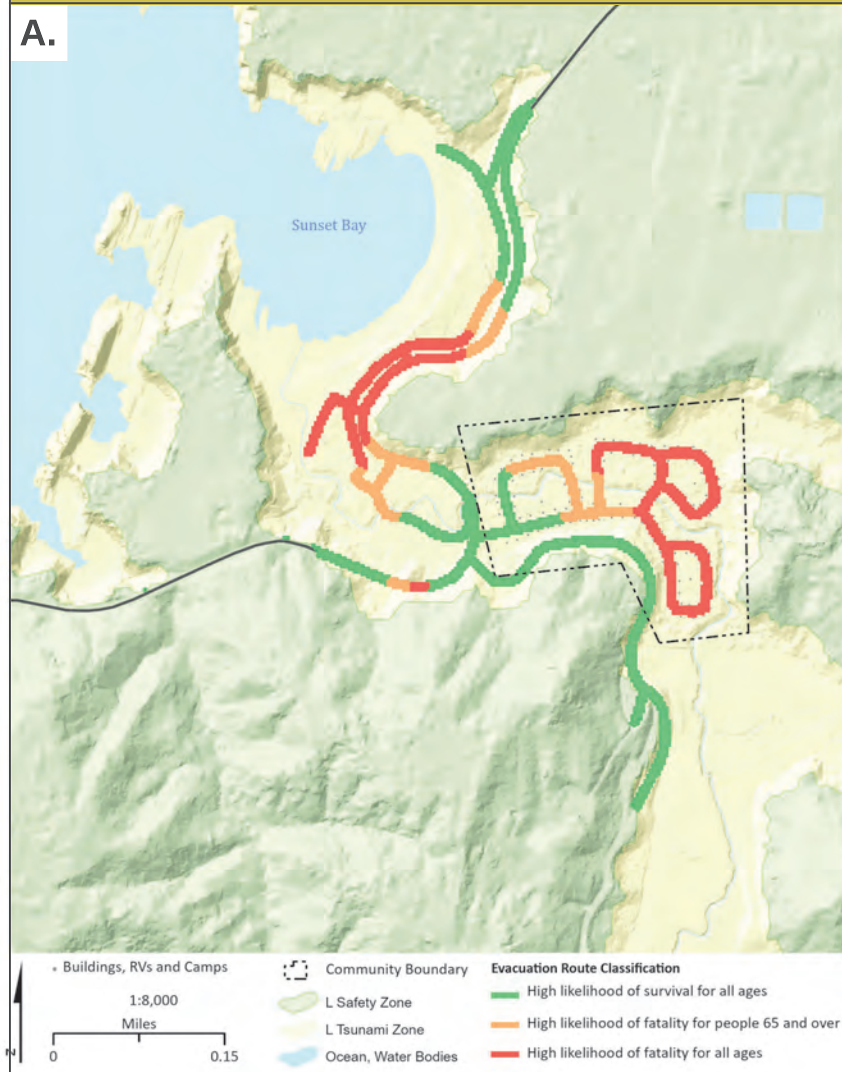


Description	Total
Earthquake Injuries (Entire Community)	0
Tsunami Injuries - Permanent + Temporary	11
Tsunami Fatalities - Permanent	0
Tsunami Fatalities - Temporary @ ~100% occupancy	133
Displaced Population - Permanent	0
Displaced Population - Permanent + Temporary	292

Sunset Bay State Park - L1

Casualty estimates assume a MODERATE WALK travel speed (4 ft per second)

A.



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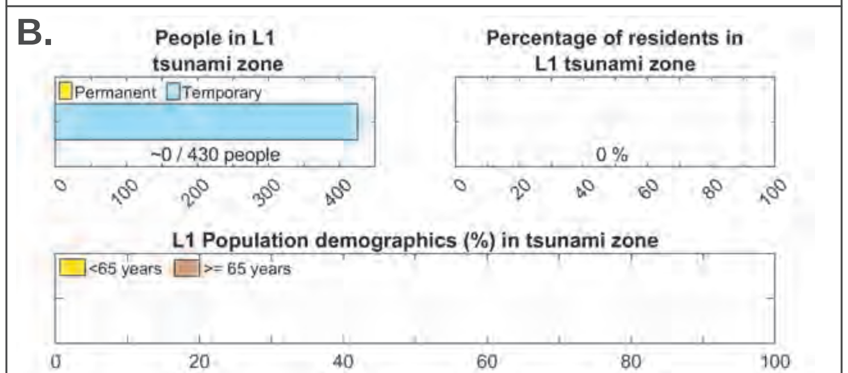

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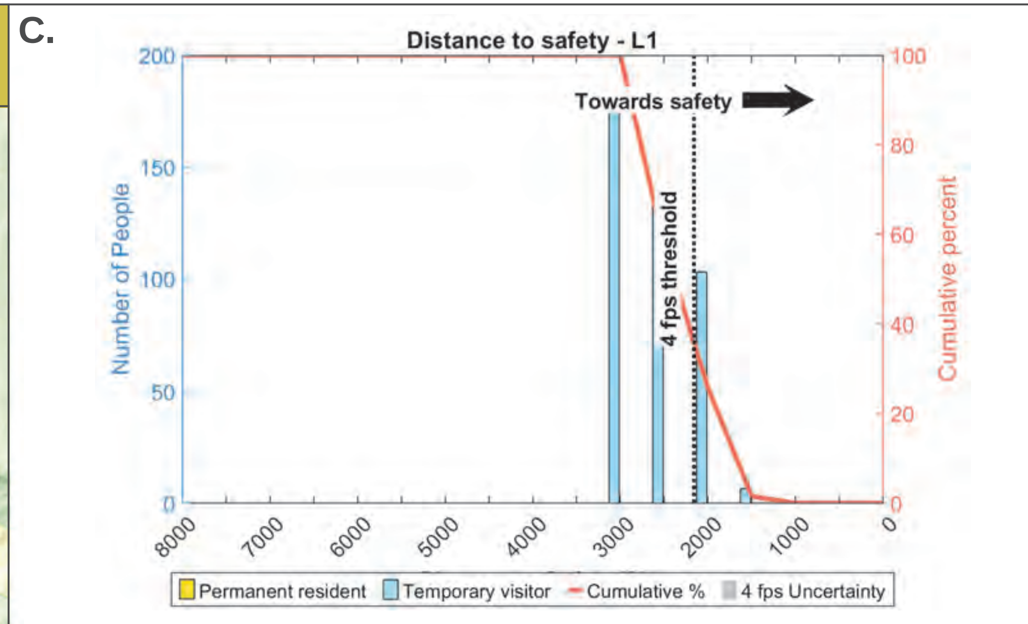

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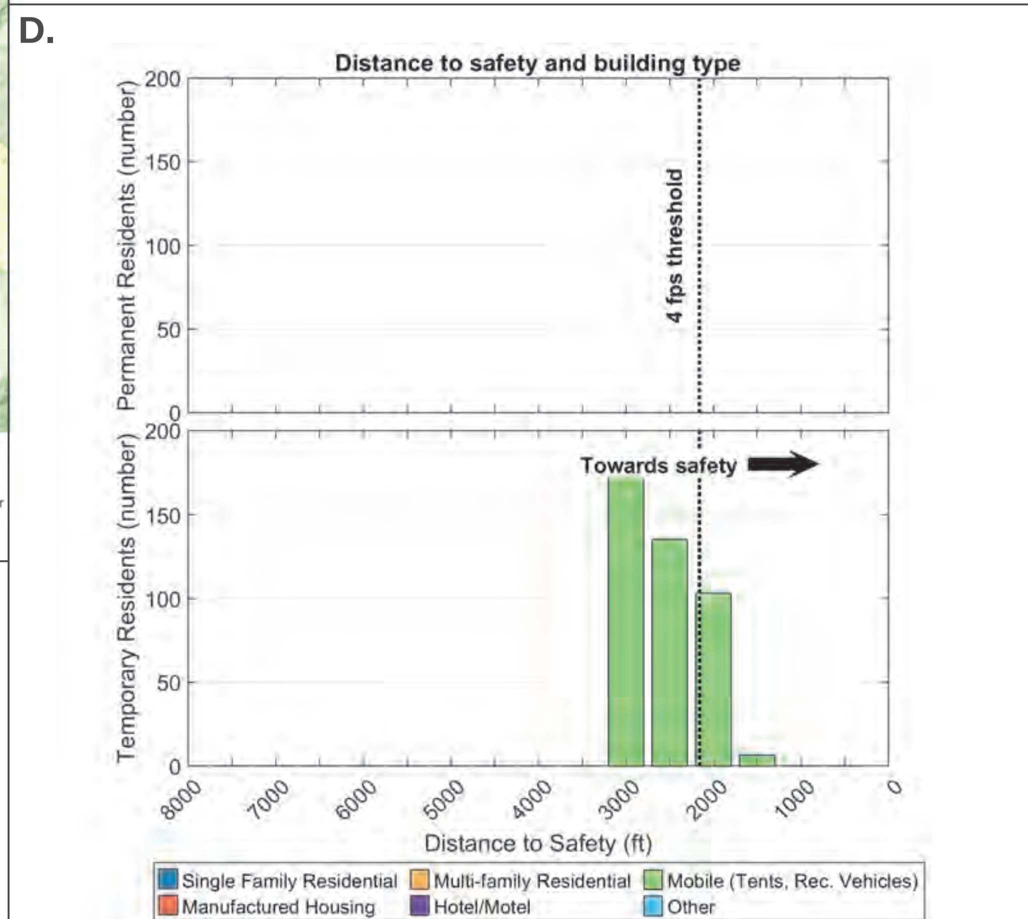

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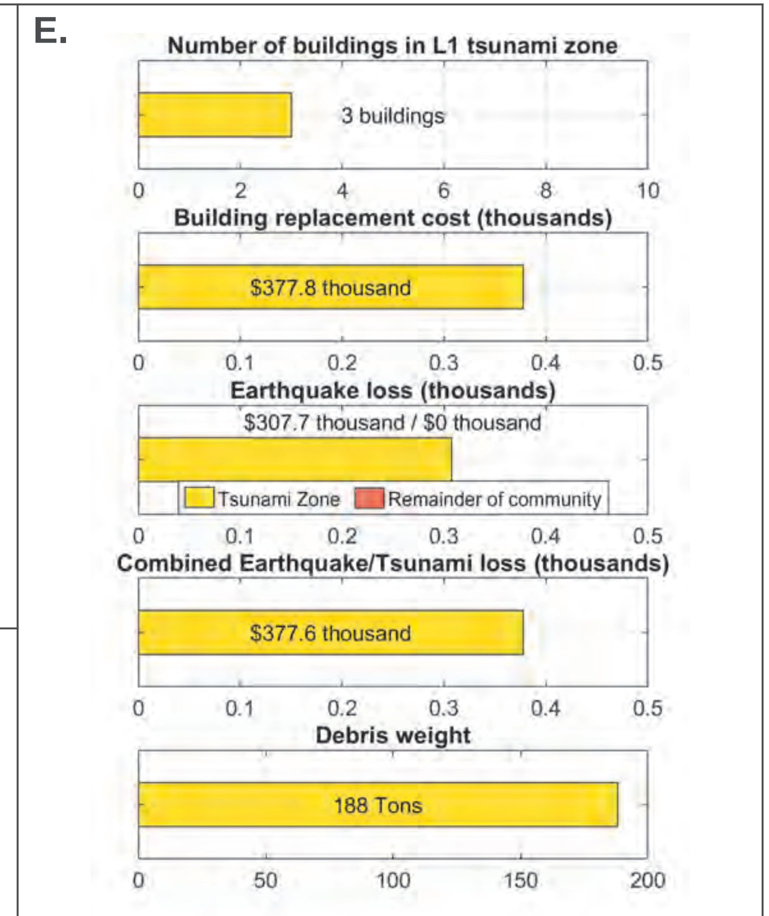

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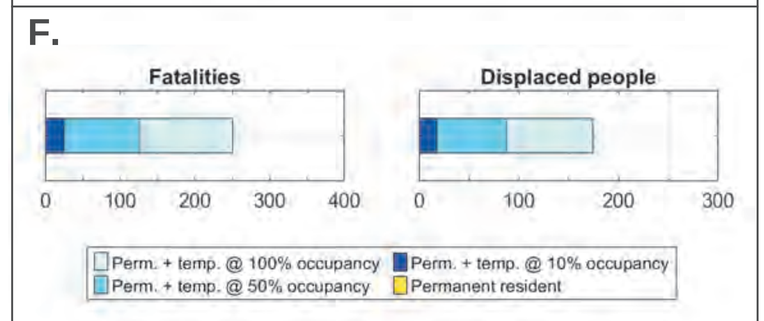
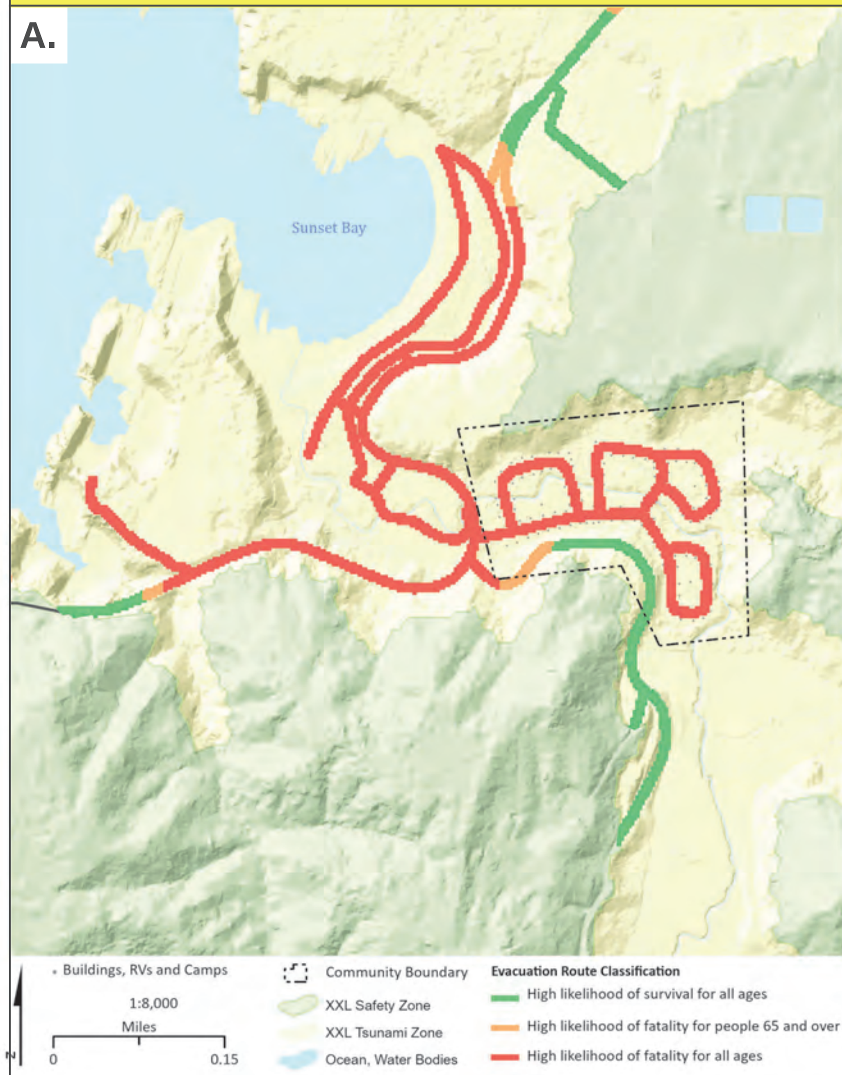


Description	Total
Earthquake Injuries (Entire Community)	0
Tsunami Injuries - Permanent + Temporary	40
Tsunami Fatalities - Permanent	0
Tsunami Fatalities - Temporary @ ~100% occupancy	251
Displaced Population - Permanent	0
Displaced Population - Permanent + Temporary	174

Sunset Bay State Park - XXL1

Casualty estimates assume a MODERATE WALK travel speed (4 ft per second)

A.



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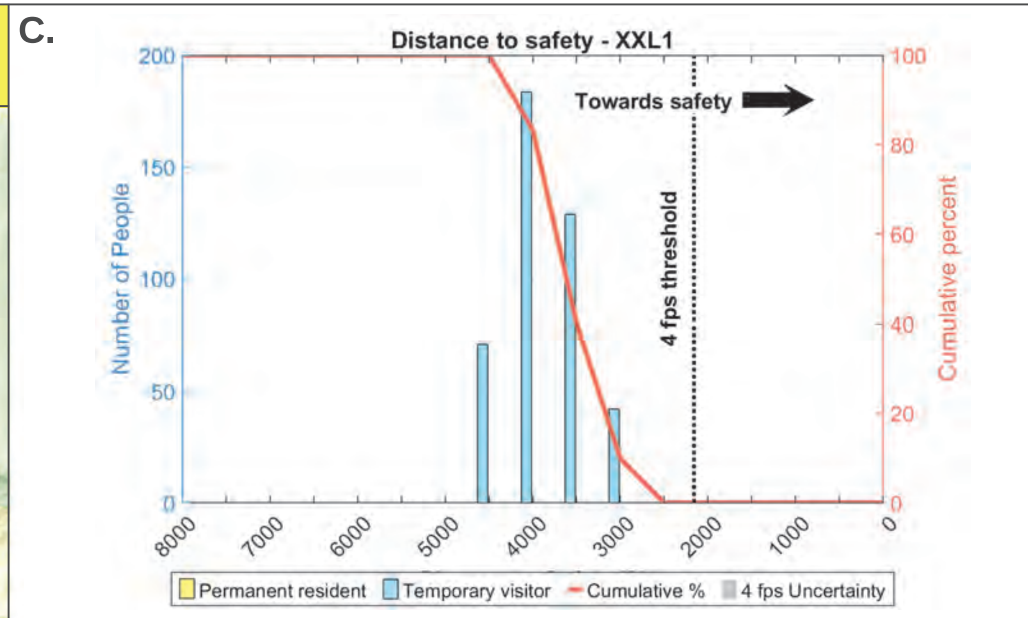

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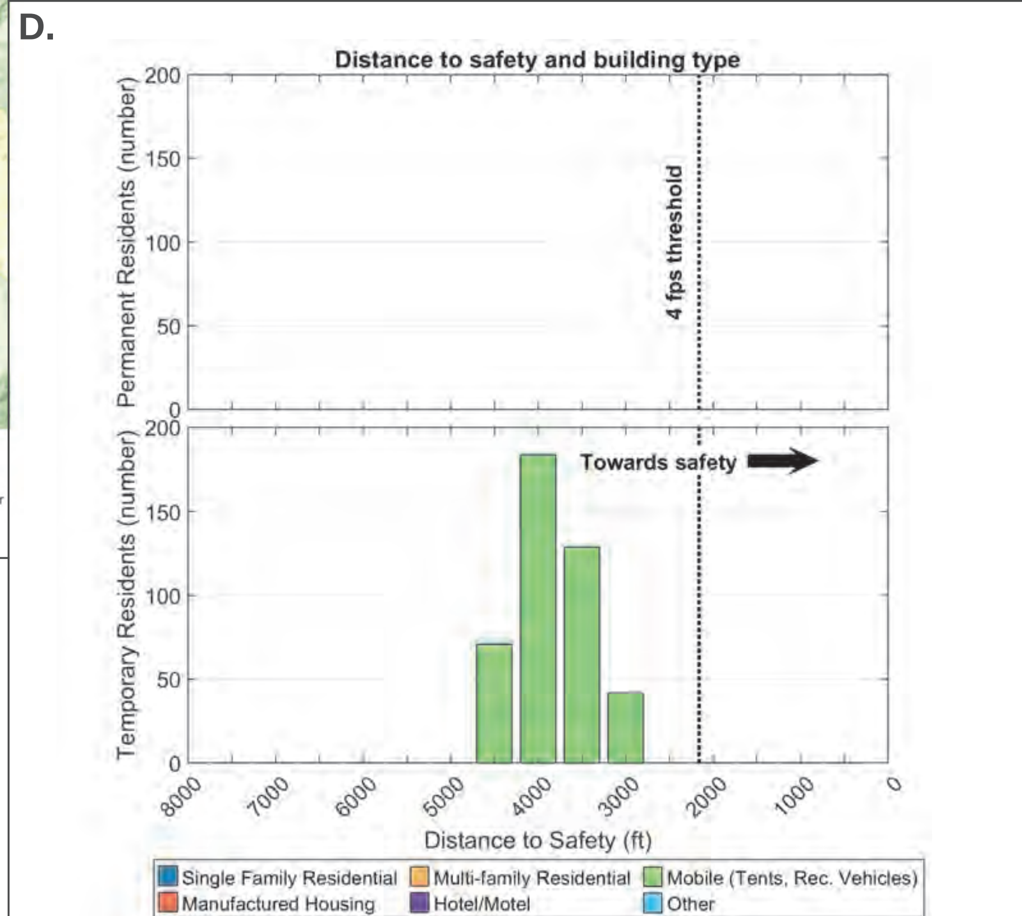

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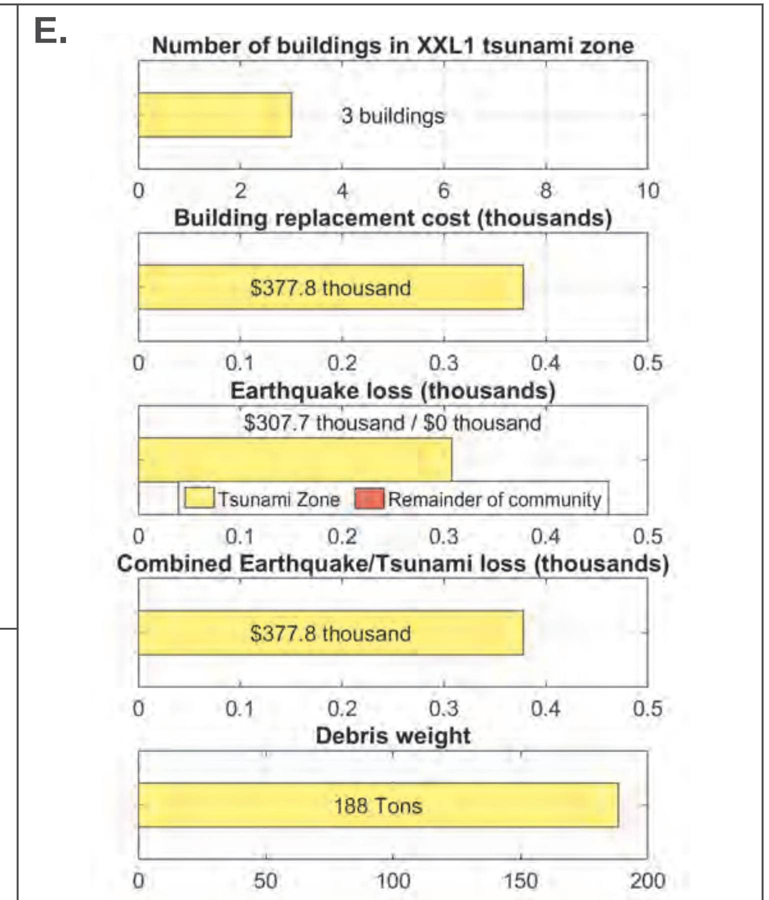

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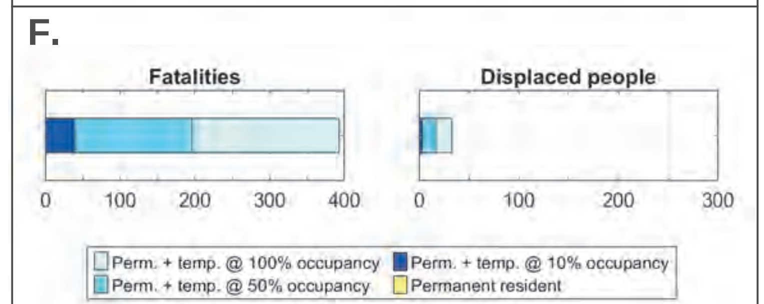

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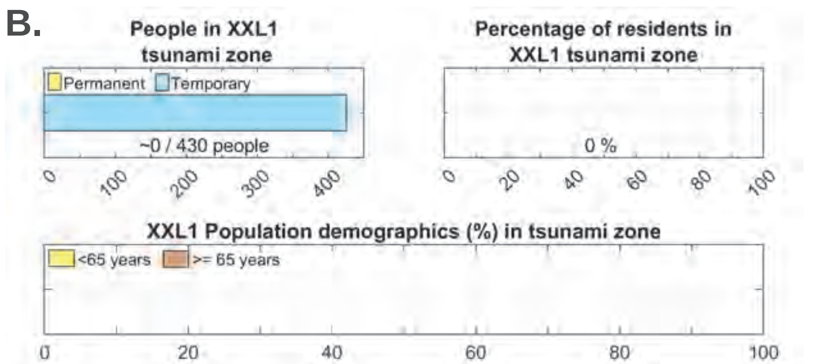
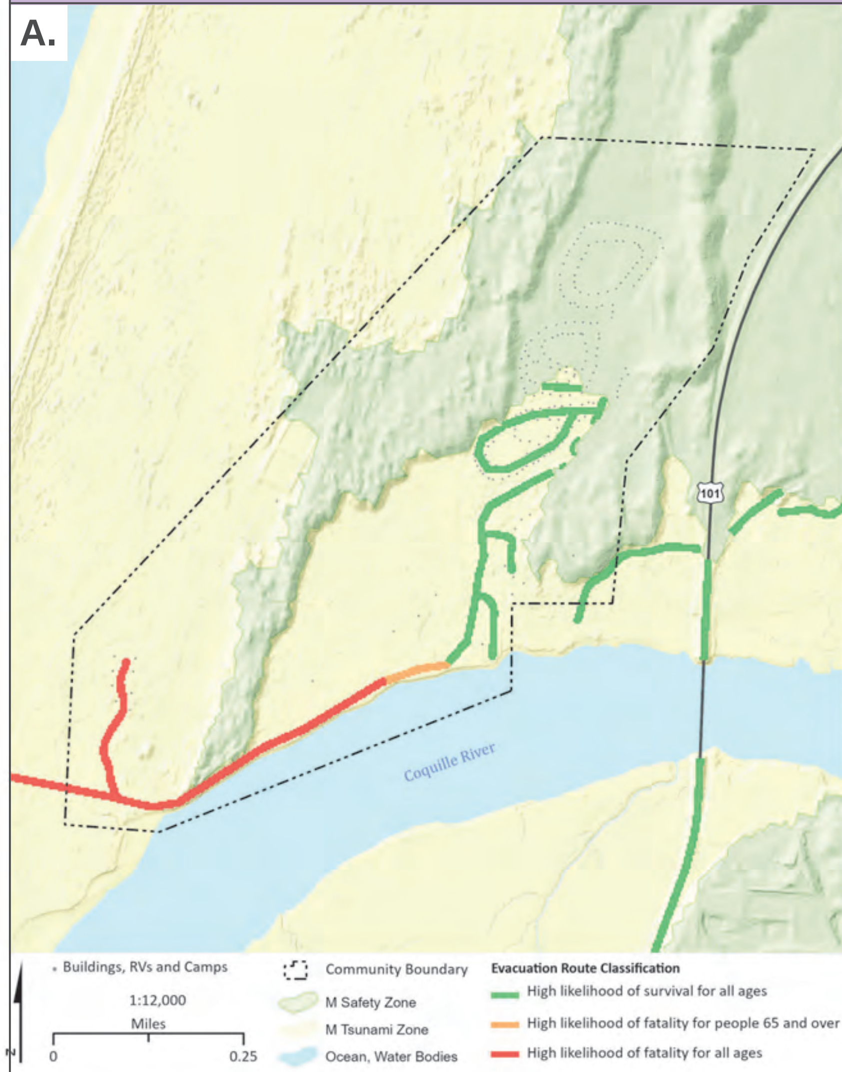


Description	Total
Earthquake Injuries (Entire Community)	0
Tsunami Injuries - Permanent + Temporary	30
Tsunami Fatalities - Permanent	0
Tsunami Fatalities - Temporary @ ~100% occupancy	392
Displaced Population - Permanent	0
Displaced Population - Permanent + Temporary	33

Bullards Beach State Park - M1

Casualty estimates assume a MODERATE WALK travel speed (4 ft per second)

A.



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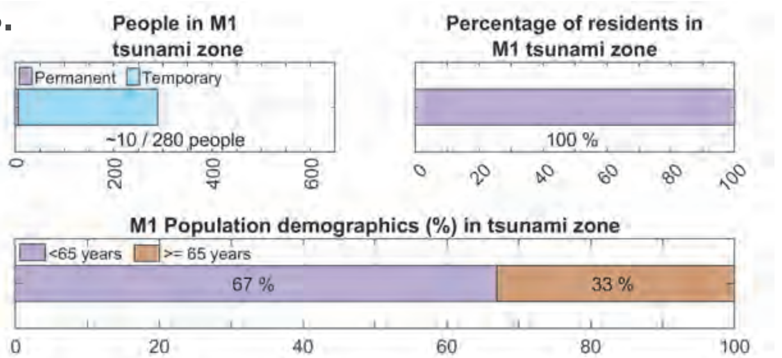

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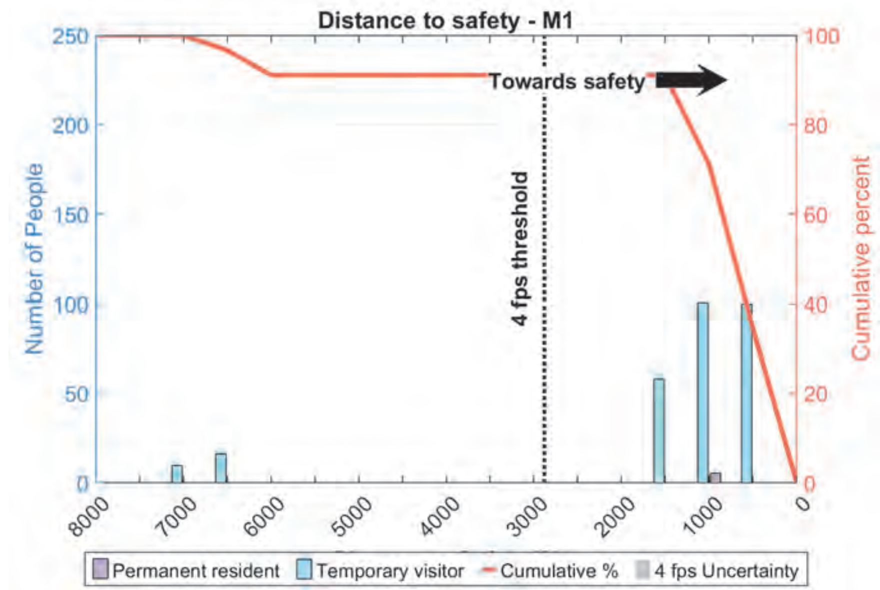

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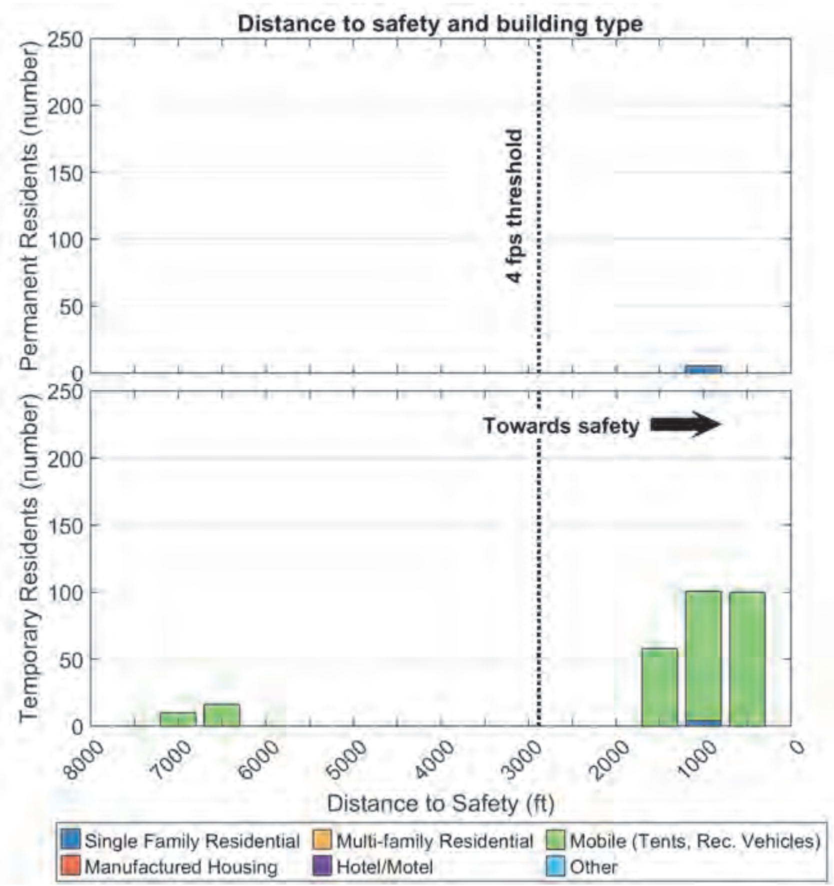

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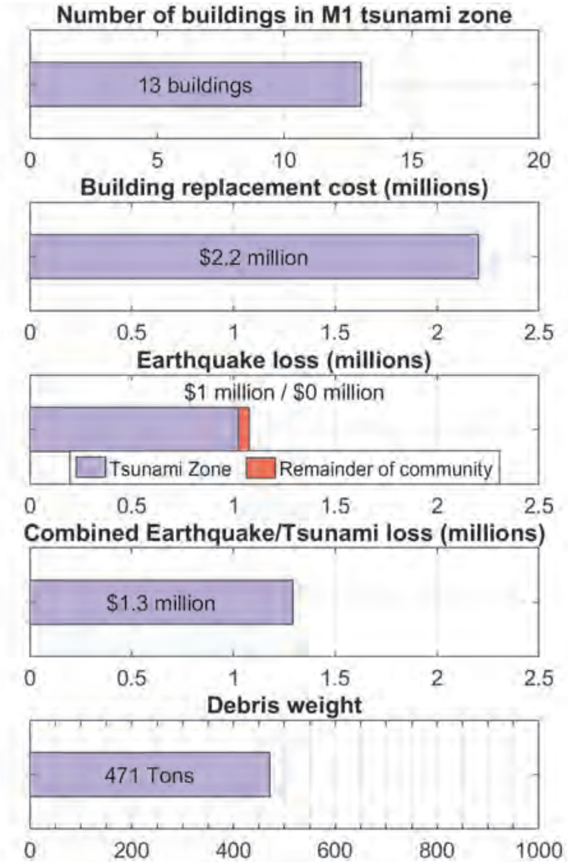

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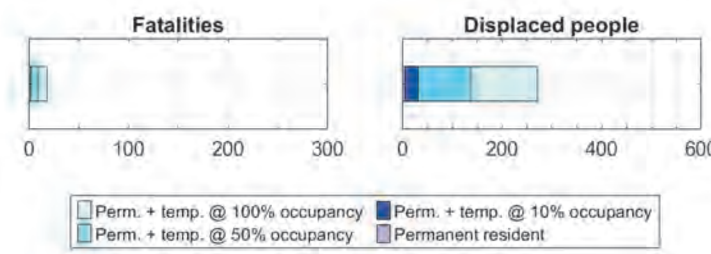
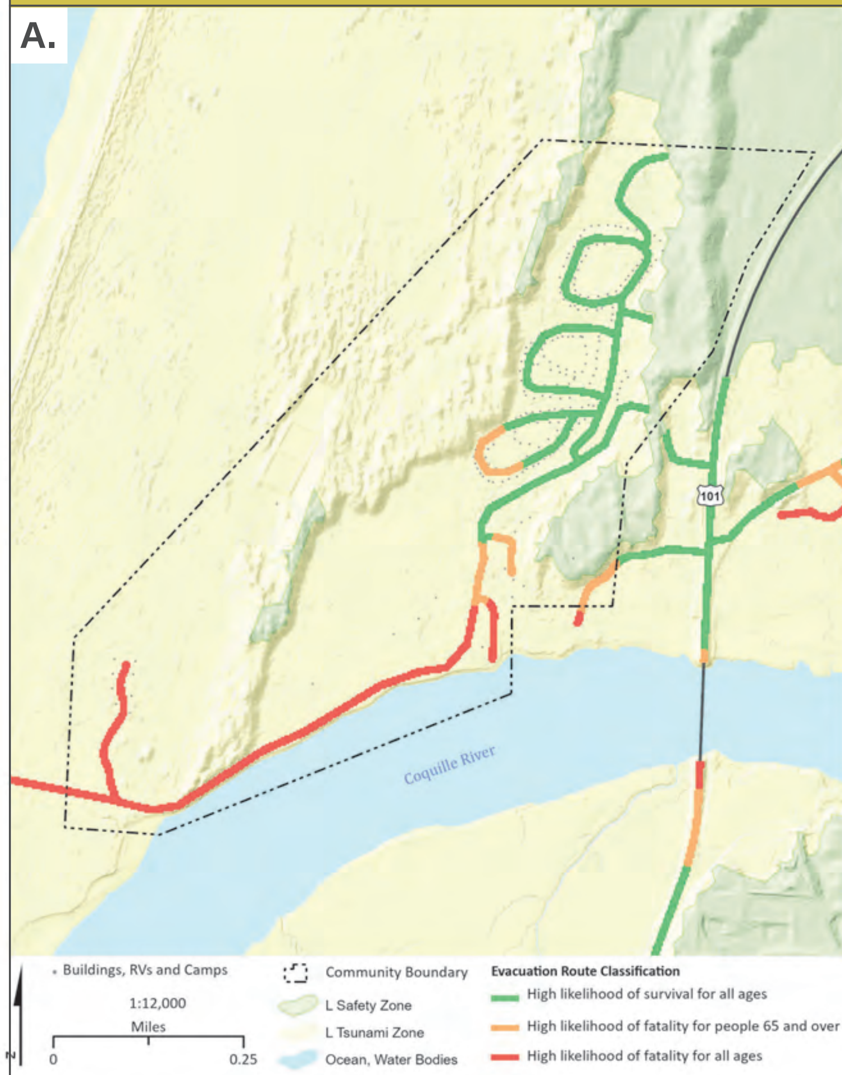
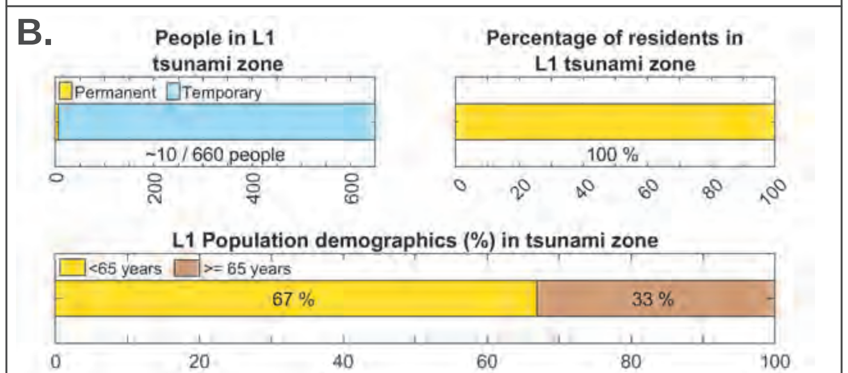


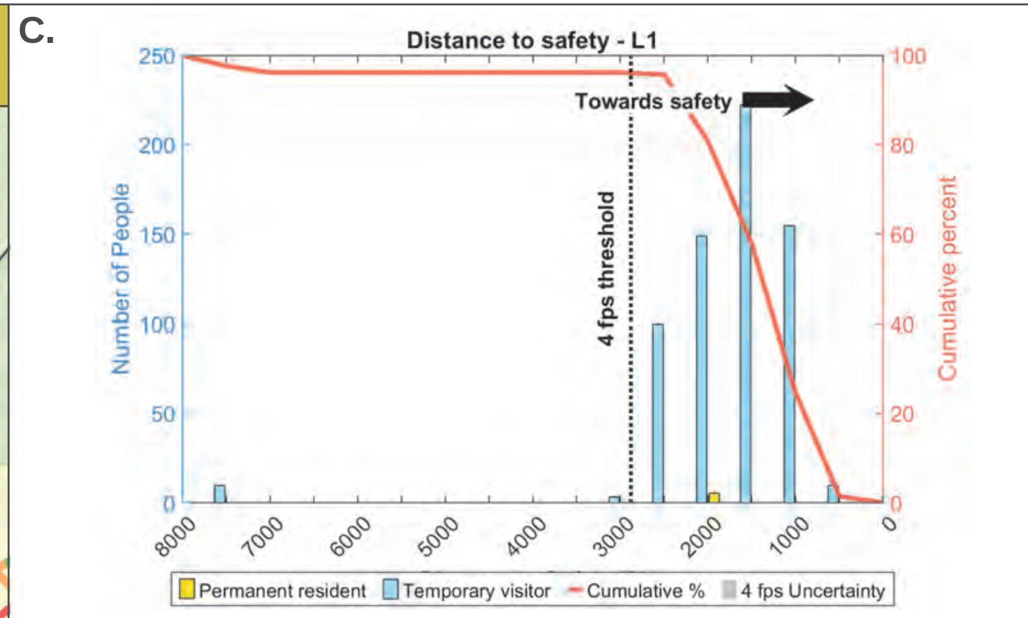
Description	Total
Earthquake Injuries (Entire Community)	0
Tsunami Injuries - Permanent + Temporary	14
Tsunami Fatalities - Permanent	0
Tsunami Fatalities - Temporary @ ~100% occupancy	18
Displaced Population - Permanent	5
Displaced Population - Permanent + Temporary	272

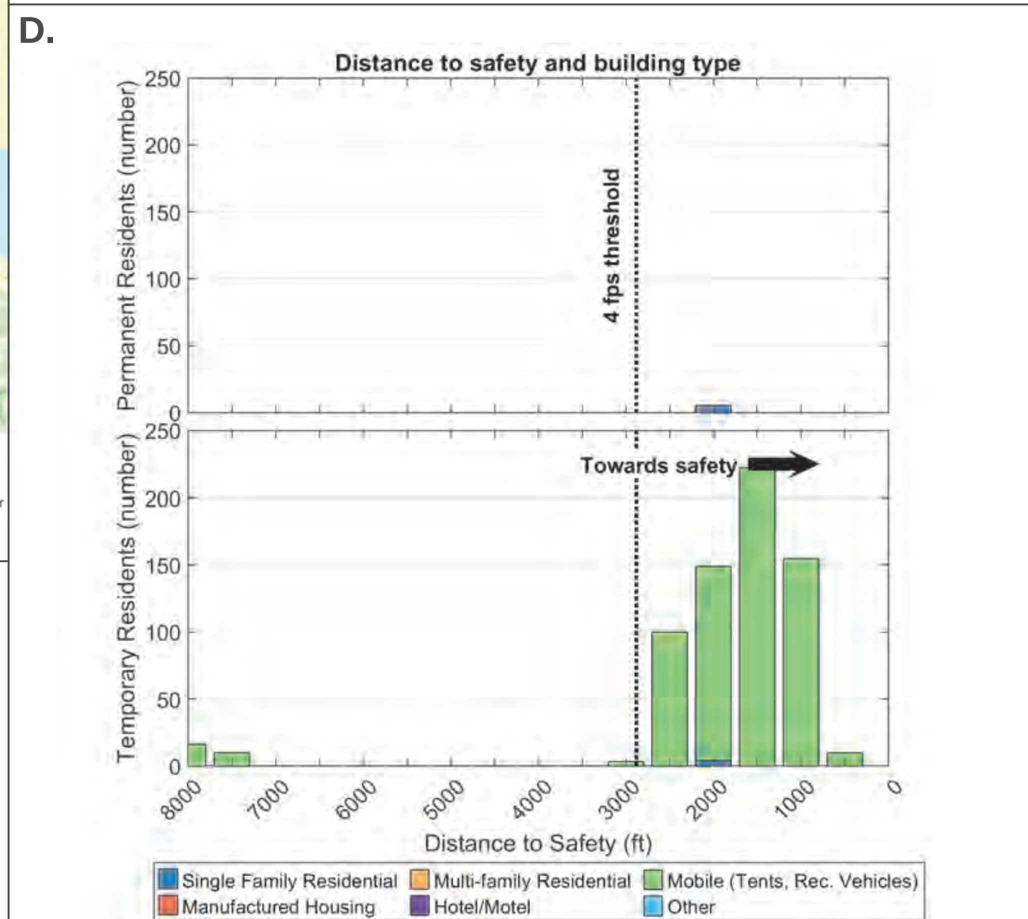
Bullards Beach State Park - L1

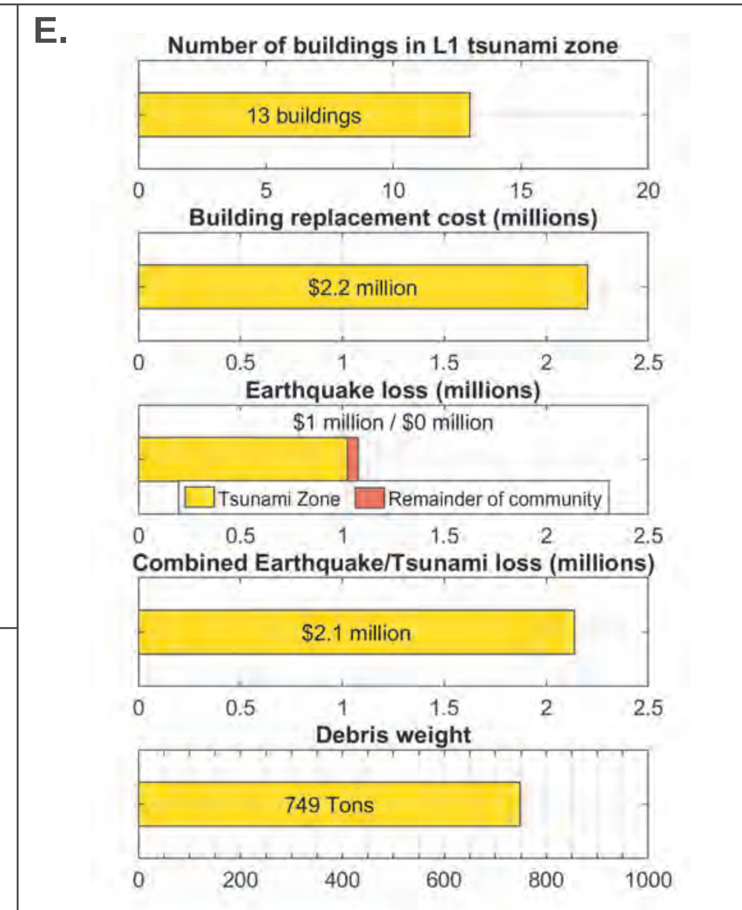
Casualty estimates assume a MODERATE WALK travel speed (4 ft per second)

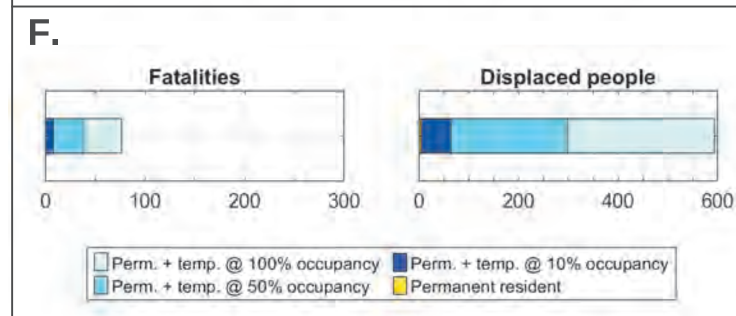










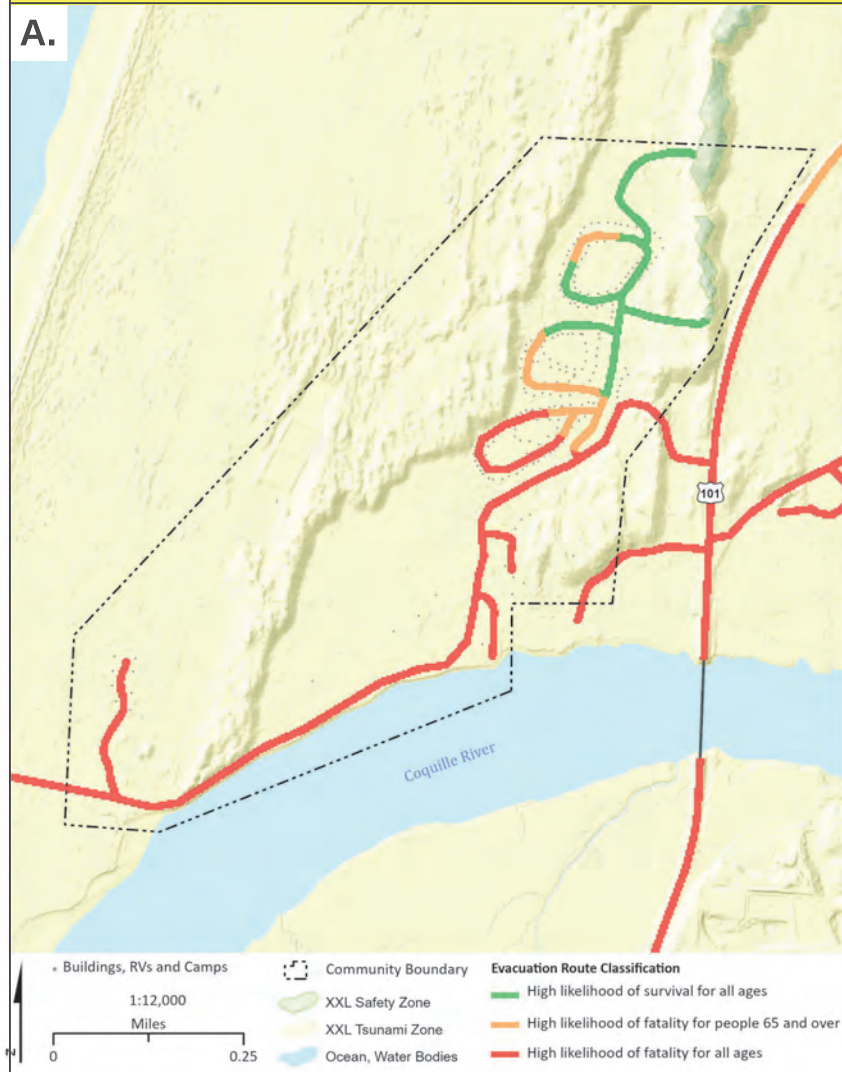


Description	Total
Earthquake Injuries (Entire Community)	0
Tsunami Injuries - Permanent + Temporary	35
Tsunami Fatalities - Permanent	0
Tsunami Fatalities - Temporary @ ~100% occupancy	76
Displaced Population - Permanent	5
Displaced Population - Permanent + Temporary	593

Bullards Beach State Park - XXL1

Casualty estimates assume a MODERATE WALK travel speed (4 ft per second)

A.



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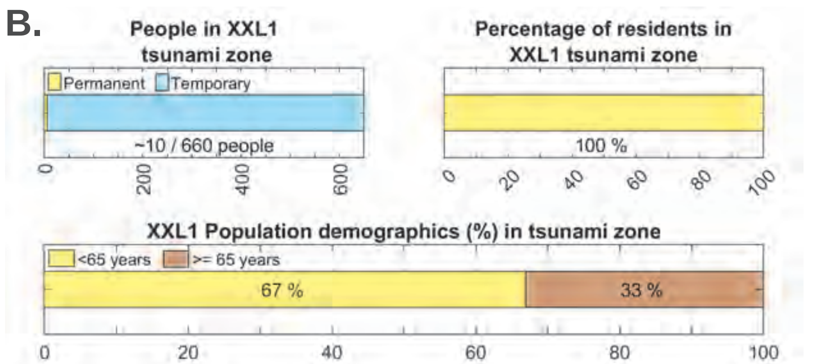

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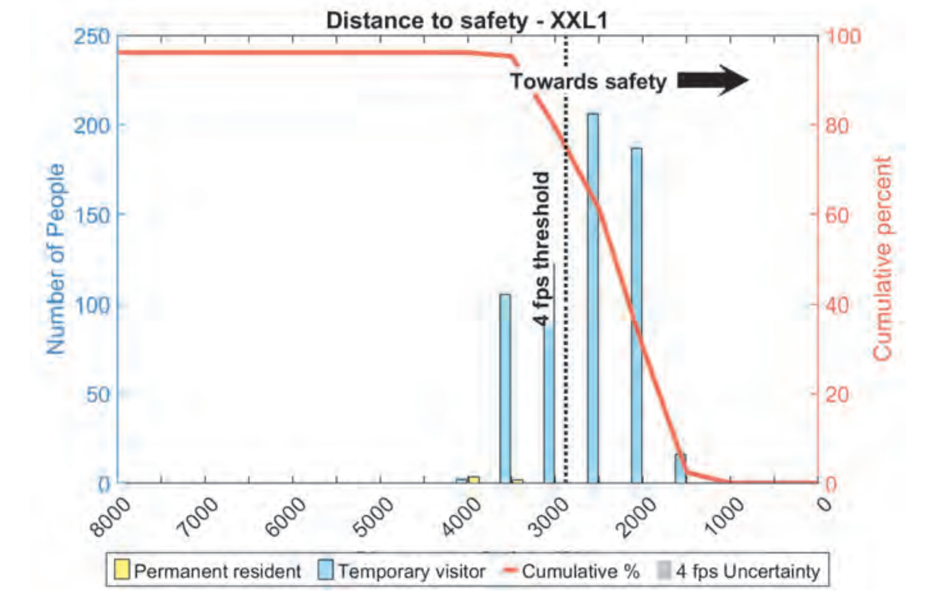

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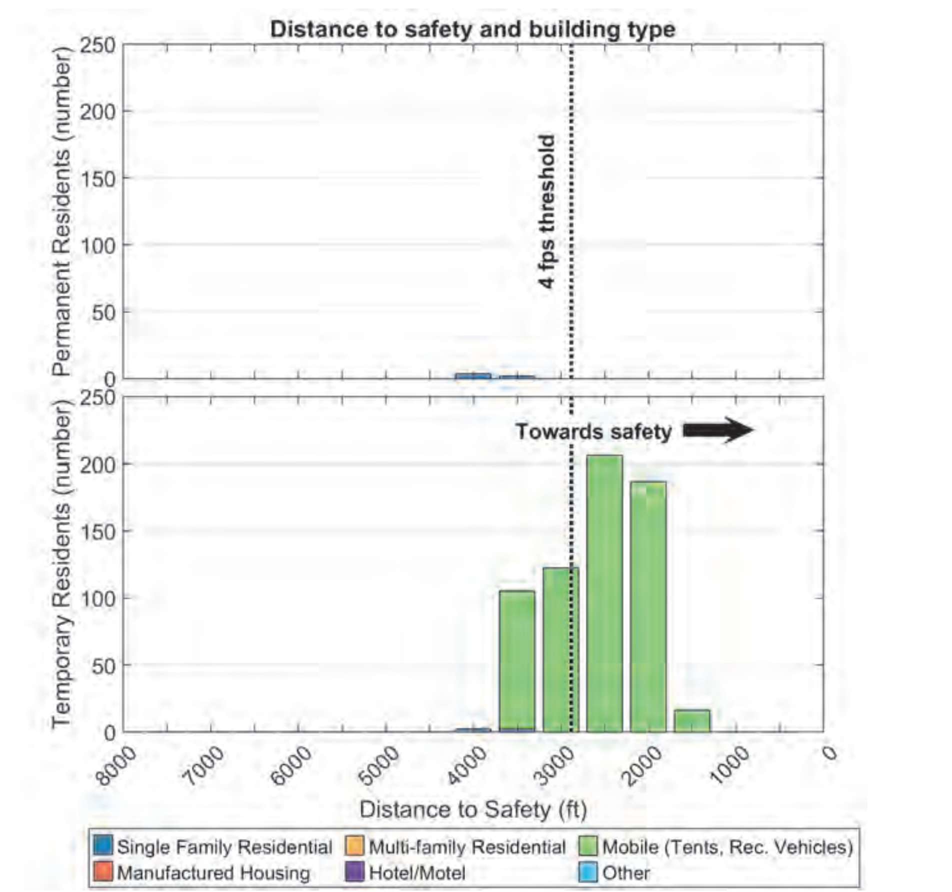

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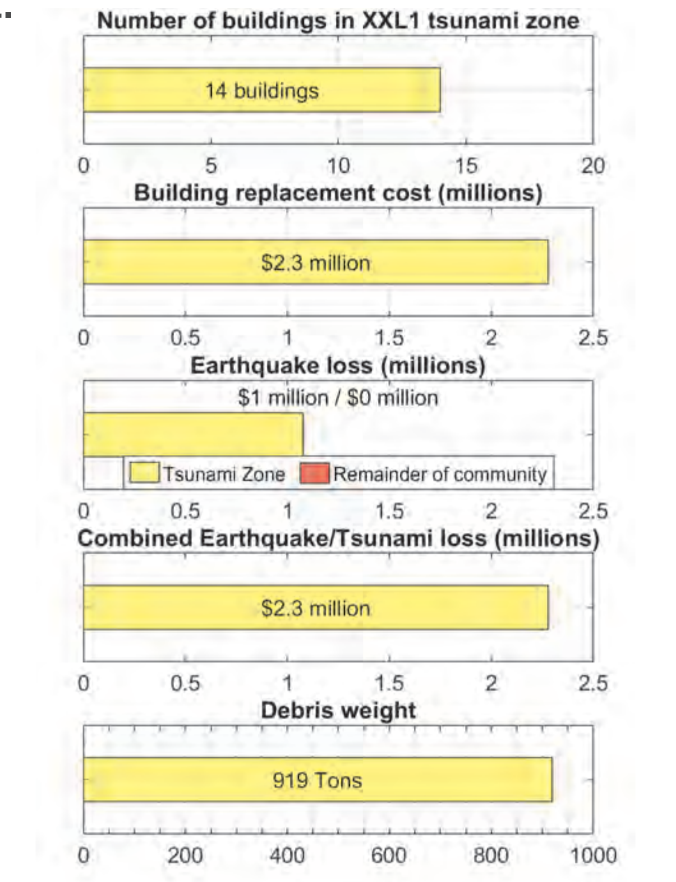

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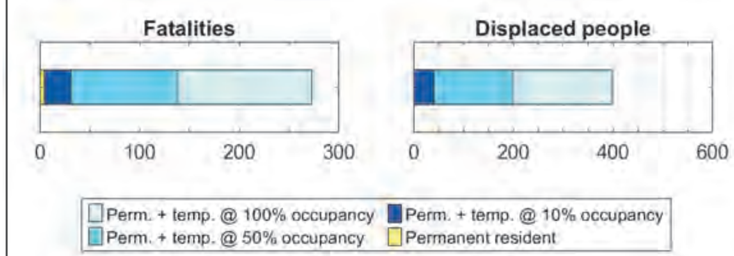


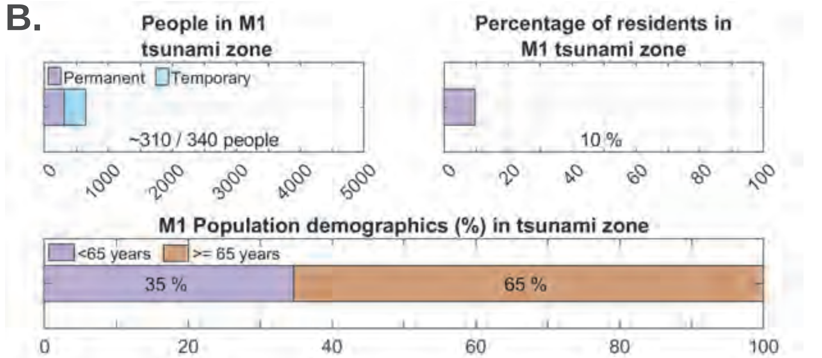
Description	Total
Earthquake Injuries (Entire Community)	0
Tsunami Injuries - Permanent + Temporary	57
Tsunami Fatalities - Permanent	4
Tsunami Fatalities - Temporary @ ~100% occupancy	268
Displaced Population - Permanent	1
Displaced Population - Permanent + Temporary	397

Bandon - M1

Casualty estimates assume a MODERATE WALK travel speed (4 ft per second)

A.

B.



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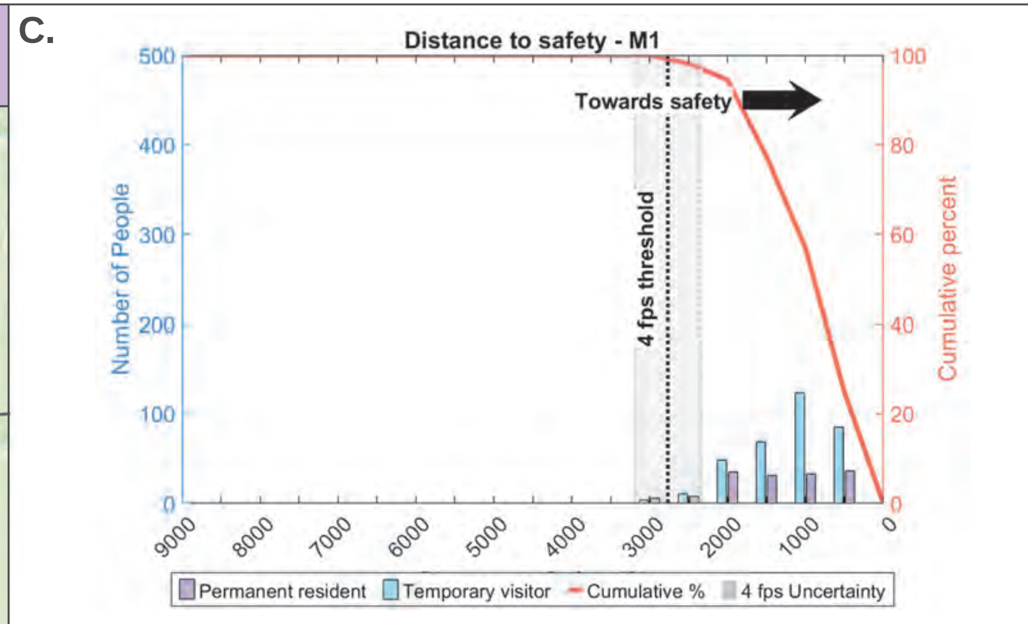

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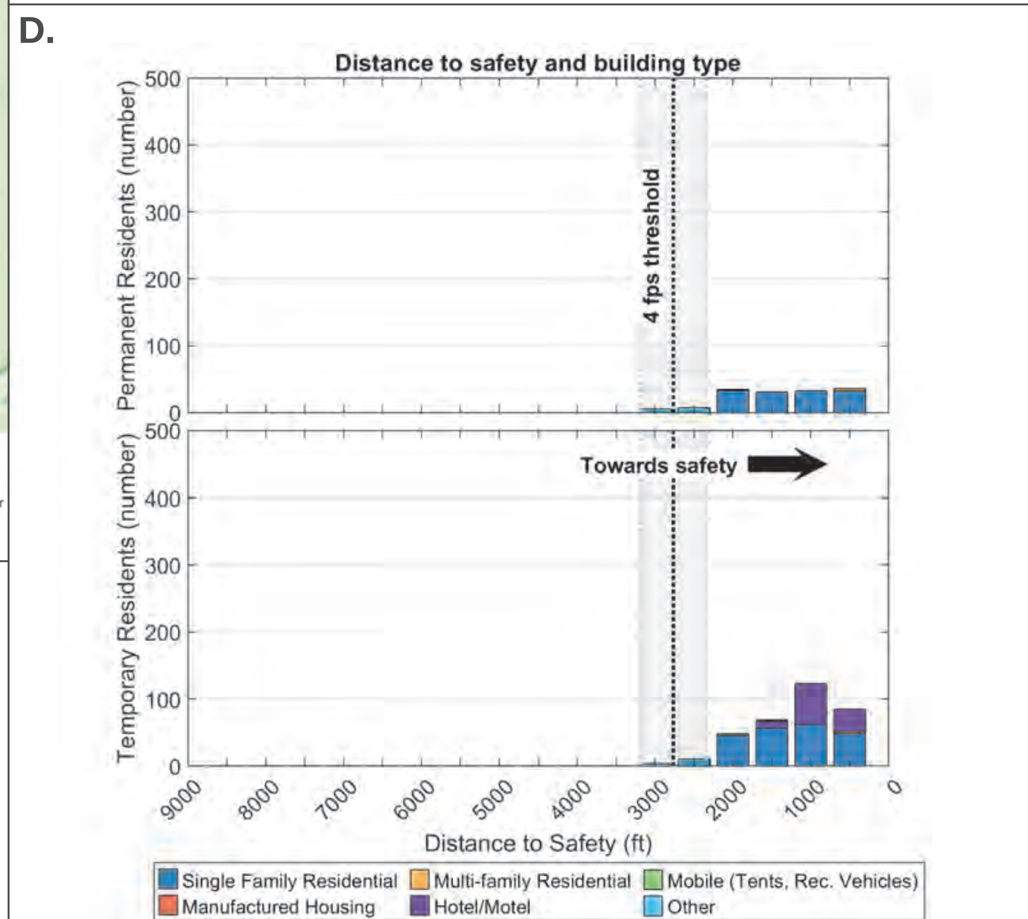

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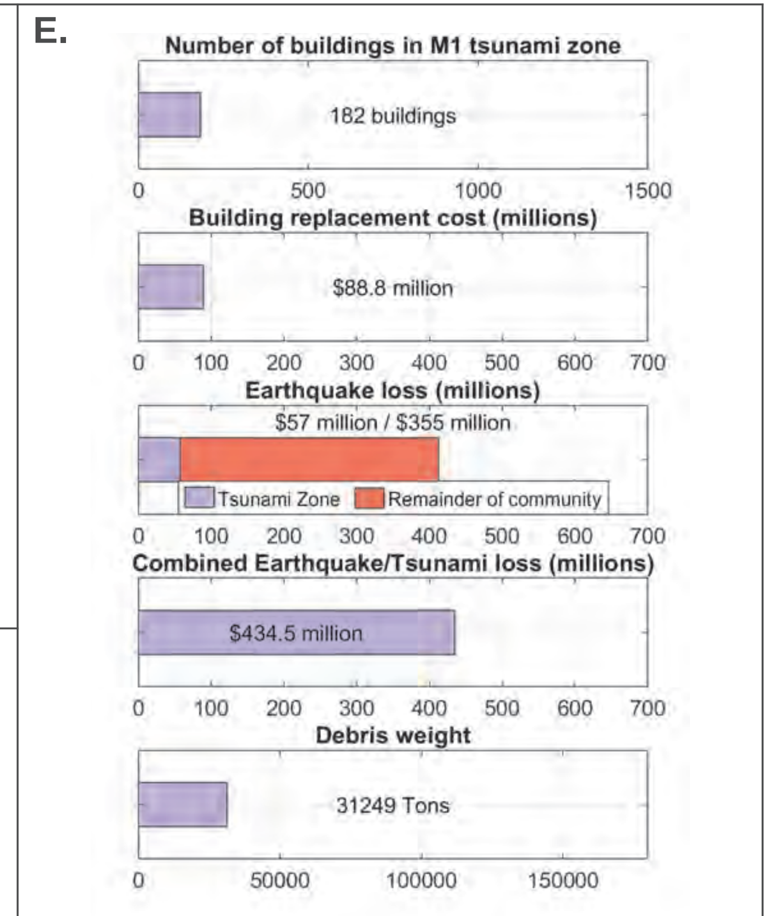

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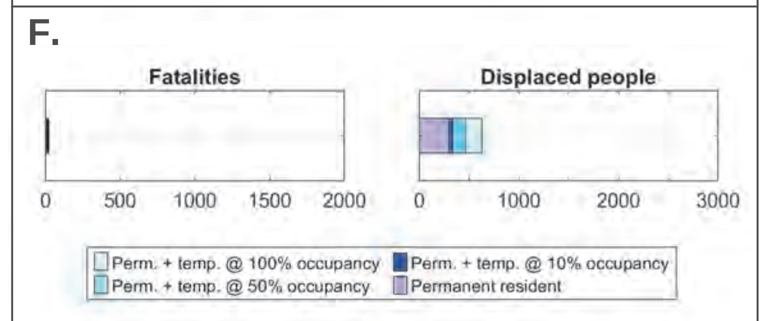
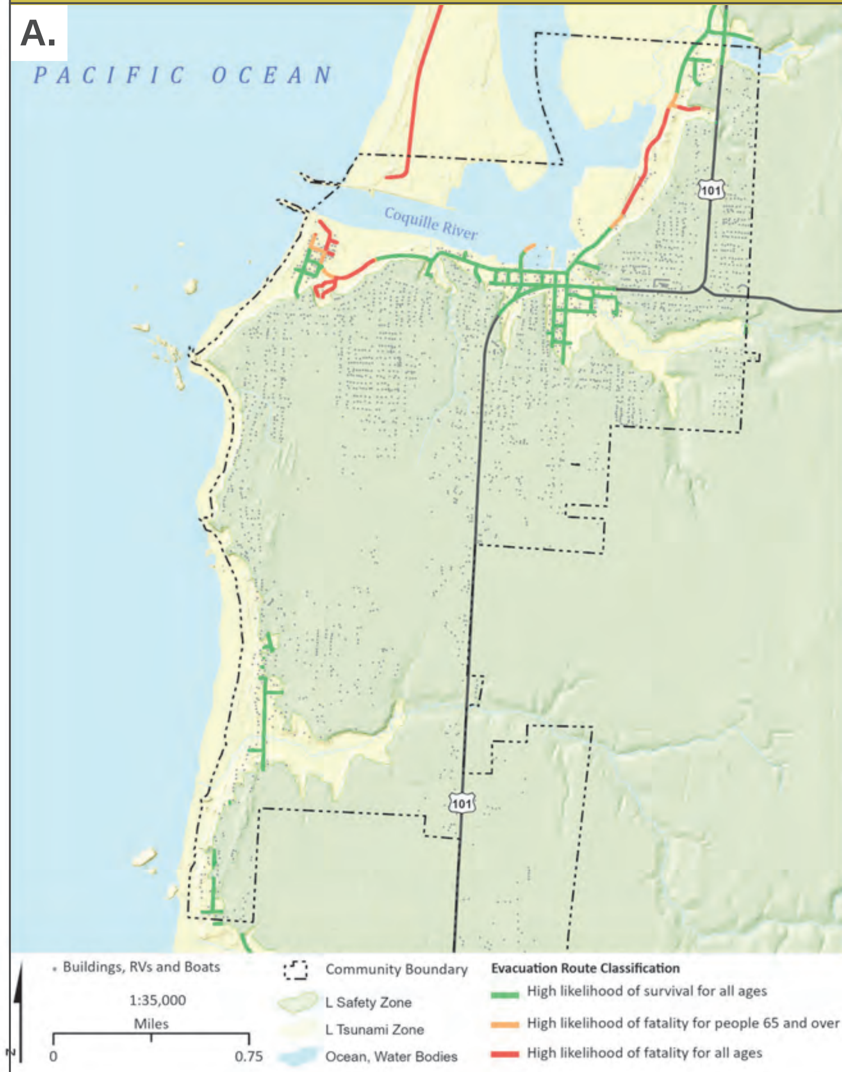
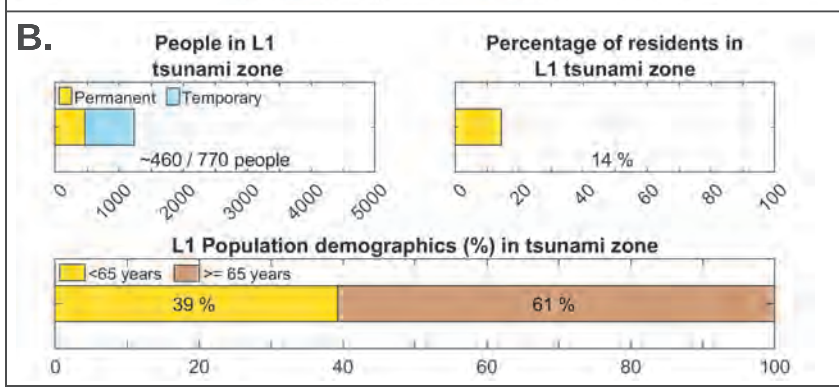


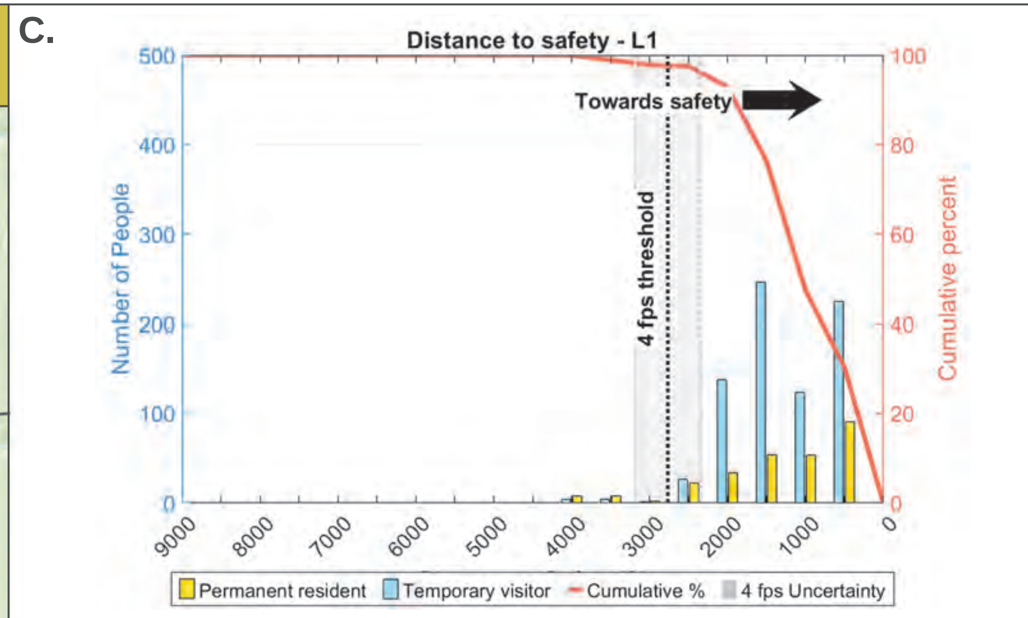
Description	Total
Earthquake Injuries (Entire Community)	215
Tsunami Injuries - Permanent + Temporary	9
Tsunami Fatalities - Permanent	9
Tsunami Fatalities - Temporary @ ~100% occupancy	13
Displaced Population - Permanent	301
Displaced Population - Permanent + Temporary	627

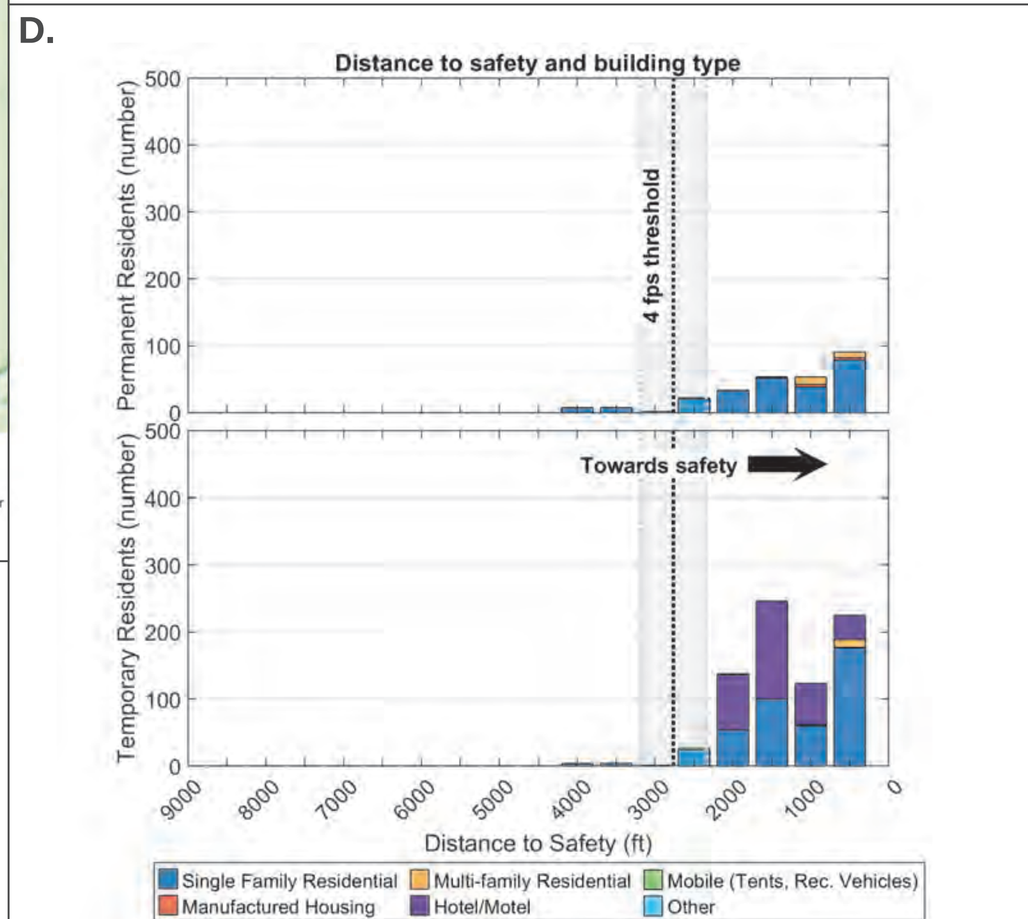
Bandon - L1

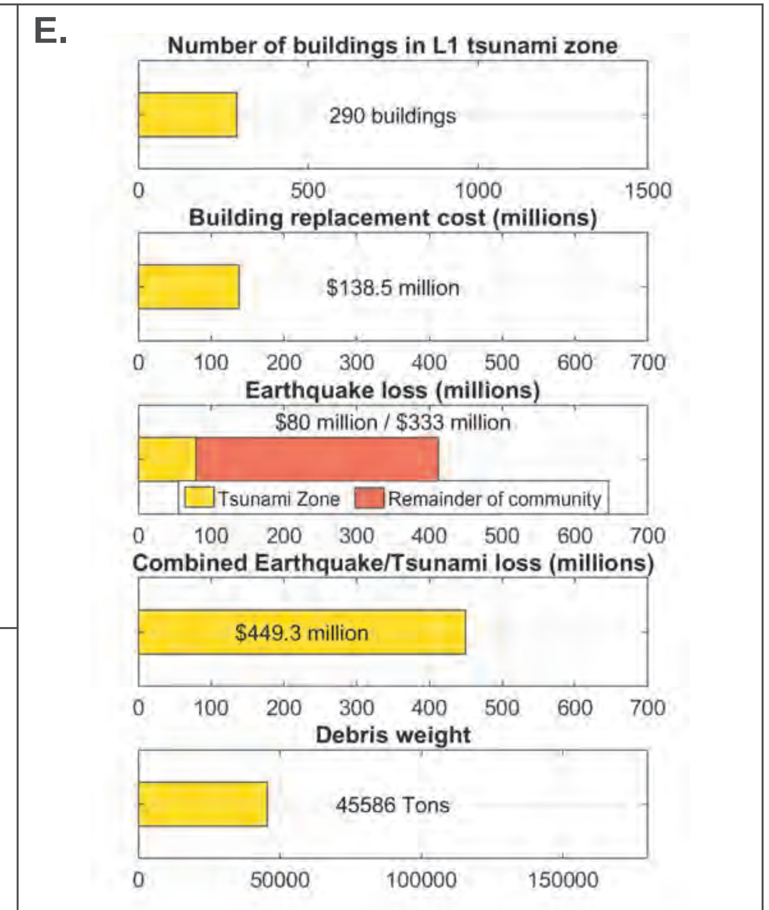
Casualty estimates assume a MODERATE WALK travel speed (4 ft per second)

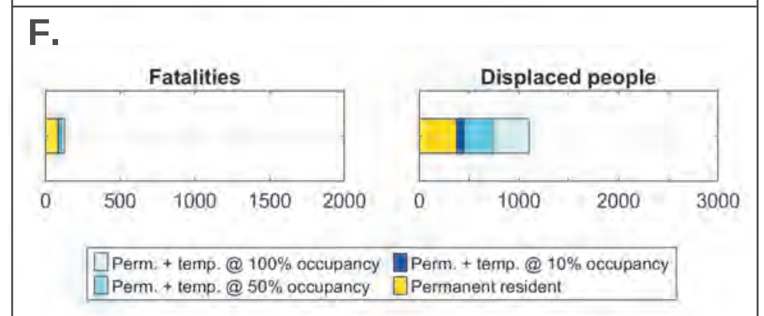










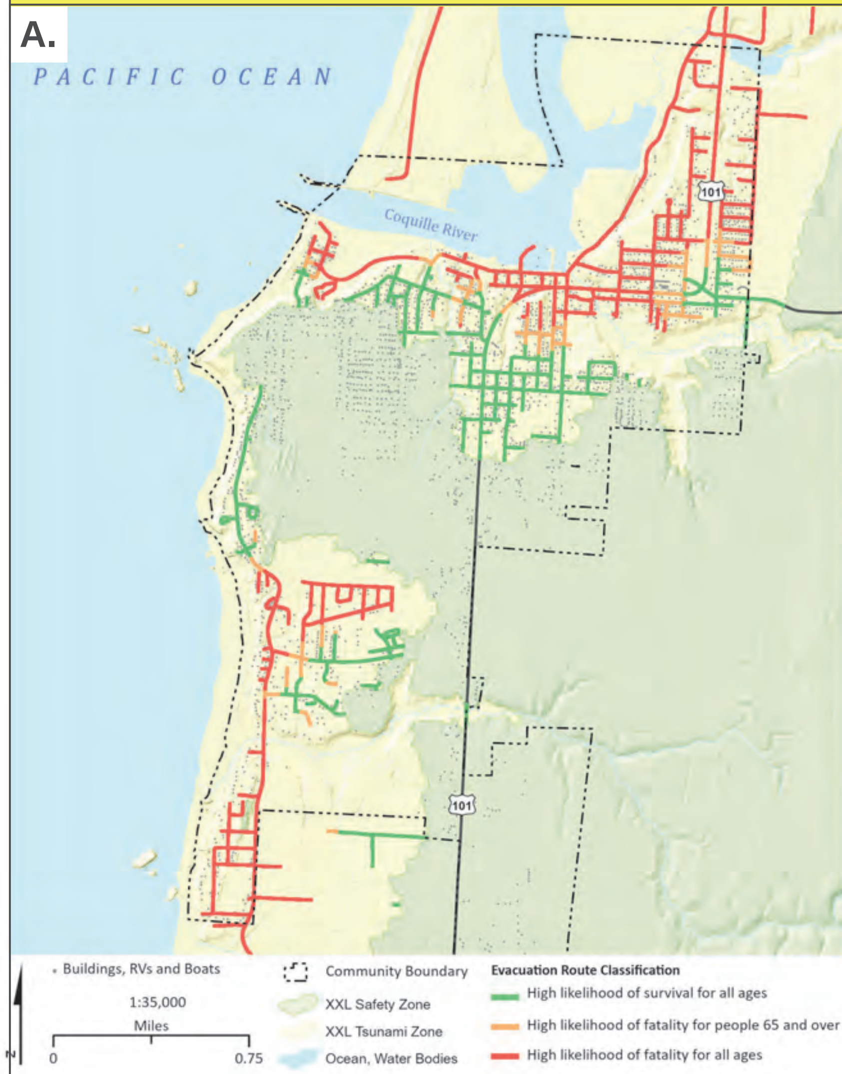


Description	Total
Earthquake Injuries (Entire Community)	215
Tsunami Injuries - Permanent + Temporary	73
Tsunami Fatalities - Permanent	86
Tsunami Fatalities - Temporary @ ~100% occupancy	42
Displaced Population - Permanent	379
Displaced Population - Permanent + Temporary	1,103

Bandon - XXL1

Casualty estimates assume a MODERATE WALK travel speed (4 ft per second)

A.



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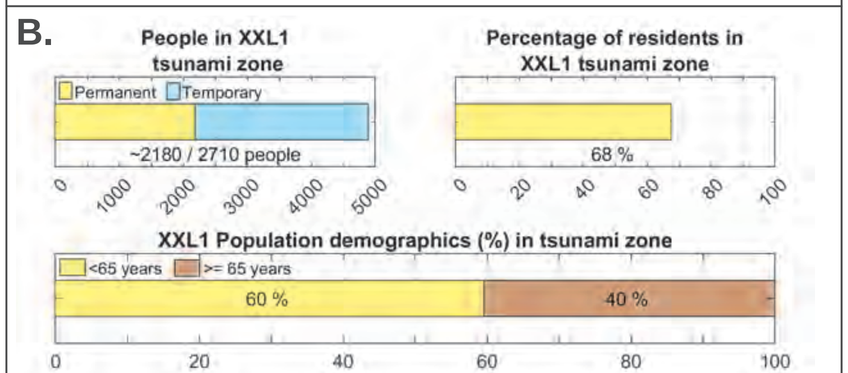

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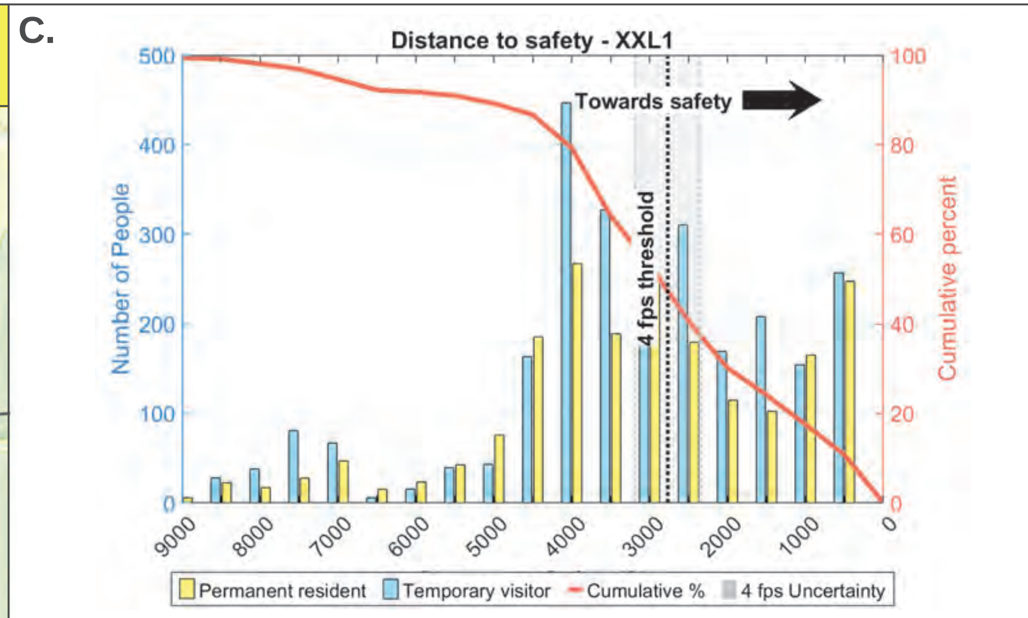

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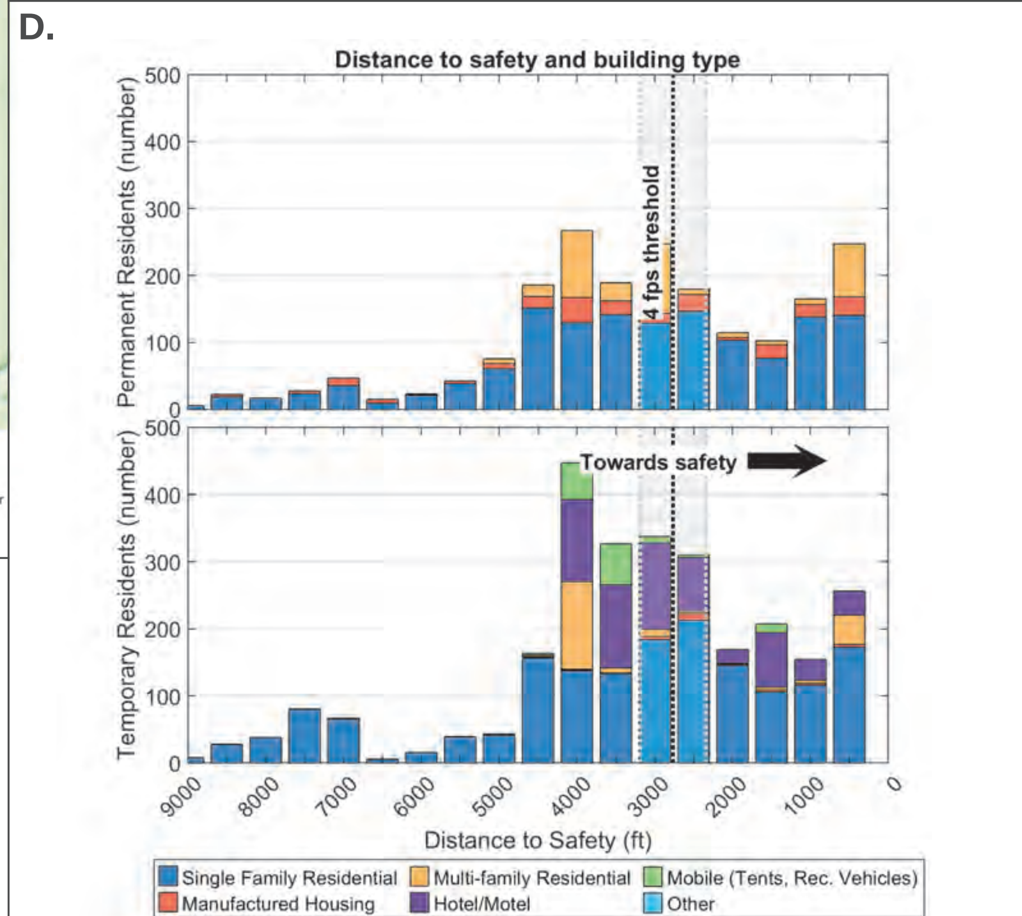

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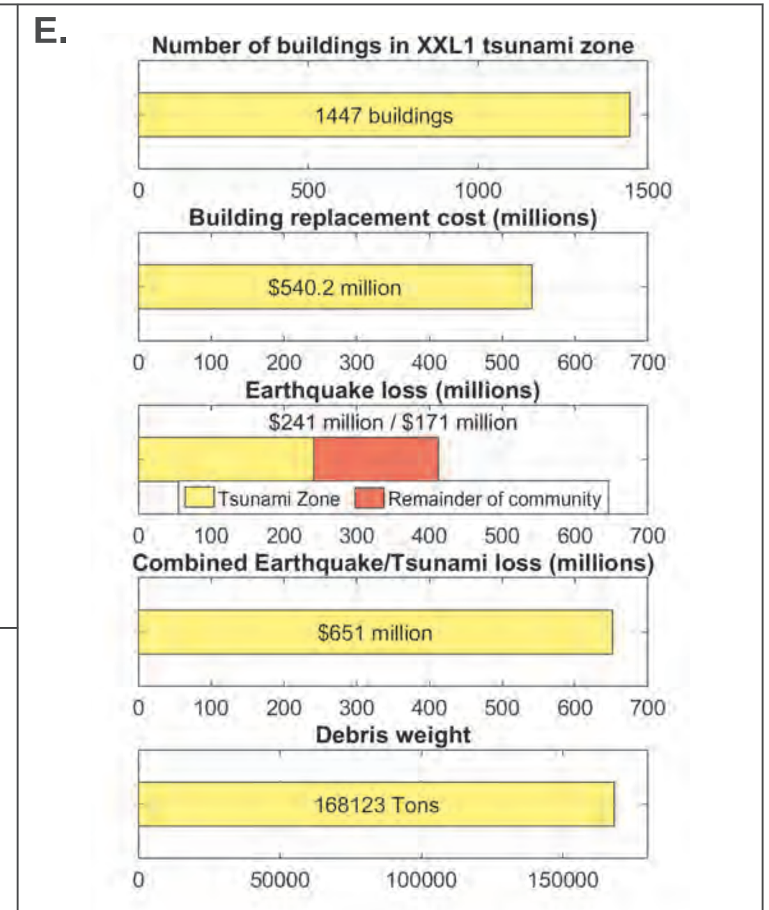

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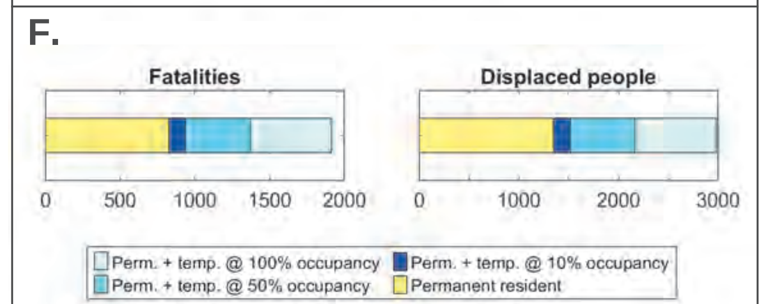
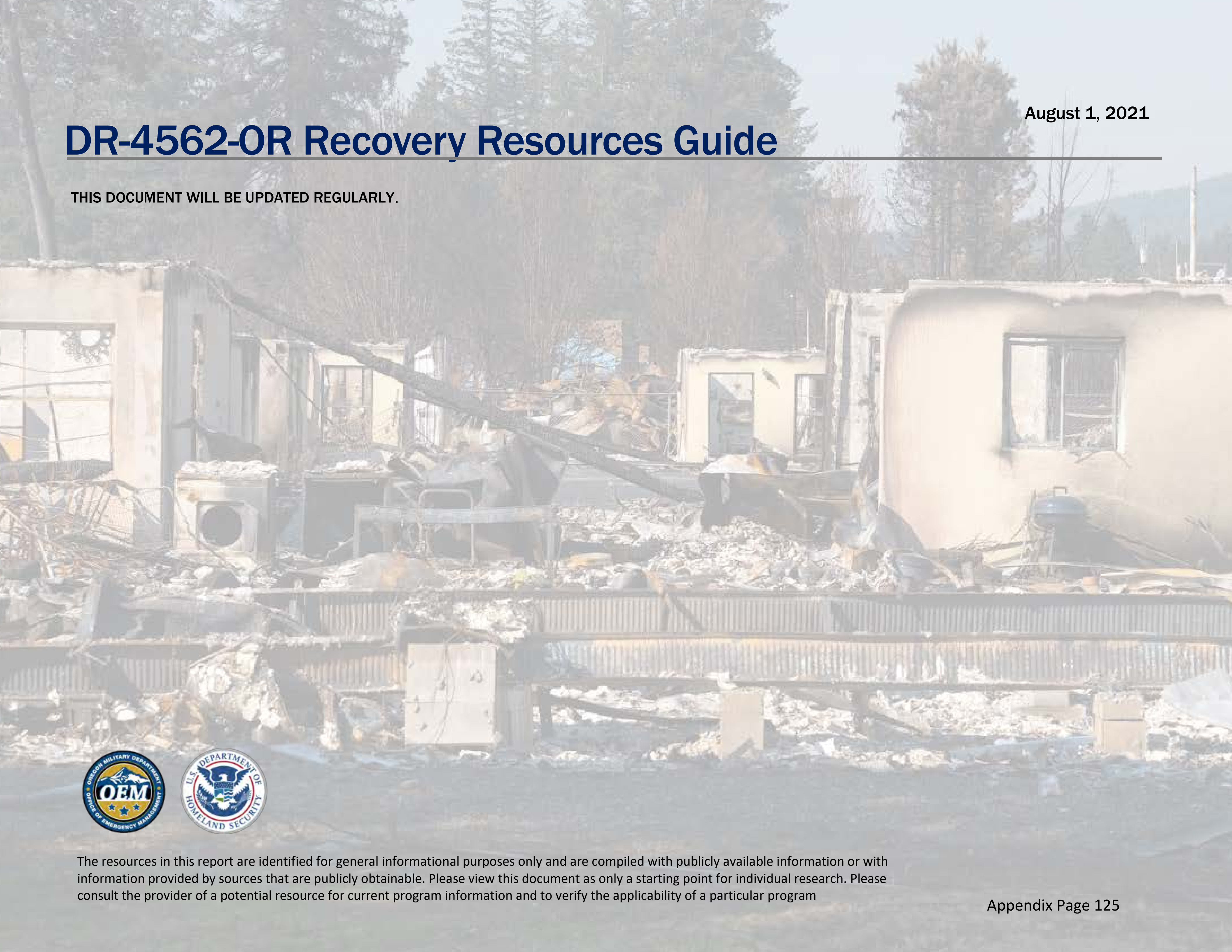


Description	Total
Earthquake Injuries (Entire Community)	215
Tsunami Injuries - Permanent + Temporary	1,047
Tsunami Fatalities - Permanent	828
Tsunami Fatalities - Temporary @ ~100% occupancy	1,085
Displaced Population - Permanent	1,354
Displaced Population - Permanent + Temporary	2,975

B. Appendix B

1. Funding: Recovery Resource Guide



August 1, 2021

DR-4562-OR Recovery Resources Guide

THIS DOCUMENT WILL BE UPDATED REGULARLY.

Contents

Agriculture

Arts and Culture

Program Title/Website	Resource Provider	Description	Eligible Applicants	Contact	Deadline
Redevelopment and Recovery Strategies of Historic Properties Support	Advisory Council on Historic Preservation	In coordination with State Historic Preservation Officers (SHPOs) and Tribal Historic Preservation Officers (THPOs), provides technical expertise to assist Federal, state and local agencies identify programs that fund or support redevelopment and recovery strategies that involve affected historic properties.	Local Government & Authority, State, Territory, Tribe	achp@achp.gov 202-517-0200	None Listed
FY21 Shuttered Venue Operators Grant (SVO)	US Small Business Administration	The SVO Grant program was established by the Economic Aid to Hard-Hit Small Businesses, Nonprofits, and Venues Act, signed into law on December 27, 2020. The program includes $15 billion in grants to shuttered venues, to be administered by the SBA's Office of Disaster Assistance. Eligible applicants may qualify for SVO Grants equal to 45% of their gross earned revenue, with the maximum amount available for a single grant award of $10 million. $2 billion is reserved for eligible applications with up to 50 full-time employees.	Live venue operators or promoters, Theatrical producers, Live performing arts organization operators, museum operators, zoos and aquariums that meet specific criteria, motion picture theater operators, talent representatives, business entities owned by an eligible entity	SVOGrant@sba.gov	Applications accepted continuously.

Broadband / Technology

Program Title/Website	Resource Provider	Description	Eligible Applicants	Contact	Deadline
FY20 Community Development Block Grant Program: Broadband Infrastructure	(USHUD) Dept. of Housing and Urban Development	CDBG funds may be used to install wiring, fiber optic cables, and permanently affixed equipment such as receivers for areas to receive broadband/internet access. Eligible activities include: The acquisition, construction, reconstruction, rehabilitation, or installation of public facilities and improvements. FAQ	Local Government & Authority, State, Territory	Bryan G. Guiney bryan.g.guiney@hud.gov 971-222-2612	None Listed
FY20 Community Planning and Development - Section 108 Loan Guarantee Program (14.248)	(USHUD) Dept. of Housing and Urban Development - Community Planning and Development	Section 108 offers state and local governments the ability to transform a small portion of their CDBG funds into federally guaranteed loans large enough to pursue physical and economic revitalization projects.	Local Government & Authority, Nonprofit Organizations, State, Territory	Bryan G. Guiney bryan.g.guiney@hud.gov 971-222-2612	None Listed
EPA Smart Growth - Cool & Connected	(USEPA) Environmental Protection Agency - Smart Growth	Technical Assistance: Helps community members develop strategies and an action plan for using broadband to create walkable, connected, economically vibrant main streets and small-town neighborhoods that improve human health and the environment.	For-Profit Organizations, Individuals & Households, Local Government & Authority, Nonprofit Organizations, Public/Private Institutions of Higher Education	smartgrowth@epa.gov 202-566-2878	None Listed

Program Title/Website	Resource Provider	Description	Eligible Applicants	Contact	Deadline
Broadband USA Appropriations Act, 2021	National Telecommunications and Information Administration (NTIA)	**Tribal Broadband Connectivity Grants**: $1 billion to expand broadband adoption and deployment on tribal lands, as well as to support distance learning, remote work, and telehealth during the COVID-19 pandemic. Grants for Infrastructure (including submarine cable landing stations), affordability programs, digital literacy, telehealth, distance learning	Tribal governments (subgrantees allowed), Tribal organizations, TCUs, the Native Hawaiian Community, and Native Corporations	Chris Tamarin Christopher.tamarin@oregon.gov	A webinar that covered the new grants was held on March 17. A recording of the Grant Programs in the Consolidated Appropriations Act of 2021 can be found here.
		Broadband Infrastructure Deployment Grants: $300 million for state-and-provider partnerships to support broadband infrastructure deployment to areas lacking broadband, especially rural area. Grants for covered broadband projects, defined as competitively and technologically neutral projects for the deployment of fixed broadband service in a census block with at least one household or business that does not have access to 25/3.	Partnerships between a state, or one or more political subdivisions of a state and providers of fixed broadband service. ETC designation is not required.		
		Connecting Minority Communities Pilot Program: $285 million to help students and communities get connected to the internet through affordable broadband service. Grants to eligible recipients in anchor communities for the purchase of broadband internet access service or any eligible equipment, or to hire and train information technology personnel.	Historically Black and Tribal colleges and universities, Minority-serving institutions, and minority business enterprises and nonprofits		
FY20 Neighborhood Networks	(HUD) Dept. of Housing and Urban Development	Grant funding for Public Housing Authorities (PHAs) to establish, expand and/or update community technology centers. Program purpose: Broadband adoption, digital skills training, public computer access	Public/Indian Housing Authorities, Tribe	Dina Lehman-Kim Dina.lehmann-kim@hud.gov 202-402-2430	None Listed
FY20 Public & Indian Housing: Title VI Loan Guarantee	(HUD) Dept. of Housing and Urban Development	Assists Indian Housing Block Grant recipients to finance affordable housing construction and related community development. Tribes and Tribally designated housing entities can utilize the program for broadband access.	Tribes	Dina Lehman-Kim Dina.lehmann-kim@hud.gov 202-402-2430	Ongoing
Realty Program: Utility Right-of-Way (through EO: Accelerating Broadband Infrastructure Deployment 2012)	(DOT) Dept. of Transportation	Program purpose: Non-Highway Use of Federal Aid Rights of Way. There is no direct funding specifically for broadband. However, broadband may be eligible for reimbursement with federal-aid highway funds if it supports a transportation use. Broadband Funding Guide, Dept. of Transportation	Local Government & Authority, State, Territory, Tribe	Maggie Duncan-Augustt Maggie.duncan-augustt@dot.gov 202-366-9901	Ongoing

Program Title/Website	Resource Provider	Description	Eligible Applicants	Contact	Deadline
American Rescue Plan – FY21 Public Works & Economic Adjustment Assistance Programs (11.300 &11.307)	(USEDA) Economic Development Administration	Funding for rural & urban areas to provide investments that support construction, non-construction, technical assistance, & revolving loan fund projects under EDA's Public Works and EAA programs. Grants and cooperative agreements are designed to leverage existing regional assets and support the implementation of economic development strategies to advance economic prosperity in distressed communities. Broadband projects in are eligible for funding.	For-Profit Organizations, Local Government & Authority, Nonprofit Organizations, State, Territory, Tribe	J. Wesley Cochran jcochran@eda.gov 206-561-6646	Ongoing
Consolidated Appropriations Act: FY21 Broadband Infrastructure Program (11.031)	(DOC) National Telecommunications and Information Administration	Support the deployment of broadband infrastructure; enhance and expand public computer centers; encourage sustainable adoption of broadband service; and promote statewide broadband planning and data collection activities. Grants will be awarded to partnerships between a state, or political subdivisions of a state, and providers of fixed broadband service.	For-Profit Organizations, Local Government & Authority, Public/Private Institutions of Higher Education, State, Territory, Tribe	Jennifer Duane jduane@ntia.gov 202-482-2048	Aug. 17, 2021
Telecom Infrastructure Loan Program (10.851)	(USDA) Dept. of Agriculture- Rural Development	This program provides financing for the construction, maintenance, improvement and expansion of telephone service and broadband in rural areas.	For-Profit Organizations, Local Government & Authority, Nonprofit Organizations, State, Territory, Tribe	John Holman John.holman2@usda.gov 503-310-7692	Ongoing

CDBG: Community Development Block Grant

Program Title/Website	Resource Provider	Description	Eligible Applicants	Contact	Deadline
CDBG Disaster Recovery Program	(USHUD) Dept. of Housing and Urban Development	CDBG Disaster Recovery grants may be authorized by Congress to rebuild the affected areas and provide crucial seed money to start the recovery process. CDBG-DR funds cannot duplicate funding available from federal, state or local governments, private and nonprofit organizations, insurance proceeds, or any other source of assistance. CDBG-DR funds may be used to match other federal resources and can also be used in combination with the Dept. of Health and Human Services (HHS) Social Services Block Grants (SSBGs).	Local Government & Authority, State, Territory	disaster_recovery@hud.gov 202-708-3587	Ongoing
Community Development Block Grant Program: State Formula (14.228)	(USHUD) Dept. of Housing and Urban Development - Community Planning and Development	States award grants to smaller units of general local government that develop and preserve decent affordable housing, to provide services to the most vulnerable in our communities, and to create and retain jobs.	State, Territory	Bryan G. Guiney bryan.g.guiney@hud.gov 971-222-2612	None Listed

Program Title/Website	Resource Provider	Description	Eligible Applicants	Contact	Deadline
Community Development Block Grant Program: Entitlement Communities Funding (14.218)	(USHUD) Dept. of Housing and Urban Development - Community Planning and Development	The CDBG Entitlement Program provides annual grants on a formula basis to entitled cities and counties to develop viable urban communities by providing decent housing and a suitable living environment, and by expanding economic opportunities. Each activity must meet one of the following national objectives for the program: benefit low- and moderate-income persons, prevention or elimination of slums or blight, or address community development needs having a particular urgency because existing conditions pose a serious and immediate threat to the health or welfare of the community for which other funding is not available.	Local Government & Authority	Bryan G. Guiney bryan.g.guiney@hud.gov 971-222-2612	None Listed
Community Development Block Grant Program: Section 108 Loan Guarantee Program Funding (14.248)	(USHUD) Dept. of Housing and Urban Development	Provides CDBG recipients with the ability to leverage their annual grant allocation to access low-cost, flexible financing for economic development, housing, public facility, and infrastructure projects. Communities can use Section 108 guaranteed loans to either finance specific projects or to launch loan funds to finance multiple projects over several years.	Local Government & Authority, State, Territory	Bryan G. Guiney bryan.g.guiney@hud.gov 971-222-2612	None Listed

Children and Youth

Program Title/Website	Resource Provider	Description	Eligible Applicants	Contact	Deadline
National School Lunch Afterschool Snack Program (Ongoing)	(USDA) Dept. of Agriculture - Food and Nutrition Service	Funding for schools and residential childcare institutions to provide afterschool snacks to low-income children who participate in the National School Lunch program.	Local Government & Authority, Nonprofit Organizations, Public/Private Institutions of Education K-12	FNS Regional Office	None Listed
Community Facilities Direct Loan & Grant Program in Oregon **Community Facilities Guaranteed Loan Program in Oregon**	(USDA) Dept. of Agriculture- Rural Development	Funding to construct, rehabilitate, or repair essential community facilities in rural areas including public buildings, schools, hospitals, childcare centers, community centers, etc. May also fund the purchase of equipment for community facilities.	Public bodies, Community-based non-profit corporations, Federally-recognized Tribes with projects in communities of 20,000 or less. Guaranteed loans may be made for projects in communities of 50,000 or less.	Holly Halligan Holly.halligan@usda.gov 541-801-2682	Ongoing
DanPaul Foundation Grants	DanPaul Foundation	The Foundation is interested in providing funding (up to $15,000) to programs that directly serve the health, education, development, and welfare of the world's youth.	Non-profits	danpaulfoundation@gmail.com	None Listed

Program Title/Website	Resource Provider	Description	Eligible Applicants	Contact	Deadline
Weyerhaeuser Giving Fund	Weyerhaeuser Company	Provides funding in four areas: affordable housing and shelter, education and youth development, environmental stewardship, and human services, civic, and cultural growth.	Nonprofit Organizations	Anne Leyva Anne.leyva@weyerhaeuser.com 206-539-3000	None Listed

Community Planning and Development

Capacity Building

Program Title/Website	Resource Provider	Description	Eligible Applicants	Contact	Deadline
National Dislocated Worker Grants Program	(USDOL) Dept. of Labor	Provides resources to states and other eligible applicants to respond to large, unexpected layoff events causing significant job losses. Funding is intended to temporarily expand capacity to serve dislocated workers and meet the increased demand for WIOA employment and training services, with a purpose to reemploy laid off workers and enhance employability and earnings. It provides funding to create temporary employment opportunities to assist with clean-up and recovery effort	Local Government & Authority, State, Territory, Tribe	McEnery_Jenifer@dol.gov	None Listed
Community Capacity & Land Stewardship Program	National Forest Foundation	The National Forest Foundation Community Capacity and Land Stewardship Program™ (CCLS™) provides funding to increase the capacity of organizations implementing large scale restoration projects that benefit National Forests in Southeast Alaska and Pacific Northwest Region.	501(c)3 nonprofits, universities, and federally recognized Native American tribes are eligible to receive CCLS grants. If an organization does not meet this eligibility requirement, it must utilize an eligible fiscal sponsor, in compliance with the NFF Policy on Fiscal Sponsorship.	grants@nationalforests.org	One time per year. Oct. 15, 2020
Support for Crisis Response	US Digital Response (USDR)	USDR deploys highly qualified professionals to support governments and NGOs in their efforts to deliver critical services to the people who need them. USDR matches professionals to the needs of states, counties, cities, federal agencies, and other organizations. We are committed to partnering directly with governments on the specific issues facing your communities. No issue is too big or too small.	Government and government partners.	www.usdigitalresponse.org/request-help/	

Program Title/Website	Resource Provider	Description	Eligible Applicants	Contact	Deadline
Indian Environmental General Assistance EFRP Program (GAP) (66.926)	(USEPA) Environmental Protection Agency	Assist tribes and intertribal consortia to develop capacity to manage their own environmental protection programs; develop/implement solid/hazardous waste programs in accordance with individual tribal needs and applicable federal laws & regulations.	Tribes	American Indian Environmental Office	
On-Request Technical Assistance from DOE Office of Indian Energy	(DOE) Office of Indian Energy Policy and Programs	Technical experts from DOE and its national laboratories, along with other partnering organizations, provide support to assist Indian tribes and Alaska Native villages with energy planning, housing and building energy efficiency, project development, policy and regulation, resilience, and village power. For more information, visit the on-request technical assistance description.	Tribes and Alaska Native villages	indianenergy@hq.doe.gov 240-562-1352	
Strategic Project & Initiative Grants	M.J. Murdock Charitable Trust	Provides grants to nonprofits in the Pacific Northwest. Focused giving to nonprofits that serves AK, ID, MT, OR & WA. - Strategic Project Grants: Capacity-building awards for mission-focused projects and infrastructure investment. - Initiative Grants: A variety of grant programs focused on scientific research, education and calling.	Individuals & Households, Nonprofit Organizations	**info@murdocktrust.org** 360-694-8415	Ongoing

Public Spaces

Program Title/Website	Resource Provider	Description	Eligible Applicants	Contact	Deadline
Community Building Spaces Capital Grants	The Ford Family Foundation (TFFF)	Grants support the development of physical places that are open to the public and have multiple uses. Bricks, mortar and equipment. Bring your community together to build or renovate spaces that foster collaboration, civic participation or community events. Parks, pools and splash pads projects are welcome. Maximum award $250,000. Funds requested may not exceed one-third of the project's total budget. Funds from these grants must serve communities in rural Oregon or Siskiyou County, California, with less than 35,000 in population not adjacent to or part of an urban or metropolitan area .	Local Government & Authority, Nonprofit Organizations, Public/Private Institutions of Education K-12, Public/Private Institutions of Higher Education, State, Tribe	Rozalyn Mock rmock@tfff.org 541-957-5574	
Main Street America	National Main Street Center, Inc. (NMSC)	Main Street America is a program of the National Main Street Center. We revitalize older and historic commercial districts to build vibrant neighborhoods and thriving economies. Our two signature programs – Main Street America and UrbanMain – provide direct support to local leaders in small towns, mid-sized cities, and urban neighborhoods.		mainstreet@savingplaces.org 312-610-5613 Sheri Stuart Sheri.stuart@oregon.gov Oregon Main Street Coordinator 503-986-0679	

Program Title/Website	Resource Provider	Description	Eligible Applicants	Contact	Deadline
T-Mobile-FY21 Hometown Grant	T-Mobile with consulting partners Smart Growth America and Main Street America	The Hometown Grant program invests in small towns by awarding up to 100 towns a year with project funding—up to $50,000 each. They're focusing on revitalizing community spaces in towns with 50,000 people or less. Community Leaders and Civic Officials may submit proposals: https://t-mobile.custhelp.com/app/HTG/HTG_Application	Local Government & Authority, Nonprofit Organizations, Territory, Tribe	None listed	Quarterly: Jan – March April – June July- Sept Oct – Dec

Planning and Project Development

Program Title/Website	Resource Provider	Description	Eligible Applicants	Contact	Deadline
Hazard Mitigation Grant Program: Post Fire	(DHS) Hazard Mitigation	FEMA makes assistance available through its Hazard Mitigation Grant Program Post Fire (HMGP Post Fire) to help communities implement hazard mitigation measures after wildfire disasters that substantially reduce the risk of future damage, hardship, loss, or suffering. Some examples of eligible projects include erosion control measures, defensible space, slope failure prevention, and flash flooding measures.	State, Territory, Federally-recognized Tribes affected by fires resulting in an Fire Management Assistance Grant	Anna Feigum shmo@mil.state.or.us 503-378-2260	None Listed
EDA FY21-23 Planning Program and Local Technical Assistance	(USDOC) Department of Commerce	EDA assists eligible recipients in creating regional economic development plans designed to build capacity and guide the economic prosperity and resiliency of an area or region. The Planning program also helps support organizations and Tribes with Short Term and State Planning investments designed to guide the creation and retention of high-quality jobs, particularly for the unemployed and underemployed in economically distressed regions. The Local Technical Assistance program strengthens the capacity eligible recipients to undertake and promote effective economic development programs through projects such as feasibility analyses and impact studies. Additional Information.	State, County, local governments, Special district governments, Public and State controlled institutions of higher education, federally recognized Native American tribal governments, Nonprofits other than institutions of higher education, Private institutions of higher education – Others.	Wes Cochran jcohran@eda.gov 206-561-6646 Francis Sakaguchi fsakaguchi@eda.gov	Ongoing

Program Title/Website	Resource Provider	Description	Eligible Applicants	Contact	Deadline
FY 2020 EDA Public Works and Economic Adjustment Assistance Programs	(USDOC) Department of Commerce	A flexible fund that can include assisting state and local interests in designing and implementing strategies to adjust or bring about change to an economy. The program focuses on areas that have experienced or are under threat of serious structural damage to the underlying economic base	State, County, local governments, Special district governments, Public and State controlled institutions of higher education, federally recognized Native American tribal governments, Nonprofits other than institutions of higher education, Private institutions of higher education – Others.	Wes Cochran jcohran@eda.gov 206-561-6646 Francis Sakaguchi fsakaguchi@eda.gov	Ongoing
Community Facilities Direct Loan & Grant Program in Oregon Community Facilities Guaranteed Loan Program in Oregon	(USDA) Dept. of Agriculture- Rural Development	Funding to construct, rehabilitate, or repair essential community facilities in rural areas including public buildings, schools, hospitals, childcare centers, community centers, etc. May also fund the purchase of equipment for community facilities.	Public bodies, Community-based non-profit corporations, Federally-recognized Tribes with projects in communities of 20,000 or less. Guaranteed loans may be made for projects in communities of 50,000 or less.	Holly Halligan Holly.halligan@usda.gov 541-801-2682	Ongoing
EPA Smart Growth - Cool & Connected	(USEPA) Environmental Protection Agency - Smart Growth	Technical Assistance: Helps community members develop strategies and an action plan for using broadband to create walkable, connected, economically vibrant main streets and small-town neighborhoods that improve human health and the environment.	For-Profit Organizations, Individuals & Households, Local Government & Authority, Nonprofit Organizations, Public/Private Institutions of Higher Education	smartgrowth@epa.gov 202-566-2878	None Listed
FY19 Disaster Supplemental (11.307)	(USDOC) Dept. of Commerce - Economic Development Administration	Grant funding for non-construction and construction projects, as appropriate, to address economic challenges in areas where a Presidential declaration of a major disaster was issued. Applications must clearly incorporate principles for enhancing the resilience of the relevant community/region or demonstrate the integration of resilience principles into the investment project itself. Inclusion of resilience principles in the project is a necessary step to improve the capacity of the region to recover more quickly from future disaster events.	For-Profit Organizations, Local Government & Authority, Nonprofit Organizations, Public/Private Institutions of Higher Education, State, Territory, Tribe	Seattle Regional Office 206-220-7660	Ongoing

Program Title/Website	Resource Provider	Description	Eligible Applicants	Contact	Deadline
American Planning Association	American Planning Association	The Community Planning Assistance Teams (CPAT) program organizes multidisciplinary teams of planning professionals to work with local stakeholders to create a vision plan and implementation strategy. The program brings planning resources and opportunities to communities with a demonstrated need for assistance. The CPAT provides the time of senior-level planning experts to a community without compensation. However, the community is expected to raise funds to cover travel expenses and accommodations.	Local Government and Authority	CPAT@planning.org 312-786-6359	
Community Facilities Technical Assistance & Training Grant	(USDA) Dept. of Agriculture - Rural Development	Grant funding to public bodies and non-profit organizations to provide technical assistance and/or training to rural communities on identifying and planning for community facility needs; identifying resources to finance community facility construction or repair projects; prepare reports and surveys necessary to request related financial assistance; and prepare applications for Agency financial assistance.	Public bodies and nonprofit institutions assisting communities, Indian Tribes, and nonprofits to identify and plan for community facility needs that exist in rural communities of 20,000 or less.	Charlotte Bentley Charlotte.Bentley@usda.gov 503-414-3362	FY 21 application cycle has closed. Next application window expected after January 1, 2022.
Community Resilience Planning Guide for Buildings and Infrastructure Systems: A Playbook	(USDOC) National Institute of Standards and Technology (NIST)	All communities can improve their resilience and capacity to protect lives, livelihoods, and the quality of life for their residents and businesses. The Planning Guide recognizes that communities must prioritize their limited resources and that improving resilience is a process achieved over time. The Guide's planning process provides a structured yet flexible way to set community-scale goals, align priorities and resources, identify key stakeholders, and develop plans for recovery of community functions. Community resilience planning can inform and integrate other community plans and also reduce conflicting goals between plans.			
Building Blocks for Sustainable Communities	US Environmental Protection Agency	Building Blocks provides quick, targeted technical assistance to selected communities using a variety of tools that have demonstrated results and widespread application. This round of Building Blocks will offer a more flexible approach that leverages EPA staff expertise, facilitates rapid learning and exchange, does not rely on in-person workshops, and focuses on emerging challenges communities face related to land use planning and development. EPA will offer sequential tiers of assistance, starting with staff-led calls only and then selecting some communities for more in-depth, contractor-supported assistance.	Local, county, or tribal governments, or nonprofit organizations that have the support of the local government on whose behalf they are applying	Abby Hall hall.abby@epa.gov	Contact Abby Hall for information

Program Title/Website	Resource Provider	Description	Eligible Applicants	Contact	Deadline
Recreation Economy for Rural Communities	US Environmental Protection Agency	Recreation Economy for Rural Communities is a planning assistance program to help communities develop strategies and an action plan to revitalize their Main Streets through outdoor recreation.	Local governments, Indian tribes, and nonprofit institutions and organizations representing any community in the United States.	Stephanie Bertaina Bertaina.stephanie@epa.gov	Currently closed but anticipate a call for communities to apply later in 2021
FY21 Real Estate Technical Assistance Grant	Center for Creative Land Recycling (CCLR)	CCLR is partnering with the CRE Foundation of the Counselors of Real Estate (CRE)® to provide select redevelopment projects with the targeted, pro bono strategic guidance of credentialed real estate problem-solvers. The program provides real estate analysis and tailored action plans which address real estate challenges. We are accepting applications now for publicly-owned properties. Technical Assistance can potentially be used for Vision-to-Action (V2A) projects.	Local governments, nonprofits, community groups, and quasi-governmental agencies such as redevelopment agencies or housing authorities.	510-918-3374 info@cclr.org	Currently accepting applications

Economic Development and Recovery

Program Title/Website	Resource Provider	Description	Eligible Applicants	Contact	Deadline
Community Disaster Loan (CDL) Program (97.030)	DHS	Loans to local governments to help local governments maintain existing functions of a municipal operating character. The local government must demonstrate a need for financial assistance.	Local Government & Authority, Tribe	Martha Castro Martha.castro@fema.dhs.gov	
Shuttered Venue Operators Grant (SVO)	US Small Business Administration	The SVO Grant program was established by the Economic Aid to Hard-Hit Small Businesses, Nonprofits, and Venues Act, signed into law on December 27, 2020. The program includes $15 billion in grants to shuttered venues, to be administered by the SBA's Office of Disaster Assistance. Eligible applicants may qualify for SVO Grants equal to 45% of their gross earned revenue, with the maximum amount available for a single grant award of $10 million. $2 billion is reserved for eligible applications with up to 50 full-time employees.	Live venue operators or promoters, Theatrical producers, Live performing arts organization operators, Relevant museum operators, zoos and aquariums that meet specific criteria, motion picture theater operators, talent representatives, and each business entity owned by an eligible entity that also meets the requirements	SVOGrant@sba.gov	Applications accepted continuously.

Program Title/Website	Resource Provider	Description	Eligible Applicants	Contact	Deadline
Economic Injury Disaster Loans (EIDL)	US Small Business Administration	EIDL provide working capital to help small businesses, small agricultural cooperatives, small businesses engaged in aquaculture, and most private, nonprofit organizations of all sizes meet their ordinary and necessary financial obligations that cannot be met as a direct result of the disaster. These loans are intended to assist through the disaster recovery period. EIDL loan applications will continue to be accepted through December 2021, pending the availability of funds. Loans are offered at very affordable terms, with a 3.75% interest rate for small businesses and 2.75% interest rate for nonprofit organizations, a 30-year maturity, and an automatic deferment of one year before monthly payments begin. Every eligible small business and nonprofit are encouraged to apply to get the resources they need.	Small businesses, small agricultural cooperatives and most private nonprofit organizations located in a declared disaster area and which have suffered substantial economic injury may be eligible for an SBA Economic Injury Disaster Loan (EIDL)	Richard Jenkins Richard.jenkins@sba.gov 916-735-1500	December 31, 2021
Business and Industry (B&I) Loan Guarantee Program	(USDA) Dept. of Agriculture - Rural Development	USDA Rural Development provides a guarantee on loans made by other lenders to businesses. The purpose is to encourage lending for projects that could not otherwise secure affordable	USDA-approved lenders providing loans for projects that bolster economic opportunity and create jobs in rural communities of 50,000 or less	Mandie Cole Mandie.cole@usda.gov 541-378-3538	Ongoing
FY 2020 EDA Public Works and Economic Adjustment Assistance Programs including CARES Act Funding	(USEDA) Economic Development Administration	EDA solicits applications from applicants in rural and urban areas to provide investments that support construction, non-construction, technical assistance, and revolving loan fund projects under EDA's Public Works and EAA programs. Grants and cooperative agreements made under these programs are designed to leverage existing regional assets and support the implementation of economic development strategies that advance new ideas and creative approaches to advance economic prosperity in distressed communities.	Public and State controlled institutions of higher education Nonprofits having a 501(c)(3) status, other than institutions of higher education County governments Private institutions of higher education Special district governments Native American tribal governments	Wes Cochran jcochran@eda.gov 206-561-6646	Rolling
Intermediary Relending Program: IRP	(USDA) Dept. of Agriculture - Rural Development	This program provides one percent loans to local lenders or "intermediaries" that re-lend to businesses to improve economic conditions and create jobs in rural communities.	Nonprofits, cooperatives, Federally-recognized Indian Tribes, and public agencies.	Mandie Cole Mandie.cole@usda.gov 541-378-3538	Quarterly competitions: March 31, 2021; June 30, 2021

Program Title/Website	Resource Provider	Description	Eligible Applicants	Contact	Deadline
NALCAB Rural Capacity Building Program	National Assoc. for Latino Community Asset Builders & HUD	Provide technical assistance and loans to rural nonprofits that are engaged in creating community and economic development opportunities and affordable housing for low income communities in rural areas. Through its past work under the HUD Rural Capacity Building Program, NALCAB has developed a Rural Revolving Loan Fund (RLF) to support eligible rural affordable housing and economic development projects. The Program provides short-term, 0% interest, no-origination-fee lending capital to eligible entities serving LMI rural communities in 15 states and Puerto Rico.	Nonprofit Organizations	Colton Powell cpowell@nalcab.org Info@nalcab.org 202-991-9100	Rolling
Leveraging Development Finance Tools to attract Opportunity Zone Investment	(USEPA) Office of Economic Revitalization	EPA Toolkit created in collaboration with CDFA and Skeo Solutions. This guide provides an overview of various development finance tools and suggestions for how communities could use these tools to finance projects in Opportunity Zones. More Information. Additional resources.		smartgrowth@epa.gov 202-566-2878	NA
Rural Community Assistance Corporation (RCAC)	Rural Community Assistance Corporation (RCAC)	Variety of loans for water and/or wastewater planning, environmental work, and construction. Also offers funding application assistance.	Non-profit organizations, public agencies, tribes, and low-income rural communities with a 50,000 population or less, or 10,000 or less if guaranteed by USDA Rural Development financing.	Jason Carman Rural Development Specialist JCarman@rcac.org 458-221-3473	Ongoing
American Rescue Plan – FY21 Public Works & Economic Adjustment Assistance Programs (11.300 &11.307)	(USEDA) Economic Development Administration	Funding for rural & urban areas to provide investments that support construction, non-construction, technical assistance, & revolving loan fund projects under EDA's Public Works and EAA programs. Grants and cooperative agreements are designed to leverage existing regional assets and support the implementation of economic development strategies to advance economic prosperity in distressed communities. Broadband projects in are eligible for funding.	For-Profit Organizations, Local Government & Authority, Nonprofit Organizations, State, Territory, Tribe	J. Wesley Cochran jcochran@eda.gov 206-561-6646	Ongoing
Rural Cooperative Development Grant	Department of Agriculture	The primary objective of the RCDG program is to improve the economic condition of rural areas by assisting individuals or entities in the startup, expansion or operational improvement of rural cooperatives and other business entities.	Nonprofit Organizations, Public/Private Institutions of Higher Education	202-720-1400	August 10, 2021

Program Title/Website	Resource Provider	Description	Eligible Applicants	Contact	Deadline
Rural Innovation Stronger Economy (RISE) Grants	Department of Agriculture	To create and augment high-wage jobs, accelerate the formation of new businesses, support industry clusters and maximize the use of local productive assets in eligible low-income rural areas.	Agricultural Producers, Local Government & Authority, Nonprofit Organizations, Public/Private Institutions of Higher Education, State, Territory, Tribe	202-720–1400	August 2, 2021

Education

Program Title/Website	Resource Provider	Description	Eligible Applicants	Contact	Deadline
Community Facilities Direct Loan & Grant Program in Oregon Community Facilities Guaranteed Loan Program in Oregon	(USDA) Dept. of Agriculture- Rural Development	Funding to construct, rehabilitate, or repair essential community facilities in rural areas including public buildings, schools, hospitals, childcare centers, community centers, etc. May also fund the purchase of equipment for community facilities.	Public bodies, Community-based non-profit corporations, Federally-recognized Tribes with projects in communities of 20,000 or less. Guaranteed loans may be made for projects in communities of 50,000 or less.	Holly Halligan Holly.halligan@usda.gov 541-801-2682	Ongoing

Environmental

Conservation

Program Title/Website	Resource Provider	Description	Eligible Applicants	Contact	Deadline
Plant Materials Program (10.905)	(USDA) U.S. Dept of Agriculture	Program aims to find plant solutions to solve conservation problems. The Plant Materials center delivers needed plants and plant technology throughout the United States. The program is dedicated to developing plants and plant technology to solve conservation problems.	Local Government & Authority, State, Territory, Tribe. See announcement for restrictions.	**John Englert** John.englert@wdc.usda.gov 202-720-0536	None listed
Weyerhaeuser Giving Fund	Weyerhaeuser Company	Provides funding in four areas: affordable housing and shelter, education and youth development, environmental stewardship, and human services, civic, and cultural growth.	Nonprofit Organizations	Anne Leyva Anne.leyva@weyerhaeuser.com 206-539-3000	None Listed

Program Title/Website	Resource Provider	Description	Eligible Applicants	Contact	Deadline
FY21 American-Made Solar Prize Round 5: Hardware & Software Tracks	Department of Energy	Designed to support U.S. solar manufacturing and address challenges to rapid, equitable solar energy deployment by incentivizing hardware and software development.	For-Profit Organizations, Individuals & Households, Nonprofit Organizations, Public/Private Institutions of Higher Education		October 5, 2021
FY21 Building Partner Capacity & Promoting Resiliency & Equity Under Clean Water Act: Wetlands, Nonpoint Source, Monitoring, Assessment, & Listing	Environmental Protection Agency	Provides support for training & related activities to build the capacity of agricultural partners, state, territorial and tribal officials and nongovernmental stakeholders in activities to be carried out to support the goals of the Clean Water Act (CWA).	Healthcare Institution, Local Government & Authority, Nonprofit Organizations, Public/Private Institutions of Higher Education, State, Territory, Tribe	202-566-1382	October 8, 2021
New this Month					
FY22 Native American Affairs: Technical Assistance to Tribes	Department of the Interior	Grants and cooperative agreements to provide technical assistance to Indian tribes and tribal organizations for water needs assessments, improved water management studies, water quality data collection and assessments, and water measurement studies.	Tribes		October 20, 2021

Forests

Program Title/Website	Resource Provider	Description	Eligible Applicants	Contact	Deadline
Community Capacity & Land Stewardship Program	National Forest Foundation	The National Forest Foundation Community Capacity and Land Stewardship Program™ (CCLS™) provides funding to increase the capacity of organizations implementing large scale restoration projects that benefit National Forests in Southeast Alaska and Pacific Northwest Region.	501(c)3 nonprofits, universities, and federally recognized Native American tribes are eligible to receive CCLS grants. If an organization does not meet this eligibility requirement, it must utilize an eligible fiscal sponsor, in compliance with the NFF Policy on Fiscal Sponsorship.	grants@nationalforests.org	One per Year Oct. 15, 2020

Program Title/Website	Resource Provider	Description	Eligible Applicants	Contact	Deadline
NFF Grant Programs	National Forest Foundation	Supports action-oriented projects that directly enhance the health and well-being of America's National Forests and Grasslands and that engage the public in stewardship. Nonprofit organizations dedicated to addressing natural resource issues on National Forests and Grasslands can apply for support to complete projects through three distinct grant programs. NOTE: Treasured Landscapes, Unforgettable Experiences is an invitation only	Local Government & Authority, Nonprofit Organizations, Public/Private Institutions of Higher Education, State, Territory, Tribe	ALiljeblad@nationalforests.org	Multiple
Tree Planting Program	National Forest Foundation	The National Forest Foundation is undertaking an effort to plant 50 million trees across our National Forests by 2023. Individuals, businesses, and organizations interested in supporting tree-planting can start their own online fundraiser.		406-542-2805	None Listed
Innovative Finance for National Forests Grant Program	National Forest Foundation	The program supports the development and implementation of innovative finance models that leverage private capital to support the resilience of the National Forest System and surrounding lands. IFNF supports local communities and stakeholders looking for new ways to support healthy forests, project developers working to connect investment capital to forested landscapes, and Forest Service managers and collaborators exploring new ways to support unfunded projects.		Jeff Lerner jalanlerner@gmail.com 202-236-1883	None Listed
Healthy Forests Reserve Program (10.922)	(USDA) Dept. of Agriculture - Natural Resources Conservation Service	One-time payments to landowners in exchange for easements, designed to enhance and protect forestland resources on private lands.	Farm Bill eligible landowners – Agricultural Producers, Individuals & Households, Tribe	Misty Beals Misty.beals@usda.gov 503-320-6953	None Listed
Emergency Forest Restoration Program: EFRP	(USDA) Dept. of Agriculture - Farm Service Agency	Grant funding for owners of non-industrial private forests (NIPF) to restore forest health damaged by natural disasters. Assistance helps landowners carry out emergency measures to restore forest health on land damaged by floods, hurricanes or other natural disasters.	For-Profit Organizations, Individuals & Households, Nonprofit Organizations	FSA County Office	None Listed
Environmental Quality Incentive Program (EQIP) (10.912)	(USDA) Dept. of Agriculture - Natural Resources Conservation Service	Provides financial and technical assistance to agricultural producers through contracts up to a maximum term of ten years in length. These contracts provide financial assistance to help plan and implement conservation practices that address natural resource concerns and for opportunities to improve soil, water, plant, animal, air, and related resources on agricultural land and non-industrial private forestland.	Farm Bill eligible landowners - Agricultural Producers, Individuals & Households, Tribe	Misty Beals Misty.beals@usda.gov 503-320-6953	None Listed
AmeriCorps Student Conservation Association	AmeriCorps	Student Conservation Association is an AmeriCorps partnership that may be a potential resource for labor-intensive conservation-focused projects. Conservation Association could partner with regional communities on urban reforestation and park restoration efforts.		aseda@thesca.org	None Listed

Program Title/Website	Resource Provider	Description	Eligible Applicants	Contact	Deadline
One Tree Planted - Reforestation Funding	One Tree Planted	Fostering tree-planting projects and supporting reforestation through partnerships with US Forest Service, US State Forest & Conservation District, they plant trees across the United States, including California, Colorado, Florida & Oregon.	Agricultural Producers, For-Profit Organizations, Healthcare Institution, Individuals & Households, Local Government & Authority, Nonprofit Organizations, Public/Indian Housing Authorities, Public/Private Institutions of Education K-12, Public/Private Institutions of Higher Education, State, Territory, Tribe	800-408-7850 Online Contact Form	None Listed
FY21 Ford Bronco Wild Fund	Ford Motor Company	This initiative supported by profits from Ford Motor Company in partnership with the National Forest Foundation; Outward Bound, USA; and Sons of Smokey. Help with grants, scholarships, contributions from profits, tree-planting.	Local Government & Authority, Nonprofit Organizations, Public/Private Institutions of Higher Education	Ford Motor Company Customer Relationship Center PO Box 6248 Dearborn MI 48126	

Land Acquisition

Program Title/Website	Resource Provider	Description	Eligible Applicants	Contact	Deadline
Hazard Mitigation Grant Program: Post Fire	(DHS) Hazard Mitigation	FEMA makes assistance available through its Hazard Mitigation Grant Program Post Fire (HMGP Post Fire) to help communities implement hazard mitigation measures after wildfire disasters that substantially reduce the risk of future damage, hardship, loss, or suffering. Some examples of eligible projects include erosion control measures, defensible space, slope failure prevention, and flash flooding measures.	State, Territory, Federally-recognized Tribes affected by fires resulting in an Fire Management Assistance Grant	FEMA Hazard Mitigation Region 10 FEMA-R10-MIT@fema.dhs.gov	Ongoing
FY21 Land & Water Conservation Fund/Great American Outdoors Act: Nationally Competitive Funds (15.916)	(USDOI) Dept. of the Interior - National Park Service	The purpose of the competitive funding is to provide grants to acquire and/or develop public lands for outdoor recreation purposes consistent with the purposes of the LWCF.	State, Territory	Ginger Carter Ginger_carter@nps.gov 202-354-6467 Elizabeth Foundriest Elisabeth_foundriest@nps.gov 202-354-6916	Aug. 20, 2021

Program Title/Website	Resource Provider	Description	Eligible Applicants	Contact	Deadline
The Clean Water State Revolving Fund (CWSRF): Habitat Protection and Restoration and Silviculture	(USEPA) Environmental Protection Agency	The CWSRF can provide assistance for projects that result in the protection or restoration of surface water. This includes land conservation and restoration. Eligible projects include: Purchase of land, Leasing, Fee-simple purchase, Easement	For-Profit Organizations, Nonprofit Organizations, State, Territory, Tribe	Contact Form https://go.usa.gov/xsBVK	Ongoing
Land and Water Conservation Fund	Oregon Parks and Recreation	The Land and Water Conservation Fund (LWCF) is a Federally funded grant program administrated by the Oregon Parks and Recreation Department. Typically, the program awards about $1.5 million to qualified projects every other year for Oregon recreational areas and facilities. LWCF grants are available to either acquire land for public outdoor recreation or to develop basic outdoor recreation facilities. Can be used to do rehab work in public parks.	Cities, Counties, Park and Recreation Districts, METRO Port District, Indian Tribes, Oregon State Agencies (Parks & Recreation Dept., Dept. of State Lands, Department of Fish and Wildlife and Dept. of Forestry).	Nohemi Enciso Nohemi Enciso 503-480-9092	2021 Not Listed
Agricultural Conservation Easement Program (ACEP)	(USDA) Dept. of Agriculture – Natural Resources Conservation Service	The ACEP program provides financial and technical assistance to help conserve agricultural lands and wetlands and their related benefits.	Farm Bill eligible landowners – Agricultural Producers, Individuals & Households, Tribes	Misty Beals Misty.beals@usda.gov 503-320-6953	Ongoing
Oregon Brownfields Program	Oregon Business Development Department dba Business Oregon	Oregon's Brownfields Program consists of two Funds which are available to provide financing for a full range of environmental activities – assessment through cleanup – associated with brownfields redevelopment. Environmental actions must be linked to site redevelopment that facilitates economic development or community revitalization. Eligible redevelopment projects include business development projects, industrial lands capacity, community facility and downtown or mixed-use center revitalization projects.	Any individual, business, non-profit organization, prospective purchaser, municipality, special district, port, or tribe.	Karen Homolac karen.homolac@oregon.gov	Rolling

Renewable

Program Title/Website	Resource Provider	Description	Eligible Applicants	Contact	Deadline
HDR Foundation Grants	HDR Foundation	Grant funding for education, public health and environmental projects in communities where our employees live and work (Ashland, Bend, Portland, and Salem) Examples of projects we may fund include:- Active transportation modes, such as walking or biking -Water, energy and waste reduction projects •Innovative, small-scale renewable energy and water reuse -Community-led environmental restoration efforts	Nonprofits	HDRFoundation@hdrinc.com	2nd Small Grant Cycle May 12 – June 7, 2021 Large Grant Cycle July 20 – Aug 19, 2021
DOE/EERE – Energy Efficiency & Conservation Block Grant Program	Office of Energy Efficiency & Renewable Energy	Increasing renewable energy capacity, technical knowledge, and deployment of energy efficiency projects at the local level.	Individuals and households, local government and authority, state, territory	877-337-3463	Ongoing

Equity and Inclusion

Program Title/Website	Resource Provider	Description	Eligible Applicants	Contact	Deadline
Oregon Immigrant and Refugee Funders Collaborative	Collins Foundation, Meyer Memorial Trust, MRG Foundation, Pride Foundation, and The Oregon Community Foundation	A coordinated funding approach to address urgent and emerging issues impacting immigrants and refugees in Oregon, and to support local organizations responding to these issues. Grants fund projects that provide legal information, services, and representation for immigrants and refugees; outreach and education about policies, programs, services, and preparedness; information gathering, research, and analysis on immigration and refugee issues; basic human needs for immigrants and refugees; and community organizing, civic engagement, and advocacy. Application Link.	501(c)(3) organizations exempt or organizations that have a qualified fiscal sponsor.	**Carol Cheney** ccheney@cllinsfoundation.org Sally Yee sally@mmt.org Niyati Desai ndesai@oregoncf.org Kim Sogge kims@pridefoundatin.org	Ongoing

Erosion Control /Floodplain / Watershed

Program Title/Website	Resource Provider	Description	Eligible Applicants	Contact	Deadline
Emergency Watershed Protection Program - Floodplain Easement Option (EWPP-FPE) (10.973)	(USDA) Dept. of Agriculture - Natural Resources Conservation Service (NRCS)	NRCS recommends this option to landowners and others where acquiring an easement is the best approach (more economical and prudent) to reduce threat to life and/or property.	Farm Bill eligible participants – Individuals, Households & Tribes	Molly Dawson Molly.dawson@usda.gov 503-414-3234	Ongoing

Program Title/Website	Resource Provider	Description	Eligible Applicants	Contact	Deadline
Emergency Watershed Protection (EWP) Program	(USDA) Dept. of Agriculture - Natural Resources Conservation Service (NRCS)	Offers vital recovery options for local communities to help people reduce hazards to life and property caused by floodwaters, droughts, wildfires, earthquakes, windstorms, and other natural disasters. Project funds address erosion related watershed impairments by supporting activities such as removing debris from stream channels, road culverts, and bridges; reshaping and protecting eroded banks; correcting damaged drainage facilities; repairing levees and structures; and reseeding damaged areas	Public and private landowners are eligible but must be represented by a project sponsor. Sponsors include legal subdivisions of the State, such as a city, county, general improvement district, conservation district, or any Native American tribe or tribal.	Molly Dawson Molly.dawson@usda.gov 503-414-3234	None Listed
Watershed Protection and Flood Prevention Program	USDA Natural Resources Conservation Service	The program provides for cooperation between the Federal government and the states and their political subdivisions to work together to prevent erosion; floodwater and sediment damage; to further the conservation development, use and disposal of water; and to further the conservation and proper use of land in authorized watersheds up to 250,000 acres.	Local Government & Authority, Nonprofit Organizations, State, Territory, Tribe	Gary Diridoni Gary.diridoni@usda.gov 503-414-3092	None Listed
Watershed Surveys and Planning Program	USDA Natural Resources Conservation Service	The purpose of the program is to assist governments with the protection watersheds from damage caused by erosion, floodwater, and sediment and to conserve and develop water and land resources. Resource concerns addressed by the program include water quality, opportunities for water conservation, wetland and water storage capacity, agricultural drought problems, rural development, municipal and industrial water needs, upstream flood damages, and water needs for fish, wildlife, and forest-based industries. Types of surveys and plans include watershed plans, river basin surveys and studies, flood hazard analyses, and flood plain management assistance.	Local Government & Authority, State, Territory, Tribe	Gary Diridoni Gary.diridoni@usda.gov 503-414-3092	None Listed
Good Neighbor Authority (Ongoing)	(USDA) Dept. of Agriculture - Forest Service	Funding through a cooperative agreement to execute watershed restoration and forest management work on USFS lands.	Local Government & Authority, State, Territory, Tribe		None Listed

Program Title/Website	Resource Provider	Description	Eligible Applicants	Contact	Deadline
Clean Water State Revolving Fund: **Specific Information on Nonpoint Source Implementation Loans**	Oregon Department of Environmental Quality (DEQ)	Below-market rate loans for the planning, design and construction of water pollution control activities to attain and maintain water quality standards, and necessary to protect beneficial uses	Eligible public agencies include tribal nations, cities, counties, sanitary districts, soil and water conservation districts, irrigation districts, various special districts and certain intergovernmental entities. "Public agency" in this program is defined by ORS 468.423. If you are unsure whether your organization qualifies, contact DEQ at 503-229-5622	For general questions: CWSRFinfo@deq.state.or.us 503-229-LOAN Regional Project Officers: https://www.oregon.gov/deq/wq/cwsrf/ Pages/CWSRF-Contacts.aspx	Applications are accepted year round with scheduled review and ranking in the first week of January, May, and September.
Drinking Water Source Protection Fund (DWSP)	Oregon Health Authority – Drinking Water Services	Low interest loans up to a maximum of $100,000 per project, and grant funds up to $30,000 per water system. Eligible activities include those that lead to risk reduction within the delineated drinking water source area or would contribute to a reduction in contaminant concentration within the drinking water source	Any Public and Privately-owned Community and Nonprofit Non-Community water systems with a completed Source Water Assessment. Must demonstrate a direct link between the proposed project and maintaining or improving drinking water quality.	Tom Pattee, OHA Drinking Water Services/ Source Water Protection/ Groundwater Coordinator tom.pattee@dhsoha.state.or.us 541-726-2587 ext. 24. Julie Harvey DEQ Water Quality Division Julie.harvey@state.or.us 503-229-5664 Adam DeSemple OHA Drinking Water Services Adam.desemple@dhsoha.state.or.us 971-673-0422	Request for 2021 Letters of Interest closes on March 24, 2021. Year-round application window for Emergency Grant but water quality threat must have occurred within 180 days
Oregon Watershed Enhancement Board – Grant Programs	State of Oregon Watershed Enhancement Board	Providing grants to help protect and restore healthy watersheds and natural habitats that support thriving communities and strong economies in Oregon. Include Restoration, Monitoring, Technical Assistance, Acquisition, See individual grant pages for addition grant opportunities.	Varies by grant. Please reference individual grant pages. www.oregon.gov/oweb/grants/Pages/grant-programs.aspx	Oweb.grant.pgm@oregon.gov 503-986-0178	None listed

Fisheries/Aquaculture

Program Title/Website	Resource Provider	Description	Eligible Applicants	Contact	Deadline
FY20 National Fish Habitat Action Plan (15.608)	(USDOI) Dept. of the Interior - United States Fish and Wildlife Service	Projects must protect, restore, and enhance fish and aquatic habitats. Projects under this program, directly or indirectly, support and promote public access to recreational fishing opportunities.	Individuals & Households, Local Government & Authority, Nonprofit Organizations, State, Territory, Tribe	Stephanie Long Stephanie_a_long@fws.gov 703-358-1749	Dec 31, 2021
Saltonstall-Kennedy Competition: Fisheries Research & Economic Development	Department of Commerce	For fisheries research and development projects addressing aspects of U.S. fisheries, including, but not limited to, harvesting, processing, marketing, and associated business infrastructures.	For-Profit Organizations, Individuals & Households, Local Government & Authority, Nonprofit Organizations, State, Territory, Tribe	808-725-5055	November 29, 2021

Food Security and Nutrition

Program Title/Website	Resource Provider	Description	Eligible Applicants	Contacts	Deadline
FY21 Disaster Assistance for State Units on Aging & Tribal Organizations in Major Disasters Declared by the President (93.048)	(USHHS) Dept. of Health and Human Services - Administration for Community Living	Grants awarded under this announcement are to provide disaster reimbursement and assistance funds to those State Units on Aging (SUAs), and federally recognized Tribal Organizations who are currently receiving a grant under Title VI of the OAA.	State, Territory, Tribe	Kathleen Votava Kathleen.votava@acl.hhs.gov 202-765-7603	Sept. 7, 2021
Temporary Assistance for Needy Families: Formula Grant (93.558)	(USHHS) Dept. of Health and Human Services - Administration for Children and Families	The Temporary Assistance for Needy Families (TANF) program is designed to help needy families achieve self-sufficiency. States receive block grants to design and operate programs that accomplish one of the purposes of the TANF program.	State, Territory, Tribe	Robert Shelbourne Robert.shelbourne@acf.hhs.gov 202-401-5150 Info.OFA@acf.hhs.gov	None Listed
National School Lunch Afterschool Snack Program (Ongoing)	(USDA) Dept. of Agriculture - Food and Nutrition Service	Funding for schools and residential childcare institutions to provide afterschool snacks to low-income children who participate in the National School Lunch program.	Local Government & Authority, Nonprofit Organizations, Public/Private Institutions of Education K-12	Jan Kallio 617-565-6299	None Listed

Program Title/Website	Resource Provider	Description	Eligible Applicants	Contacts	Deadline
FY21 Supplemental Nutrition Assistance Program (SNAP): Online Purchasing Participation Assistance for Farmers & Farmers Markets	Department of Agriculture	The grantee will use resources from this grant to assist FMs and DMFs in becoming SNAP authorized Internet Retailers and supporting the participation of and processing of online transactions by these FMs and DMFs.	Nonprofit Organizations, Public/Private Institutions of Higher Education		August 23, 2021

Health

Program Title/Website	Resource Provider	Description	Eligible Applicants	Contact	Deadline
FY21 Disaster Assistance for State Units on Aging & Tribal Organizations in Major Disasters Declared by the President (93.048)	(USHHS) Dept. of Health and Human Services - Administration for Community Living	Grants awarded under this announcement are to provide disaster reimbursement and assistance funds to those State Units on Aging (SUAs), and federally recognized Tribal Organizations who are currently receiving a grant under Title VI of the OAA.	State, Territory, Tribe	Kathleen Votava Kathleen.votava@acl.hhs.gov 202-795-7603	Sept. 7,2021
Community Facilities Direct Loan & Grant Program in Oregon **Community Facilities Guaranteed Loan Program in Oregon**	(USDA) Dept. of Agriculture- Rural Development	Funding to construct, rehabilitate, or repair essential community facilities in rural areas including public buildings, schools, hospitals, childcare centers, community centers, etc. May also fund the purchase of equipment for community facilities.	Public bodies, Community-based non-profit corporations, Federally-recognized Tribes with projects in communities of 20,000 or less. Guaranteed loans may be made for projects in communities of 50,000 or less.	Holly Halligan Holly.halligan@usda.gov 541-801-2682	Ongoing
FY22 Ryan White HIV/AIDS Program, Part A: HIV Emergency Relief Grant Program (93.914)	Department of Health and Human Services	Grant recipients must use funds to support, further develop, and/or expand systems of care to meet the needs of people with HIV, who are low-income, and strengthen strategies to reach disproportionately impacted subpopulations.	Local Government & Authority	301-443-1373	October 6, 2021

Program Title/Website	Resource Provider	Description	Eligible Applicants	Contact	Deadline
Minority Leaders Development Program	Department of Health and Human Services	Establishes a fellowship program at HHS to provide training in health equity issues & leadership to early career individuals to improve the health of racial/ethnic minority & other disadvantaged populations.	Local Government & Authority, Nonprofit Organizations, Public/Indian Housing Authorities, Public/Private Institutions of Education K-12, Public/Private Institutions of Higher Education, State, Territory, Tribe	240-453-6193 240-453-8822	August 17, 2021
FY21 Projects of National Significance: Bridging the Aging and Disabilities Networks	Department of Health and Human Services	Single award to develop a Community of Practice (CoP) designed to build capacity across and within States' aging and disability networks to support futures planning for individuals with intellectual and developmental disabilities (ID/DD).	Local Government & Authority, Nonprofit Organizations, Public/Indian Housing Authorities, Public/Private Institutions of Education K-12, Public/Private Institutions of Higher Education, State, Territory, Tribe		August 24, 2021
FY21 Enhance, Manage, & Promote the Medical Reserve Corps Training & Learning Management System via the TRAIN Learning Network	Department of Health and Human Services	The MRC program office supports the MRC network by providing technical assistance, coordination, communications, strategy and policy development, cooperative agreements, and training opportunities.	Healthcare Institution, Local Government & Authority, Nonprofit Organizations, Public/Private Institutions of Higher Education, State, Territory	617-947-6496	August 25, 2021
FY21 Centers for Independent Living: Operationalizing Independent Living Services to American Indian and Alaska Native Communities	Department of Health and Human Services	Info & referral; skills training; peer counseling; advocacy; & services that facilitate transition from nursing homes/other institutions to the community, to individuals at risk of entering institutions and transition of youth to post-secondary life.	Nonprofit Organizations, Public/Private Institutions of Higher Education		August 27, 2021
FY21 Community Mental Health Services Block Grant (MHBG)	Department of Health and Human Services	The MHBG program makes funds available to support the grantees in carrying out plans for providing comprehensive community mental health services.	State, Territory	240-276-1199	None given
New this Month					

Program Title/Website	Resource Provider	Description	Eligible Applicants	Contact	Deadline
FY22 Service Area Competition Funding for Health Center Program: Round 5	Department of Health and Human Services	The Health Center Program supports public and private nonprofit community-based and patient-directed organizations that provide primary health care services to the Nation's medically underserved populations.	Local Government & Authority, Nonprofit Organizations, Public/Indian Housing Authorities, Public/Private Institutions of Education K-12, Public/Private Institutions of Higher Education, Tribe	301-594-4300	Sept. 7, 2021
FY22 Health & Public Safety Workforce Resiliency: Technical Assistance Center	Department of Health and Human Services	Supports efforts to reduce and address burnout, suicide, mental health conditions and substance use disorders; and promote resiliency among the Health Workforce in rural and underserved communities.	Healthcare Institution, Local Government & Authority, Public/Private Institutions of Higher Education, State, Territory, Tribe	301-443-1728	August 3, 2021
American Rescue Plan: FY21 Section 9813 State Planning Grants for Qualifying Community-Based Mobile Crisis Intervention Services	Department of Health and Human Services	To support the developing of a new state plan option, community-based mobile crisis intervention services for Medicaid recipients in the community who are experiencing a mental health or substance use disorder (MH/SUD) crisis.	State	Linda M Gmeiner: 410-786-9954	August 13, 2021

Housing and Homelessness

Program Title/Website	Resource Provider	Description	Eligible Applicants	Contact	Deadline
Single Family Housing Guaranteed Loan Program Oregon	(USDA) Dept. of Agriculture - Rural Development	Assists approved lenders in providing low- and moderate-income households the opportunity to own adequate, modest, decent, safe and sanitary dwellings as their primary residence in eligible rural areas.	Individuals & Households	Locate a local lender https://go.usa.gov/xsBVE	Ongoing
Farm Labor Housing Loan and Grant Program	(USDA) Dept. of Agriculture - Rural Development	Provides affordable financing to develop housing for year-round and migrant or seasonal domestic farm laborers. Federal Register Notice of Solicitation	State and local government, Tribes, associations of farmworkers and nonprofit organizations, farmers, associations of farmers and family farm corporations	MFHprocessing2@usda.gov	Round 1– April 1, 2021 Round 2 – November 1, 2021 Round 3 – November 1, 2022

Program Title/Website	Resource Provider	Description	Eligible Applicants	Contact	Deadline
Section 504 Single Family Housing Repair Loans & Grants	(USDA) Dept. of Agriculture - Rural Development	Section 504 loans and grants are intended to help very low-income make critical repairs or to remove health and safety hazards to their owner-occupied homes. Eligible Rural Areas	Very-low-income homeowners in eligible rural areas; grant available only to applicants 62 years of age or older	866-923-5626 ext. 1	Ongoing, pending availability of funds
Affordable Housing Loans for Low-Income Rural Communities	Housing Assistance Council (HAC)	Short-term loans at below market interest rates to local nonprofits, for-profits, and government entities that are working to develop affordable housing for low-income, rural communities. Loans from these funds are used for a wide variety of housing development purposes, for all types of affordable and mixed income housing projects, and for both rental and ownership units. HAC Loans may be used for: predevelopment; acquisition; construction; self-help housing; and/or preservation.	For-Profit Organizations, Local Government & Authority, Nonprofit Organizations, Tribe	hac@ruralhome.org 202-842-8600	Ongoing
Federal Housing Administration Multifamily loan programs	(USHUD) Housing and Urban Development	FHA insures multifamily loans originated by FHA approved lenders for the construction, substantial rehabilitation, and acquisition and refinancing of apartments and health care facilities.	For profit or not-for-profit Multifamily housing developers.	Multifamily West Regional Directory https://go.usa.gov/xsBVv	Ongoing
Federal Housing Administration Section 203(h) loan	Housing and Urban Development	The Section 203(h) program allows the Federal Housing Administration (FHA) to insure mortgages made by qualified lenders to victims of a major disaster who have lost their homes and are in the process of rebuilding or buying another home.	Households who lost their homes in a declared natural disaster	FHA Resource Center 1-800-call-FHA	Ongoing
FY19 Disaster Supplemental (11.307)	(USDOC) Dept. of Commerce - Economic Development Administration	Grant funding for non-construction and construction projects, as appropriate, to address economic challenges in areas where a Presidential declaration of a major disaster was issued.	For-Profit Organizations, Local Government & Authority, Nonprofit Organizations, Public/Private Institutions of Higher Education, State, Territory, Tribe	Seattle Regional Office 206-220-7660	None Listed
NALCAB Rural Capacity Building Program	National Assoc. for Latino Community Asset Builders & HUD	Provide technical assistance and loans to rural nonprofits that are engaged in creating community and economic development opportunities and affordable housing for low income communities in rural areas. Through its past work under the HUD Rural Capacity Building Program, NALCAB has developed a Rural Revolving Loan Fund (RLF) to support eligible rural affordable housing and economic development projects. The Program provides short-term, 0% interest, no-origination-fee lending capital to eligible entities serving LMI rural communities in 15 states and Puerto Rico.	Nonprofit Organizations	Colton Powell cpowell@nalcab.org Info@nalcab.org 202-991-9100	Ongoing

Program Title/Website	Resource Provider	Description	Eligible Applicants	Contact	Deadline
Rural Capacity Building for Community Development and Affordable Housing Grants (RCB)	(USHUD) Housing and Urban Development	The Rural Capacity Building program enhances the capacity and ability of rural housing development organizations, Community Development Corporations (CDCs), Community Housing Development Organizations (CHDOs), rural local governments, and Indian tribes (eligible beneficiaries) to carry out affordable housing and community development activities in rural areas for the benefit of low- and moderate-income families and persons.	Only National Organizations that are 501(c)(3) nonprofits, other than institutions of higher education	https://www.hudexchange.info/programs/rural-capacity-building/	Varies based on Notice of Funding Availability
Distressed Cities Technical Assistance	(USHUD) Housing and Urban Development	The Distressed Cities Technical Assistance (DCTA) program is designed to improve fiscal health and build administrative capacity of relatively small units of general local government (UGLGs or local governments) that are economically distressed and have been recently impacted by a natural disaster.	Small units of general local government (UGLGs or local governments) that are economically distressed and have been recently impacted by a natural disaster.	distressedcities@hud.gov	Rolling
Low Income Home Energy Assistance Program (LIHEAP)	(USHHS) Dept. of Health and Human Services - Administration for Children and Families	LIHEAP is a federally funded program that helps low-income households with their home energy bills. We may be able to offer help for the following: home energy bills; energy crises; weatherization and minor energy-related home repairs.	Individuals & Households, State	Katina Lawson Katina.lawson@acf.hhs.gov 202-401-6527 202-401-9351	None Listed
Section 502 Single Family Housing Direct Home Loans (Rolling Deadline)	(USDA) Dept. of Agriculture - Rural Development	USDA provides affordable, subsidized direct loans to qualifying low- and very-low-income homebuyers in eligible rural areas. Eligible Rural Areas	Income-qualified home buyers who meet citizenship or eligible non-citizen requirements; have the legal capacity to incur the loan; be unable to secure an affordable loan from other sources; and other requirements	direct.questions@usda.gov (866) 923-5626, extension 1	Ongoing
First Interstate BancSystem Foundation	First Interstate Bank	The majority of the Foundation's grants are focused on alleviating poverty by assisting low- and moderate-income individuals and communities. Specific areas of interest include hunger and homelessness, affordable housing, financial education, youth programs, early childhood development, arts and culture, leadership programs, and healthy living.	Nonprofit organizations in communities served by First Interstate in Idaho, Montana, Oregon, South Dakota, Washington, and Wyoming.	foundation@fib.com 406-255-5393	Ongoing
FY20 Public & Indian Housing: Title VI Loan Guarantee	(HUD) Dept. of Housing and Urban Development	Assists Indian Housing Block Grant recipients to finance affordable housing construction and related community development. Tribes and Tribally designated housing entities can utilize the program for broadband access.	Tribes	Dina Lehman-Kim Dina.lehmann-kim@hud.gov 202-402-2430	Ongoing

Program Title/Website	Resource Provider	Description	Eligible Applicants	Contact	Deadline
FY21 Indian Housing Block Grant Program (14.867)	Dept. of Housing and Urban Development	Eligible activities for the funds include housing development, operation and maintenance, modernization of existing housing, housing services to eligible families and individuals, housing management services, crime prevention and safety activities, and model activities that provide creative approaches to solving affordable housing problems in Indian Country.	Public/Indian Housing Authorities, Tribe	Hilary Atkin Hilary.c.atkin@hud.gov 202-402-3427	None Listed
American Rescue Plan: FY21 Emergency Rental Assistance Program (ERA2) (21.023)	Dept. of Treasury	The funds are provided directly to states, U.S. territories, local governments, and (in the case of ERA1) Indian tribes. Grantees use the funds to provide assistance to eligible households through existing or newly created rental assistance programs.	Local Government & Authority, State, Territory	SLFRP@treasury.gov	None Listed
Weyerhaeuser Giving Fund	Weyerhaeuser Company	Provides funding in four areas: affordable housing and shelter, education and youth development, environmental stewardship, and human services, civic, and cultural growth.	Nonprofit Organizations	Anne Leyva Anne.leyva@weyerhaeuser.com 206-539-3000	None Listed
Mutual Self-Help Housing Technical Assistance Grants Program	(USDA) Dept. of Agriculture - Rural Development	Provides grants to qualified organizations to help them carry out local self-help housing construction projects. Grant recipients supervise groups of very-low- and low-income individuals and families as they construct their own homes in rural areas.	Government non-profit organizations, Federally-recognized Tribes, and private non-profit organizations	Jill Rees jill.rees@usda.gov 503-414-3302	Ongoing
FY21 Healthy Homes and Weatherization Cooperation Demonstration Grant (14.901)	Department of Housing and Urban Development	To determine if coordination of Healthy Homes & Weatherization Assistance Programs with respect to health remediation & energy conservation achieves cost effectiveness and improves the quality of homes.	Local Government & Authority, Nonprofit Organizations, Public/Private Institutions of Higher Education, State, Tribe		August 17, 2021
FY21 Self-Help Homeownership Opportunity Program	Department of Housing and Urban Development	SHOP funding is used to facilitate and encourage innovative homeownership opportunities on a national, geographically diverse basis through the provision of self-help homeownership housing programs.	Nonprofit Organizations	202-708-2290 / 877-787-2526 (toll-free)	August 23, 2021
NEW THIS MONTH					
FY21 HBCU Cooperative Research in Housing Technologies	Department of Housing and Urban Development	Homebuilding technologies, for HBCUs, that provide the industry innovative construction products/practices for more affordable, energy efficient, resilient (durable, disaster resistant, adaptable, maintainable) and healthier housing.	Public/Private Institutions of Higher Education		August 10, 2021
FY21 Resident Opportunity & Self-Sufficiency Service Coordinator Program	Department of Housing and Urban Development	Designed to assist residents of Public and Indian Housing make progress towards economic and housing self-sufficiency by removing the educational, professional and health barriers they face.	Nonprofit Organizations, Public/Indian Housing Authorities, Tribe	202-708-1112	Sept. 17, 2021

Infrastructure

Public Works

Program Title/Website	Resource Provider	Description	Eligible Applicants	Contact	Deadline
Special Public Works Fund	Business Oregon	Provides funds for publicly-owned facilities that support economic and community development in Oregon. Funds are available to public entities for: planning; designing, purchasing; improving and constructing publicly-owned facilities; replacing publicly owned essential community facilities; and emergency projects as a **result of a disaster.** Emergency project assistance is used for reconstruction of essential community facilities that provide or support services vital to public health and safety. Funds can be used to help offset the 25% cost match for HMGP.	Oregon cities, counties, county service districts (organized under ORS Chapter 451), tribal councils; ports; districts as defined in ORS 198.010, airport districts (ORS 838)	**Regional Development Officer**	None Listed
FY21 American-Made Solar Prize Round 5: Hardware & Software Tracks	**Department of Energy**	**Designed to support U.S. solar manufacturing and address challenges to rapid, equitable solar energy deployment by incentivizing hardware and software development.**	**For-Profit Organizations, Individuals & Households, Nonprofit Organizations, Public/Private Institutions of Higher Education**		October 5, 2021

Water

Program Title/Website	Resource Provider	Description	Eligible Applicants	Contact	Deadline
Emergency Community Water Assistance Grants Program	(USDA) Dept. of Agriculture - Rural Development	To help rural communities who have experienced a significant decline in quantity or quality of water, due to an emergency event (ex. drought, earthquake, hurricane or tornado), to obtain adequate quantities of clean drinking water.	State and local governmental entities, nonprofit organizations, Federally recognized Tribes	Holly Halligan Holly.halligan@usda.gov 541-801-2682	None
Water & Waste Disposal Loan Guarantees	(USDA) Dept. of Agriculture - Rural Development	USDA guarantees loans made by private lenders; purpose is provide affordable financing to qualified borrowers to improve access to clean, reliable water and waste disposal systems for households and businesses	Federal and State-chartered banks, savings and loans, Farm Credit Banks with direct lending authority, and credit unions making loans to public bodies, Federally-recognized Tribes, non-profit businesses, and others.	Holly Halligan Holly.halligan@usda.gov 541-801-2682	None

Program Title/Website	Resource Provider	Description	Eligible Applicants	Contact	Deadline
FY21 Water & Waste Disposal Loan & Grant Program	(USDA) Dept. of Agriculture - Rural Development	This program provides funding for clean and reliable drinking water systems, sanitary sewage disposal, sanitary solid waste disposal, and storm water drainage to households and businesses in eligible rural areas.	Most state and local governmental entities, special districts, private nonprofits, and Federally-recognized Tribes	Holly Halligan Holly.halligan@usda.gov 541-801-2682	Ongoing
Water & Waste Disposal Grants to Alleviate Health Risks on Tribal Lands & Colonias	(USDA) Dept. of Agriculture - Rural Development	This program provides low-income communities, which face significant health risks, access to safe, reliable drinking water and waste disposal facilities and service on Federally recognized Tribal lands	Local Government & Authority, Nonprofit Organizations, State, Territory, Tribe	Holly Halligan Holly.halligan@usda.gov 541-801-2682	None
Safe Drinking Water on Tribal Lands	(USEPA) Office of Ground Water and Drinking Water	EPA works collaboratively with tribal governments, tribal utilities and tribal members to implement the Safe Drinking Water Act (SDWA). The goal of this collaboration is to improve access to safe drinking water on tribal lands.	Tribe	Manheimer.jennifer@epa.gov 206-553-1189 Online Form	None Listed
Sustainable Infrastructure Planning Project	Oregon Business Development Department dba Business Oregon partnering with Oregon Health Authority	Up to $20k forgivable loan planning awards for feasibility studies, asset management plan, system partnership studies, resilience plan, water rate study, leak detection study, and master plan (systems with less than 300 connections). Emergency projects may receive expedited processing and be processed outside of deadline.	Public Water Systems (non-profit, private, municipality, except federally owned or operated) providing services to at least 25 residents or more than 15 connections	Business Oregon Regional Development Officer www.orinfrastructure.org	March 15, 2021 Sept. 15, 2021 Dec. 15, 2021
Special Public Works Fund	Oregon Business Development Department dba Business Oregon	Loans for planning and construction of Utilities, Emergency projects, Levees, Firm Based Business projects, Telecom, Energy Systems, Transportation, Railroad, Road, Marine & other Public Facilities.	Municipalities: Cities, Counties, Tribal Councils, Ports, Airports, Domestic Water Supply Districts, County Service District, Sanitary Districts and Special Districts	Business Oregon Regional Development Officer www.orinfrastructure.org	Ongoing
Water/Wastewater Financing Program	Oregon Business Development Department dba Business Oregon	Grants and loans for planning and construction of storm water, water source, treatment, distribution, waste water collection and treatment.	Municipalities: Cities, Counties, Tribal Councils, Ports, Airports, Domestic Water Supply Districts, County Service District, Sanitary Districts and Special Districts	Business Oregon Regional Development Officer www.orinfrastructure.org	Ongoing

Program Title/Website	Resource Provider	Description	Eligible Applicants	Contact	Deadline
Safe Drinking Water Revolving Loan Fund	Oregon Business Development Department dba Business Oregon partnering with Oregon Health Authority	Design and construction of water system infrastructure including but not limited to treatment, transmission/ distribution mains, finished water reservoirs, water sources, pumping, aquifer storage and recovery projects, seismic improvements, redundancy/reliability infrastructure, instrumentation, telemetry, and metering. Emergency projects may receive expedited processing.	Public Water Systems (non-profit, private, municipality, except federally owned or operated) providing services to at least 25 residents or more than 15 connections	Business Oregon Regional Development Officer www.orinfrastructure.org	Letters of Interest accepted quarterly — Applications accepted year round.
Clean Water State Revolving Fund	Oregon Department of Environmental Quality (DEQ)	Below-market rate loans for the planning, design and construction of water pollution control activities to attain and maintain water quality standards, and necessary to protect beneficial uses. Fact sheet: CWSRF Disaster Response	Eligible public agencies include tribal nations, cities, counties, sanitary districts, soil and water conservation districts, irrigation districts, various special districts and certain intergovernmental entities. "Public agency" in this program is defined by ORS 468.423. If you are unsure whether your organization qualifies, contact DEQ at 503-229-5622.	For general questions: CWSRFinfo@deq.state.or.us or 503-229-LOAN Regional Project Officers: https://www.oregon.gov/deq/wq/cwsrf/Pages/CWSRF-Contacts.aspx	Applications are accepted year round with scheduled review and ranking in the first week of January, May and September.
Rural Community Assistance Corporation (RCAC)	Rural Community Assistance Corporation (RCAC)	Variety of loans for water and/or wastewater planning, environmental work, and construction. Also offers funding application assistance.	Non-profit organizations, public agencies, tribes, and low-income rural communities with a 50,000 population or less, or 10,000 or less if guaranteed by USDA Rural Development financing.	Jason Carman Rural Development Specialist JCarman@rcac.org 458-221-3473	Ongoing
FY21 Rural Energy for America (REAP) Renewable Energy Systems & Energy Efficiency Improvements Program	(USDA) Dept. of Agriculture - Rural Development	Program provides guaranteed loan financing and grant funding to agricultural producers and rural small businesses for renewable energy systems or to make energy efficiency improvements. Agricultural producers may also apply for new energy efficient equipment and new system loans for agricultural production and processing.	Agricultural producers who gain 50% or more of their gross income from agricultural operations; small businesses that are located in a rural area or town of 50,000 or less; and rural electric cooperatives.	Jessie Huff Jesie.huff@usda.gov 503-414-3314	Sept. 30, 2021

Program Title/Website	Resource Provider	Description	Eligible Applicants	Contact	Deadline
Feasibility Study Grants	Oregon Water Resources Department	Feasibility Study Grants fund qualifying costs of studies that evaluate the feasibility of a proposed conservation, reuse, or storage project that appears to have merit but is lacking important details necessary to determine whether or not to proceed with implementation.	Grants require a 50% cost match of the total cost of the feasibility study, up to $500,000. Any local government, Indian tribe, or person may apply for funding.	Becky Williams, 503-986-0869, WRD_DL_feasibilitystudygrants@oregon.gov	NA
Household Water Well System Loan Program [Western States]	Rural Community Assistance Corporation (RCAC)	Low interest loans available to construct, refurbish or replace individual water well systems.	Residence must be in a rural area, town, or community in RCAC's 13 state service area with a population not exceeding 50,000.	Jason Carman Rural Development Specialist JCarman@rcac.org 458-221-3473	None listed
National Water Well Projects	Water Well Trust	Provide long-term, low-interest loans to applicants seeking new or improved water wells. The Water Well Trust limits funding to a maximum of $11,000 per household. Loans have an interest rate of 1% with terms of up to 20 years.	Individuals & Households	info@waterwelltrust.org 202-625-4383	None listed.
New this Month					
FY21 Electric Infrastructure Loan & Loan Guarantee Program	Department of Agriculture	Loans for the construction of electric distribution facilities in rural areas.	For-Profit Organizations, Local Government & Authority, Nonprofit Organizations, State, Territory, Tribe	202-720-1422	None listed.
FY22 Clean Vessel Act	Department of the Interior	Funding allows States to construct, renovate, operate, & maintain pump-out stations & waste reception facilities for recreational boaters & to inform boaters about the use, benefits, & availability of pump-out stations & waste reception facilities.	State, Territory	703-785-3829	November 24, 2021

Technology and Renewables

Program Title/Website	Resource Provider	Description	Eligible Applicants	Contact	Deadline
Special Public Works Fund	Oregon Business Development Department dba Business Oregon	Loans for planning and construction of Utilities, Emergency projects, Levees, Firm Based Business projects, Telecom, Energy Systems, Transportation, Railroad, Road, Marine & other Public Facilities.	Municipalities: Cities, Counties, Tribal Councils, Ports, Airports, Domestic Water Supply Districts, County Service District, Sanitary Districts and Special Districts	Business Oregon Regional Development Officer www.orinfrastructure.org	Ongoing

Transportation

Program Title/Website	Resource Provider	Description	Eligible Applicants	Contact	Deadline
FY21 Formula Grants for Rural Areas - Section 5311 (20.509)	(USDOT) Dept. of Transportation - Federal Transit Administration	Provides capital, planning, and operating assistance to states to support public transportation in rural areas with populations of less than 50,000, where many residents often rely on public transit to reach their destinations.	Local Government & Authority, State, Territory, Tribe	202-366-2053	None Listed
FY20 Surface Transportation Block Grant Program	(USDOT) Dept. of Transportation - Federal Highway Administration	The Surface Transportation Block Grant program (STBG) provides flexible funding that may be used by States and localities for projects to preserve and improve the conditions and performance on any Federal-aid highway, bridge and tunnel projects on any public road, pedestrian and bicycle infrastructure, and transit capital projects, including intercity bus terminals.	Local Government & Authority, State, Territory, Tribe	David Bartz David.bartz@dot.gov 512-417-5191 Gerald.yakowenko@dot.gov Karen.scurry@dot.gov	None Listed
Special Public Works Fund	Oregon Business Development Department dba Business Oregon	Loans for planning and construction of Utilities, Emergency projects, Levees, Firm Based Business projects, Telecom, Energy Systems, Transportation, Railroad, Road, Marine & other Public Facilities.	Municipalities: Cities, Counties, Tribal Councils, Ports, Airports, Domestic Water Supply Districts, County Service District, Sanitary Districts and Special Districts	Business Oregon Regional Development Officer www.orinfrastructure.org	Ongoing
FY21 National Scenic Byways Program (202.205)	(FHWA) Federal Highway Administration	All National, State, and Tribal Scenic Byways and All-American Roads are eligible for the Program. Eligible activities include: Protection of scenic, historical, recreational, cultural, natural, and archaeological resources in an area adjacent to a scenic byway. • Development and implementation of a corridor management plan to maintain characteristics of a byway corridor while providing for accommodation of increased tourism and development of related amenities. • Construction along a scenic byway of a facility for pedestrians and bicyclists, rest area, turnout, highway shoulder improvement, overlook, or interpretive facility. • Development and implementation of a scenic byway marketing program. • An improvement that will enhance access to an area for the purpose of recreation, including water related recreation.	Local Government & Authority, State, Territory, Tribe	202-366-0660 202-366-4000	Sept. 30, 2024
New this Month					
FY21 Accelerated Innovation Deployment Demonstration Program	Department of Transportation	The AID Demonstration Program provides incentive funding for eligible entities to accelerate the implementation of proven innovation in highway transportation.	State, Territory, Tribe	404-895-6229 / 404-562-3917	Sept. 28, 2021

Mitigation and Resiliency

Program Title/Website	Resource Provider	Description	Eligible Applicants	Contact	Deadline
Hazard Mitigation Grant Program: Post Fire	(DHS) Hazard Mitigation	FEMA makes assistance available through its Hazard Mitigation Grant Program Post Fire (HMGP Post Fire) to help communities implement hazard mitigation measures after wildfire disasters that substantially reduce the risk of future damage, hardship, loss, or suffering. Some examples of eligible projects include erosion control measures, defensible space, slope failure prevention, and flash flooding measures.	State, Territory, Federally recognized Tribes affected by fires resulting in an Fire Management Assistance Grant	Anna Feigum shmo@mil.state.or.us 503-378-2260	None Listed
Hazard Mitigation Grant Program (97.039)	(USDHS) Dept. of Homeland Security (FEMA specific) - Federal Insurance and Mitigation Administration	Funds provided to state, local, tribal and territorial governments so they can rebuild in a way that reduces, or mitigates, future disaster losses in their communities.	Local Government & Authority, Nonprofit Organizations, State, Territory, Tribe	Anna Feigum shmo@mil.state.or.us 503-378-2260	DR4562: Nov 29, 2021 FM5327: May 28, 2021
Building Resilient Infrastructure and Communities (BRIC)	(USDHS) Dept. of Homeland Security Hazard Mitigation Grant Program	The BRIC program supports communities through capability- and capacity-building; encouraging and enabling innovation; promoting partnerships; and enabling large projects. For more Information. NOFO Opportunities	Local Government & Authority, State, Territory, Tribe	Anna Feigum shmo@mil.state.or.us 503-378-2260	Application period is open.
National Flood Insurance Program (97.022)	(USDHS) Dept. of Homeland Security (FEMA specific) - Federal Insurance and Mitigation Administration	The National Flood Insurance Program provides insurance to help reduce the socio-economic impact of floods.	Individuals & Households, Local Government & Authority, State	Anna Feigum shmo@mil.state.or.us 503-378-2260	None Listed
Wetland Mitigation Banking Program	Department of Agriculture	The Wetland Mitigation Banking Program (WMBP) is a competitive grants program that supports the development and establishment of wetland mitigation banks to make credits available for agricultural producers.	For-Profit Organizations, Local Government & Authority, Nonprofit Organizations, Public/Private Institutions of Higher Education, State, Territory, Tribes	800-877-8339	August 16, 2021

Recreation

Program Title/Website	Resource Provider	Description	Eligible Applicants	Contact	Deadline
FY21 Land & Water Conservation Fund/Great American Outdoors Act: Nationally Competitive Funds (15.916)	(USDOI) Dept. of the Interior - National Park Service	The purpose of the competitive funding is to provide grants to acquire and/or develop public lands for outdoor recreation purposes consistent with the purposes of the LWCF.	State, Territory	Ginger Carter Ginger_carter@nps.gov 202-354-6467 Elizabeth Foundriest Elisabeth_foundriest@nps.gov 202-354-6916	Aug-20-2021
FY21 Rivers, Trails, & Conservation Assistance Program	(USDOI) National Park Service	Our national network of conservation and recreation planning professionals partners with community groups, nonprofits, tribes, and state and local governments to design trails and parks, conserve and improve access to rivers, protect special places, and create recreation opportunities.	State and local agencies, tribes, nonprofit organizations, or citizen groups. National Parks and other Federal agencies may apply in partnership with other local organizations.	Barbara Rice Pwr_rtca@nps.gov 202-354-6922	None Listed
Land and Water Conservation Fund	Oregon Parks and Recreation	The Land and Water Conservation Fund (LWCF) is a Federally funded grant program administrated by the Oregon Parks and Recreation Department. Typically, the program awards about $1.5 million to qualified projects every other year for Oregon recreational areas and facilities. LWCF grants are available to either acquire land for public outdoor recreation or to develop basic outdoor recreation facilities.	Cities, Counties Park and Recreation Districts, METRO Port District, Indian Tribes, Oregon State Agencies (Parks & Recreation Dept., Dept. of State Lands, Department of Fish and Wildlife and Dept. of Forestry).	Nohemi Enciso nohemi.enciso@oregon.gov 503-480-9092	2021 Not Listed
Recreational Trails Program - Formula Grants (20.219)	(USDOT) Dept. of Transportation - Federal Highway Administration	The Recreational Trails Program (RTP) provides funds to the States to develop, maintain, or rehabilitate recreational trails and trail-related facilities for both nonmotorized and motorized recreational trail uses.	State, Territory	Christopher Douwes Christopher.douwes@dot.gov 202-366-5013	None Listed
Recreation Economy for Rural Communities	US Environmental Protection Agency	Recreation Economy for Rural Communities is a planning assistance program to help communities develop strategies and an action plan to revitalize their Main Streets through outdoor recreation.	Local governments, Indian tribes, and nonprofit institutions and organizations representing any community in the United States.	Stephanie Bertaina Bertaina.stephanie@epa.gov	Currently closed but anticipate a call for communities to apply later in 2021
New this Month					

Program Title/Website	Resource Provider	Description	Eligible Applicants	Contact	Deadline
FY22 Clean Vessel Act	Department of the Interior	Funding allows States to construct, renovate, operate, & maintain pump-out stations & waste reception facilities for recreational boaters & to inform boaters about the use, benefits, & availability of pump-out stations & waste reception facilities.	State, Territory	703-785-3829	November 24, 2021

Volunteers

Program Title/Website	Resource Provider	Description	Eligible Applicants	Contact	Deadline
AmeriCorps State & National Grant Programs	Corporation for National and Community Service	AmeriCorps is a federal agency that funds organizations to make positive impact in communities. Grants provide financial assistance to programs that recruit, train, and supervise AmeriCorps members who meet critical community needs in the areas of education, disaster services, health, environmental stewardship, economic opportunity, and veterans and military families.		Mary Greusel or@cns.gov 202-815-4256	None Listed
Senior Corps/Retired & Senior Volunteer Program (RSVP) Competition (94.002)	Corporation for National and Community Service	Funds Retired and Senior Volunteer Program (Senior Corps) projects that support volunteers 55 years and older serving in a diverse range of activities that meet specific local and community needs. The Senior Corps in Oregon provides three major service areas: Foster Grandparents, Senior Companions, and RSVP (safety patrols, home renovation, tutoring, environmental protection, etc.). Oregon has a robust program funded through $12.8 Million in FY 2020 funding.	Local Government & Authority, Nonprofit Organizations, Public /Private Institutions of Higher Education, State, Territory, Tribe	OR@CNS.gov 202-606-5000	None Listed
Engineers Without Borders USA	Engineers Without Borders USA (EWB-USA)	EWB-USA’s Community Engineering Corps, in partnership with the American Society of Civil Engineers and the American Water Works Association, lends volunteers' technical expertise to communities that are unable to easily retain or afford engineering services.	Local Government & Authority, State, Territory, Tribe	Lauren Butner info@ewb-usa.org 303-772-2723	None Listed

Workforce: Employment, Labor, and Training

Program Title/Website	Resource Provider	Description	Eligible Applicants	Contact	Deadline
Health Profession Opportunity Grants (HPOG)	(USHHS) Dept. of Health and Human Services - Administration for Children and Families	Provides education and training to TANF recipients and other low-income individuals for occupations in the health care field that pay well and are expected to either experience labor shortages or be in high demand.	Healthcare Institution, Local Government & Authority, Nonprofit Organizations, Public/Private Institutions of Higher Education, State, Territory, Tribe	hpog@acf.hhs.gov	None Listed
National Dislocated Worker Grants Program	(USDOL) Dept. of Labor	Provides resources to states and other eligible applicants to respond to large, unexpected layoff events causing significant job losses. Funding is intended to temporarily expand capacity to serve dislocated workers and meet the increased demand for WIOA employment and training services, with a purpose to reemploy laid off workers and enhance employability and earnings. It provides funding to create temporary employment opportunities to assist with clean-up and recovery effort	Local Government & Authority, State, Territory, Tribe	McEnery_Jenifer@dol.gov	None Listed
Minority Leaders Development Program	Department of Health and Human Services	Establishes a fellowship program at HHS to provide training in health equity issues & leadership to early career individuals to improve the health of racial/ethnic minority & other disadvantaged populations.	Local Government & Authority, Nonprofit Organizations, Public/Indian Housing Authorities, Public/Private Institutions of Education K-12, Public/Private Institutions of Higher Education, State, Territory, Tribe	240-453-6193 240-453-8822	August 17, 2021
New this Month					
FY22 Scientists in Parks Internship Program: Youth & Veteran Organization Conservation Activities	Department of the Interior	Puts America's youth and veterans to work protecting, restoring, and enhancing America's great outdoors.	Nonprofit Organizations		October 1, 2021

2. Policy Framework for Natural Hazards in Oregon

The primary responsibility for the development and implementation of risk reduction strategies and policies lies with local jurisdictions. However, resources exist at the state and federal levels. Some of the key agencies in this area include Oregon Emergency Management (OEM), Oregon Building Codes Division (OBCD), Oregon Department of Forestry (ODF), Oregon Department of Geology and Mineral Industries (DOGAMI), and the Department of Land Conservation and Development (DLCD).

The Disaster Mitigation Act of 2000 (DMA 2000) is the latest federal legislation addressing mitigation planning. It reinforces the importance of mitigation planning and emphasizes planning for natural hazards before they occur. As such, this Act established the Pre-Disaster Mitigation (PDM) grant program and new requirements for the national post-disaster Hazard Mitigation Grant Program (HMGP). Section 322 of the Act specifically addresses mitigation planning at the state and local levels. State and local jurisdictions must have approved mitigation plans in place in order to qualify to receive post-disaster HMGP funds. Mitigation plans must demonstrate that their proposed mitigation measures are based on a sound planning process that accounts for the risk to the individual and their capabilities.

Statewide Land Use Planning Goals

https://www.oregon.gov/lcd/OP/Pages/Goals.aspx

Planning for natural hazards is an integral element of Oregon's statewide land use planning program, which began in 1973. All Oregon cities and counties have comprehensive plans and implementing ordinances that are required to comply with the statewide planning goals. The challenge faced by state and local governments is to keep this network of local plans coordinated in response to the changing conditions and needs of Oregon communities.

The comprehensive land use planning system in Oregon begins with a set of 19 Statewide Land Use Planning Goals. These goals address the local process of land use planning, direct the state's resource preservation, give guidance for urban development, and offer direction to cities and counties who need to plan for coastal assets. The outcome of the goals is as unique as each city and county of Oregon – each local government develops a comprehensive plan that addresses the resources, constraints and opportunities specific to the place.

The following land use planning goals are particularly relevant in the management of hazards by local communities. The Department of Land Conservation and Development (DLCD) supports communities in their implementation of these goals.

Goal 5: Natural Resources, Scenic and Historic Areas, and Open Spaces

Read full text version of Goal 5

Goal 5 is a broad statewide planning goal that covers more than a dozen resources. The resources range from wildlife habitat, to historic places, and gravel mines. To protect and plan for them, local governments are asked to create a number of inventories. The inventories in a local plan may address only a portion of the resources included in Goal 5

Goal 7: Areas Subject to Natural Hazards

Read full text version of Goal 7

Goal 7 requires local comprehensive plans to address Oregon's natural hazards. Protecting people and property from natural hazards requires knowledge, planning, coordination, and education. Good planning does not put buildings or people in harm's way. Planning, especially for the location of essential services like schools, hospitals, fire and police stations, is done with sensitivity to the potential impact of nearby hazards.

A local government addresses natural hazards in its comprehensive land use plan. They do this by adopting a natural hazard inventory, overlay zones, hazard code, and supporting plans and policies.

DLCD works with the Oregon Department of Geology and Mineral Industries, the Federal Emergency Management Agency, and others to help communities plan for natural hazards. In most 2-year state legislative cycles, a limited amount of planning grant money is available through DLCD to help communities address these planning needs.

Goal 16: Estuarine Resources

Read the full text version of Goal 16

Statewide Planning Goal 16 provides the principal guidance for the planning and management of Oregon's estuaries. The overall objective of Goal 16 is to "to recognize and protect the unique environmental, economic and social values of each estuary and associated wetlands; and to protect, maintain, where appropriate develop, and where appropriate restore the long term environmental, economic and social values, diversity and benefits of Oregon's estuaries". To accomplish this, the goal establishes detailed requirements for the preparation of plans and for the review of individual development projects and calls for coordinated management by local, state and federal agencies that regulate or have an interest in activities in Oregon's estuaries.

Goal 17: Coastal Shorelands

Read the full text version of Goal 17

Statewide Planning Goal 17 outlines planning and management requirements for the lands bordering estuaries (as well lands bordering the ocean shore and coastal lakes). In general, the requirements of Goal 17 apply in combination with other planning goals to direct the appropriate use of shoreland areas. Provisions in Goal 17 specifically focus on the protection and management of resources unique to shoreland areas; examples of such resources include areas of significant shoreland habitat, lands especially suited for water dependent uses, lands providing public access to coastal waters, and potential restoration or mitigation sites.

The goal focuses on the management of shoreland areas and resources in a manner that is compatible with the characteristics of the adjacent coastal waters. Goal 17 requirements are implemented primarily through local comprehensive plans and zoning.

Water Dependent Shorelands Rule: Goal 17 use requirements direct that shorelands "especially suited for water dependent uses" be protected for such uses, and that local zoning regulations prevent the establishment of uses which would preempt the availability of such lands for water dependent development. In 1999 LCDC adopted an administrative rule to provide additional guidance for implementing this Goal 17 requirement. Known as the water dependent shorelands rule, OAR 660, Division 37 establishes a methodology for calculating the minimum amount of shorelands to be protected for water dependent and also provides more detailed guidance on the qualifications of shorelands suitable for water dependent uses, as well as suggested land use regulations and standards appropriate for the protection of these shoreland sites.

Goal 18: Beaches and Dunes Read the full text version of Goal 18

Statewide Planning Goal 18 focuses on conserving and protecting Oregon's beach and dune resources, and on recognizing and reducing exposure to hazards in this dynamic, sometime quickly changing environment. Goal 18 is central to the work of coastal communities in addressing the impacts of coastal hazards and climate change in areas along the ocean shore.

Local governments are required to inventory beaches and dunes and describe the stability, movement, groundwater resources, hazards and values of the beach, dune, and interdune areas. Local governments must then apply appropriate beach and dune policies for use in these areas.

Goal 18 includes some requirements are of particular importance:

- Prohibition Areas
- Shoreline Armoring
- Dune Grading
- Ocean Shore Regulation

Goal 19 Ocean Resources *Read full text version of Goal 19*

Goal 19 deals with matters such as dumping dredge spoils and discharge of waste products into the open sea, and prioritizes the protection of renewable marine resources over the development of non-renewable resources. It outlines state interest in conserving resources within the Ocean Stewardship Area, which includes Oregon's territorial sea out to 3 nautical miles as well as the continental margin seaward to the toe of the continental slope, and adjacent ocean areas.

Regulatory Agencies

Oregon Parks and Recreation Department (OPRD)

The Oregon Parks and Recreation Department (OPRD) is responsible for protecting the scenic, recreational, and natural resource values of the Oregon coast. OPRD accomplishes this through an extensive permitting program for shoreline protection under the authority of The Ocean Shores Statutes (ORS 390.605 - 390.770), also known as the Beach Bill. OPRD is the permitting authority for actions affecting the ocean shorelands up to the statutory vegetation line. The Ocean Shores Statutes require that a permit be obtained from the OPRD for all "beach improvements" seaward of the Statutory Vegetation Line or the actual vegetation line, whichever is farther inland. Permits for shoreline protective structures may be issued only for developments that existed prior to January 1, 1977.

OPRD approval is also required for dune management plans and subsequent dune management, resloping or other alterations of bluff slopes below the vegetation line, alteration of stream channels on the ocean shore, and other ocean shore alterations associated with hazard mitigation.

Oregon Department of Forestry

Oregon Department of Forestry was given legislative authority to develop landslide hazard mapping based on historical data and the new Lidar mapping system. New maps were printed in 2007.

Department of State Lands

The Department of State Lands (DSL) regulates removal and filling of the seabed (seaward of the extreme low tide line) and estuaries, including any dredged materials or seabed materials. DSL manages the state-owned seabed within three nautical miles of the low tide line. In some instances, a permit may also be required from the U.S. Army Corps of Engineers. When a Corps permit is required, the Oregon Department of Environmental Quality may also need to issue a water quality certification and the Department of Land Conservation and Development (DLCD) a coastal zone concurrence before the Corps can issue a final permit. The agency recently integrated Local Wetland Inventories (LWIs) into a statewide dataset available at: https://www.oregon.gov/dsl/WW/Pages/SWI.aspx

Oregon Water Resource Department

Oregon Revised Statute (ORS) Chapter 536 identifies authorities available during a drought. To trigger specific actions from the Water Resources Commission and the Governor, a "severe and continuing drought" must exist or be likely to exist. Oregon relies upon two inter-agency groups to evaluate water supply conditions, and to help assess and communicate potential drought-related impacts: Oregon Drought Readiness Council and the Water Supply Availability Committee.

Drought Resources:

Oregon Water Resources Department's *2017 Integrated Water Resources Strategy*:
https://www.oregon.gov/OWRD/wrdpublications1/2017_IWRS_Final.pdf
The *Drought Annex of the State of Oregon Emergency Operations Plan* was updated in January 2016 following the record drought of 2015:
https://www.oregon.gov/owrd/WRDPublications1/2016ORDroughtAnnex.pdf
Monitor the status of drought in Oregon at: https://www.drought.gov/drought/states/oregon

U.S. Army Corps of Engineers

The U.S. Army Corps of Engineers is responsible for the protection and development of the nation's water resources to ensure that they are used in the public interest (Figure CE-5). Any person, firm, or agency planning work in the waters of the United States must first obtain a permit from the Corps.

Permits are required even when land next to or under the water is privately owned. Examples of activities in waters that may require a permit include: construction of a pier, placement of intake and outfall pipes, dredging, excavation and depositing of fill. Permits are generally issued only if the activity is found to be in the public interest. DLCD reviews and certifies that Corps permits and other federal activities are consistent with state and local requirements for protecting coastal resources.

C. Appendix C

1. Future Climate Projections Report: Coos County

This report informs the consideration of hazards for the local risk assessment evaluations conducted for the 2023 Coos County Multi-Jurisdictional Natural Hazard Mitigation Plan Update. The production of this report was contracted by the Oregon Department of Land Conservation and Development for the purpose of the plan update. It is cited as Dalton et al, 2022 within the text.

Dalton, M. M., Fleishman, E., & D. Bachelet. (2022, May). Future Climate Projections: Coos County, Oregon. Oregon Climate Change Research Institute. College of Earth, Ocean and Atmospheric Sciences, Oregon State University. https://oregonstate.box.com/s/80o86jyfx5drcup0dvc6qtc9p3f4bhvv

Future Climate Projections
Coos County, Oregon

May 2022

Oregon Climate Change Research Institute

Shore Acres State Park, Coos County, Oregon. Photograph by Rick Obst, CC BY 2.0, via flickr.com.

OCCRI DLCD

Future Climate Projections: Coos County, Oregon

Report to the Oregon Department of Land Conservation and Development

Meghan Dalton, Erica Fleishman, Dominique Bachelet
Oregon Climate Change Research Institute
College of Earth, Ocean, and Atmospheric Sciences
104 CEOAS Admin Building
Oregon State University
Corvallis, OR 97331

May 2022

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Executive Summary

Climate change is expected to increase the occurrence of many climate-related natural hazards. Confidence that the risk of heat waves will increase is very high (Table 1) given strong evidence in the peer-reviewed literature, consistency among the projections of different global climate models, and robust theoretical principles underlying increasing temperatures in response to ongoing emissions of greenhouse gases. Confidence that the risk of many other natural hazards will increase as climate changes is high or medium (Table 1), reflecting moderate to strong evidence and consistency among models, yet these risks are influenced by multiple secondary factors in addition to increasing temperatures. Confidence in projections of changes in risks is indicated as low if projections suggest relatively few to no changes or evidence is limited.

Table 1. Projected direction and level of confidence in changes in the risks of climate-related natural hazards. Very high confidence means that the direction of change is consistent among nearly all global climate models and there is robust evidence in the peer-reviewed literature. High confidence means that the direction of change is consistent among more than half of models and there is moderate to robust evidence in the peer-reviewed literature. Medium confidence means that the direction of change is consistent among more than half of models and there is moderate evidence in the peer-reviewed literature and. Low confidence means that the direction of change is small compared to the range of model responses or there is limited evidence in the peer-reviewed literature.

	Low Confidence	Medium Confidence	High Confidence	Very High Confidence
Risk Increasing ↑	Reduced Air Quality Loss of Wetlands	Drought Expansion of Pests, Pathogens, and Non-native Invasive Species	Heavy Rains Flooding Wildfire Changes in Ocean Temperature and Chemistry Coastal Hazards	Heat Waves
Risk Unchanging =	Windstorms			
Risk Decreasing ↓				Cold Waves

This report presents future climate projections for Coos County relevant to specified natural hazards for the 2020s (2010–2039) and 2050s (2040–2069) relative to the 1971–2000 historical baseline. The projections are presented for a lower greenhouse gas emissions scenario (RCP 4.5) and a higher greenhouse gas emissions scenario (RCP 8.5), with multiple global climate models. All projections in this executive summary refer to the 2050s, relative to the historical baseline, under the higher emissions scenario. Projections for both time periods and emissions scenarios are included in the main report.

Heat Waves

The number, duration, and intensity of extreme heat events is expected to increase as temperatures continue to warm.

In Coos County, the number of extremely hot days (days on which the temperature is 90°F or higher) and the temperature on the hottest day of the year are projected to increase by the 2020s and 2050s under both the lower (RCP 4.5) and higher (RCP 8.5) emissions scenarios.

In Coos County, the number of days per year with temperatures 90°F or higher is projected to increase by an average of 5 days (range 1–11 days) by the 2050s, relative to the 1971–2000 historical baselines, under the higher emissions scenario.

In Coos County, the temperature on the hottest day of the year is projected to increase by an average of about 5°F (range 2–8°F) by the 2050s, relative to the 1971–2000 historical baselines, under the higher emissions scenario.

Cold Waves

Cold extremes will become less frequent and intense as the climate warms.

In Coos County, the temperature on the coldest night of the year is projected to increase by an average of 4.5°F (range 2–8°F) by the 2050s, relative to the 1971–2000 historical baselines, under the higher emissions scenario.

Heavy Rains

The intensity of extreme precipitation is expected to increase as the atmosphere warms and holds more water vapor.

In Coos County, the number of days per year with at least 0.75 inches of precipitation is not projected to change substantially. However, by the 2050s, the amount of precipitation on the wettest day and wettest consecutive five days per year is projected to increase by an average of 12% (range -2–25%) and 9% (range -5–23%), respectively, relative to the1971–2000 historical baselines, under the higher emissions scenario.

In Coos County, the number of days per year on which a threshold for landslide risk, which is based on prior 18-day precipitation accumulation, is exceeded is not projected to change substantially. However, landslide risk depends on multiple factors, and this metric does not reflect all aspects of the hazard.

River Flooding

Winter flood risk in coastal rain-dominated watersheds in Coos County is projected to increase as winter temperatures increase. The temperature increase will lead to an increase in the percentage of precipitation falling as rain rather than snow.

Drought

Drought, as represented by low summer soil moisture, low summer runoff, and low summer precipitation, is projected to become more frequent in Coos County by the 2050s.

Wildfire

Wildfire risk, expressed as the average number of days per year on which fire danger is very high, is projected to increase in Coos County by 11 days (range -6–30) by the 2050s, relative to the historical baseline, under the higher emissions scenario.

In Coos County, the average number of days per year on which vapor pressure deficit is extreme is projected to increase by 30 days (range 9–56) by the 2050s, compared to the historical baseline, under the higher emissions scenario.

Reduced Air Quality

The risk of wildfire smoke in Coos County is projected to increase.

In Coos County, the number of days per year on which the concentration of wildfire-derived fine particulate matter results in poor air quality is projected to decrease by 15%, and the concentration of fine particulate matter is projected to increase by 69%, from 2004–2009 to 2046–2051 under a medium emissions scenario.

Coastal Erosion and Flooding

The risk of coastal erosion and flooding on the Oregon coast is expected to increase as climate changes due to sea level rise and changing wave dynamics.

In Coos County, local sea level is projected to rise by 1.2 to 5.3 feet by 2100. This projection is based on the intermediate-low to intermediate-high global sea level scenarios used in the 2018 U.S. National Climate Assessment. Because these local sea level projections account for estimated trends in vertical land movement, they are relative to the future land position.

Given these levels of sea level rise, the multiple-year likelihood of a flood reaching four feet above mean high tide is 4–34% by the 2030s, 25–100% by the 2050s, and 100% by 2100.

At risk within the four-foot inundation zone in Coos County as of the 2010 census are 1062 people, $72 million in property value, 10.9 miles of highways and roads, 9.4 miles of railways, 3 critical facilities, 2 municipal drinking water facilities, 3 potential contaminant sources, and 715 buildings.

Changes in Ocean Temperature and Chemistry

The open-ocean surface temperature off the Northwest coast increased by 1.2 ± 0.5°F since the year 1900, and is projected to increase by about another 5.0 ± 1.1°F by the year 2080. These changes in temperature may affect many other drivers of ocean change. For example, increases in temperature accelerate the rate of reduction of dissolved oxygen and increase the toxicity of harmful algal blooms. Ocean acidity is projected to increase by roughly 100–150%, resulting in a drop in open-ocean pH from 8.1 to 7.8. The change in pH is likely to affect shell formation in diverse species of commercial, recreational, and cultural value.

Loss of Wetlands

The structure, composition, and function of coastal wetland ecosystems will be affected by rising sea levels and saltwater intrusion, coastal erosion and flooding, changes in temperature and precipitation, and ocean acidification.

Wetland area in the Coos Bay and Coquille River estuaries is projected to decrease with increasing sea levels. Under 4.7 feet of sea level rise, tidal wetland area in these estuaries is projected to decrease by about 50%. Tidal wetland area in the New River Area is projected to increase by more than 2000%, but whether future tides will push into this area is uncertain.

Windstorms

Limited research suggests little if any change in the frequency and intensity of windstorms in the Northwest as a result of climate change.

Expansion of Pests, Pathogens, and Non-native Invasive Species

In general, invasive and pest species in Coos County are likely to become more prevalent in response to projected increases in temperature, especially minimum winter temperature, and increases in the frequency, duration, and severity of drought. However, many of these responses are uncertain, are likely to vary locally, and may change over time.

Introduction

Industrialization has increased the amount of greenhouse gases emitted worldwide, which is causing Earth's atmosphere, oceans, and lands to warm (IPCC, 2021). Climate change and its effects already are apparent in Oregon (Dalton *et al.*, 2017; Mote *et al.*, 2019; Dalton and Fleishman, 2021). Climate change is expected to increase the likelihood of natural hazards such as heavy rains, river flooding, drought, heat waves, wildfires, and episodes of poor air quality, and to decrease the likelihood of cold waves.

Oregon's Department of Land Conservation and Development (DLCD) contracted with the Oregon Climate Change Research Institute (OCCRI) to analyze the influence of climate change on natural hazards. The scope of the analysis that yielded this report is limited to the geographic area encompassed by Coos, Curry, and Wallowa Counties, Oregon, which are the focus of the Pre-Disaster Mitigation (PDM) 18 grants that DLCD received from the Federal Emergency Management Agency. Products of OCCRI's analysis include county-specific data, graphics, and narrative summaries of climate projections related to ten climate-related natural hazards (Table 2). This information will be integrated into the Natural Hazards Mitigation Plan (NHMP) updates for the three counties, and can be used in other county plans, policies, and programs. In addition to the county reports, OCCRI will share data and provide other technical assistance to the counties. This report covers climate change projections related to natural hazards relevant to Coos County.

Table 2. Selected natural hazards and related climate metrics.

Heat Waves Hottest Day, Warmest Night Hot Days, Warm Nights	**Cold Waves** Coldest Day, Coldest Night Cold Days, Cold Nights
Heavy Rains Wettest Day, Wettest Five Days Wet Days, Landslide Risk Days	**River Flooding** Annual Maximum Daily Flows Atmospheric Rivers Rain-on-Snow Events
Drought Summer Flow, Spring Snow Summer Soil Moisture Summer Precipitation	**Wildfire** Fire Danger Days Extremely Dry Air Days
Reduced Air Quality Days with Unhealthy Smoke Levels	**Coastal Erosion and Flooding** Sea Level Rise Waves
Changes in Ocean Temperature and Chemistry	**Loss of Wetlands**
Windstorms	**Expansion of Pests, Pathogens, and Non-native Invasive Species**

Future Climate Projections Background

Introduction

The county-specific future climate projections presented here are derived from 10–20 global climate models and two scenarios of future global emissions of greenhouse gases. The spatial resolution of projections from global climate models has been refined to better represent local conditions. County-level summaries of changes in climate metrics (Table 2) are projected to the beginning and middle of the twenty-first century relative to a historical baseline. More information about the data sources is in the Appendix.

Global Climate Models

Global climate models (GCMs) are computer models of Earth's atmosphere, ocean, and land and their interactions over time and space. The models are grounded in the fundamental laws of physics. Over time the spatial resolution of the models has increased and more biological processes, such as wildfire emissions and dynamic vegetation, have been included (Figure 1). The latest GCMs from the sixth phase of the Coupled Model Intercomparison Project (CMIP6), the climate modeling foundation for the Intergovernmental Panel on Climate Change's (IPCC) Sixth Assessment Report, generally have higher resolution, better represent Earth system processes, and improve simulation of recent mean values of climate change indicators relative to older versions of GCMs (IPCC, 2021). However, some CMIP6 models overestimate temperatures in the twentieth century, likely due to the difficulty of accurately simulating cloud dynamics. Consequently, the IPCC ranked climate models on the basis of their ability to reproduce twentieth-century temperatures, and only used the most accurate models to produce its official warming projections given different fossil fuel emissions scenarios (Hausfather *et al.*, 2022). Because downscaled data from CMIP6 are not yet widely available, this report presents projections from GCMs from the fifth phase of the Coupled Model Intercomparison Project (CMIP5).

Differences in simulations of Oregon's projected average temperature between CMIP5 and CMIP6 were estimated in the Fifth Oregon Climate Assessment (Dalton and Fleishman, 2021). The CMIP6 models generally projected greater warming over Oregon than the CMIP5 models, largely because temperature in the CMIP6 models was more sensitive to a doubling of atmospheric carbon dioxide. The latter outcome reflected a larger amplification of temperature increases by clouds within the CMIP6 models (Dalton and Fleishman, 2021; IPCC, 2021), which may or may not be realistic (Hausfather *et al.*, 2022). In view of this uncertainty, this report presents the more conservative projections from CMIP5.

GCMs are the most sophisticated tools for understanding Earth's climate, but they still simplify the climate system. Because there are several ways to implement such simplifications, different GCMs yield somewhat different projections. Accordingly, it is best practice to average and report the range of projections from at least ten GCMs that simulate the historical climate well (Mote *et al.*, 2011; Hausfather *et al.*, 2022). More information about GCMs and uncertainty is in the Appendix.

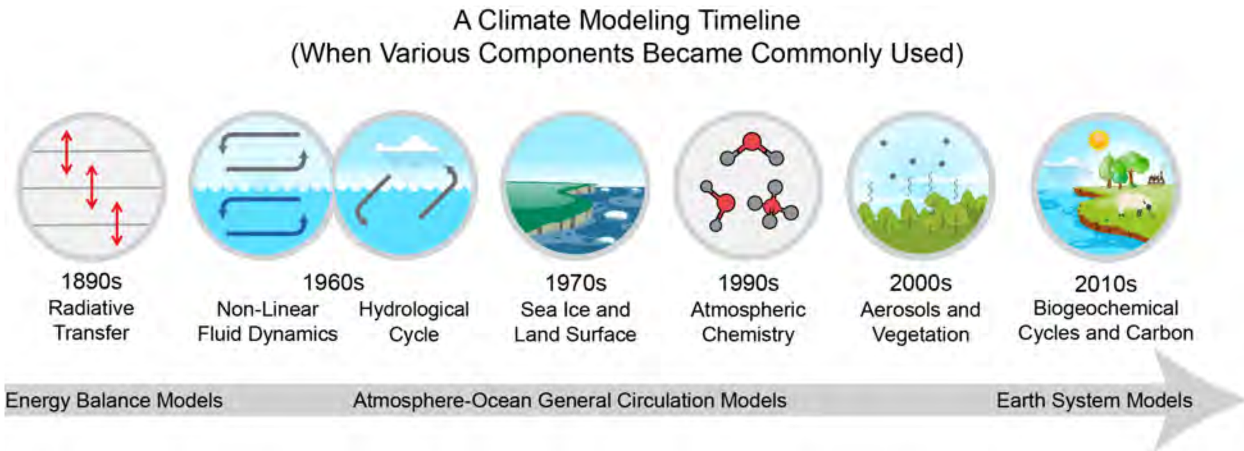


Figure 1. As scientific understanding of climate has evolved over the last 120 years, increasing amounts of physics, chemistry, and biology have been incorporated into calculations and, eventually, models. Various processes and components of the climate system became regularly included in scientific understanding of global climate calculations and, over the second half of the century as computing resources became available, formalized in global climate models. (Source: science2017.globalchange.gov)

Greenhouse Gas Emissions

When scientists use GCMs to project climate, they make assumptions about the quantity of future global emissions of greenhouse gases. The GCMs then simulate the effects of those emissions on the air, ocean, and land over the coming centuries. Because the precise amount of greenhouse gases that will be emitted in the future is unknown, scientists use multiple scenarios of greenhouse gas emissions that correspond to plausible societal trajectories. The future climate projections in this report, which are based on CMIP5 models, use Representative Concentration Pathways (RCPs) that describe different levels of radiative forcing by 2100. A fixed emission trajectory was associated with each pathway. The higher the volume of global emissions, the greater the projected increase in global temperature (Figure 2).

Projections in this report assume a lower emissions pathway (RCP 4.5) and a higher emissions pathway (RCP 8.5). These are the most commonly used pathways in the peer-reviewed literature, and downscaled data representing the effects of these scenarios on local climate are available. RCPs focused on concentrations, instead of emissions, of greenhouse gases, that were consistent with certain socio-economic assumptions. The scenarios for CMIP6 correspond to those for CMIP5. For CMIP6, each RCP was associated with a set of shared socioeconomic pathways that describe various social and economic scenarios (IPCC, 2021). More information about emissions scenarios is in the Appendix.

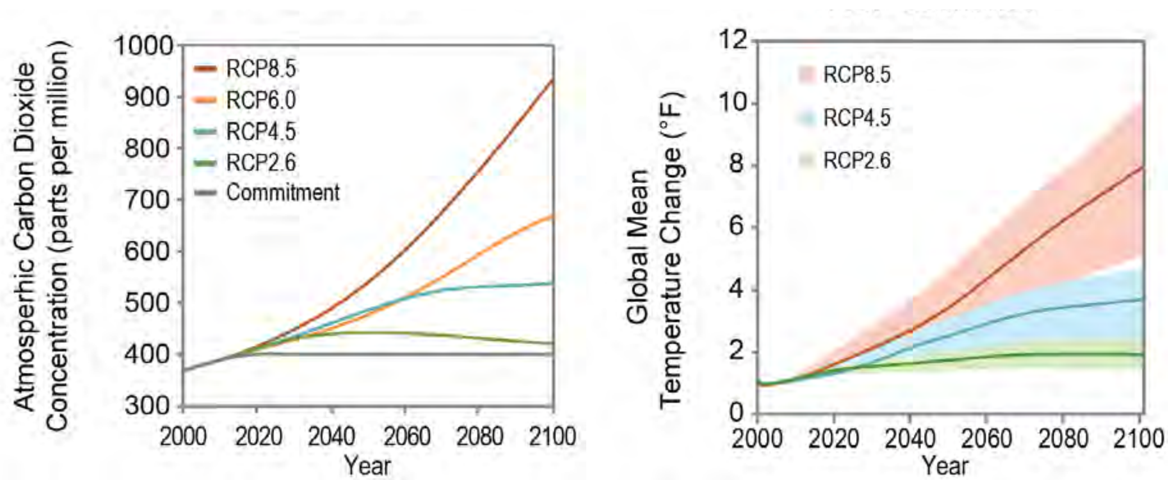


Figure 2. Future scenarios of atmospheric carbon dioxide concentrations (left) and projections of global temperature change (right) resulting from several different emissions pathways, called Representative Concentration Pathways (RCPs), that are considered in the fourth National Climate Assessment. (Source: science2017.globalchange.gov)

Downscaling

Global climate models simulate the climate across contiguous grid cells with various coarse spatial resolutions, such that only one to three grid cells cover the state of Oregon. To make these coarse-resolution simulations more locally relevant, GCM outputs are combined with historical observations, yielding higher-resolution projections. This process is called statistical downscaling. The future climate projections in this report were statistically downscaled to a resolution of about 2.5 by 2.5 miles (Abatzoglou and Brown, 2012). More information about downscaling is in the Appendix.

Future Time Periods

When analyzing GCM projections, it is best practice to compare the average of simulations across at least 30 future years to the average of simulations across at least 30 past years. The average over the 30 past simulated years is called the *historical baseline*. This report presents projections averaged over two future 30-year periods, 2010–2039 (2020s) and 2040–2069 (2050s), relative to the historical baseline from 1971–2000 (Table 3).

Because each of the 20 GCMs is based on slightly different assumptions, each yields a slightly different value for the historical baseline. Therefore, this report presents the average and range of projected *changes* in values of climate variables relative to each model's historical baseline rather than presenting the average and range of projected absolute values of variables. The average of the 20 historical baselines, the *average historical baseline*, is also presented to aid in understanding the relative magnitude of projected changes. The average historical baseline and average projected future change can be used to infer the average projected future absolute value of a given variable. However, the average historical baseline and range of projected future changes cannot be used to infer the range of projected future absolute values.

Table 3. Historical and future time periods over which projections were averaged.

Historical Baseline	2020s	2050s
1971–2000	2010–2039	2040–2069

How to Use the Information in this Report

Because the observational record may not include many values of climate variables nor the frequency of some extreme conditions that are projected to occur in the future, one cannot reliably anticipate future climate by considering only past climate. Future projections from GCMs enable exploration of a range of plausible outcomes given the climate system's complex response to increasing atmospheric concentrations of greenhouse gases. Projections from GCMs should not be considered as predictions of the weather on a specified date, but rather as projections of climate, which is the long-term statistical aggregate of weather.[1]

The projected direction and magnitude of change in values of climate variables in this report are best interpreted relative to the historical climate conditions under which a particular asset or system was designed to operate. For this reason, considering the projected changes between the historical and future periods allows one to envision how natural and human systems of interest will respond to future climate conditions that are different from past conditions. In some cases, the projected change may be small enough for the existing system to accommodate. In other cases, the projected change may be large enough to require adjustments, or adaptations, to the existing system. However, engineering or design projects would require an analysis that is more detailed than this report.

The information in this report can be used to

- Explore a range of plausible future outcomes that take into consideration the climate system's complex response to increasing concentrations of greenhouse gases
- Envision how current systems may respond under climate conditions different from those under which the systems were designed to operate
- Inform evaluation of potential mitigation actions within hazard mitigation plans to accommodate future conditions
- Inform a risk assessment in terms of the likelihood of occurrence of a particular climate-related hazard

[1] Read more: https://nca2014.globalchange.gov/report/appendices/faqs#narrative-page-38784

Average Temperature

Oregon's average temperature warmed at a rate of 2.2°F per century from 1895 through 2019 (Dalton and Fleishman, 2021). Average temperature is expected to continue increasing during the twenty-first century if global emissions of greenhouse gases continue; the rate of warming depends on the level of emissions (IPCC, 2021). By the 2050s (2040–2069), relative to the 1970–1999 historical baseline, Oregon's average temperature is projected to increase by 3.6°F (range of 1.8–5.4°F) under a lower emissions scenario (RCP 4.5) and by 5.0°F (range of 2.9–6.9°F) under a higher emissions scenario (RCP 8.5) (Dalton *et al.*, 2017; Dalton and Fleishman, 2021). Furthermore, summers are projected to warm more than other seasons (Dalton *et al.*, 2017; Dalton and Fleishman, 2021).

During the twenty-first century, average temperature in Coos County is projected to warm at a rate similar to that of Oregon as a whole (Figure **3**). Projected increases in average temperature in Coos County relative to the 1971–2000 historical baseline in each global climate model (GCM) range from 0.9–3.2°F by the 2020s (2010–2039) and 1.5–6.0°F by the 2050s (2040–2069), depending on emissions scenario and GCM (Table **4**).

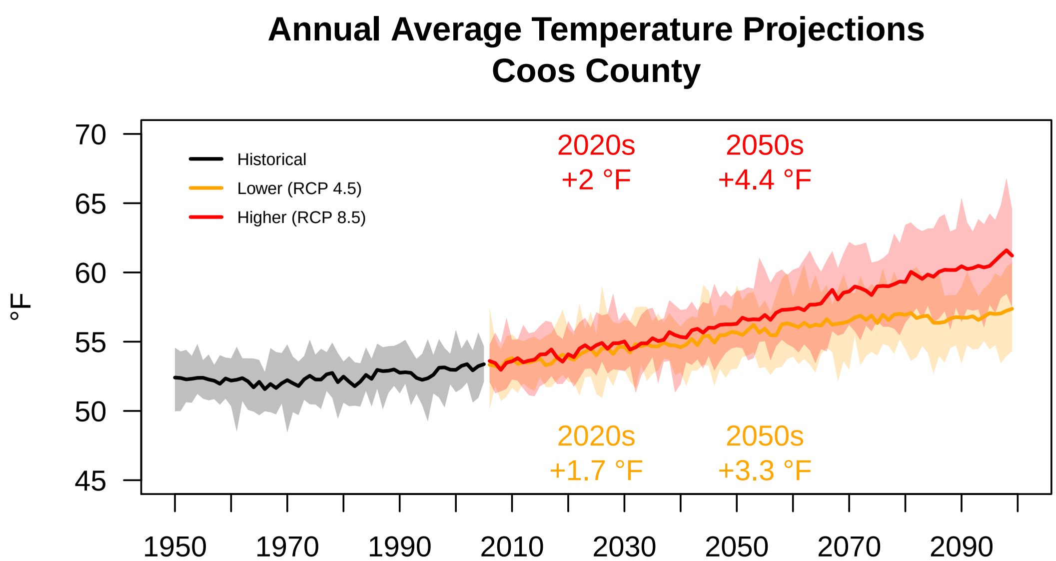


Figure 3. Projected annual average temperature in Coos County as simulated by 20 downscaled global climate models under a lower (RCP 4.5) and a higher (RCP 8.5) greenhouse gas emissions scenario. Solid lines and shading represent the 20-model mean and range, respectively. The multiple-model mean differences for the 2020s (2010–2039 average) and the 2050s (2040–2069 average) relative to the average historical baseline (1971–2000 average) are shown.

Table 4. Average (and range) of projected future changes in Coos County's annual temperature relative to the historical baselines (1971–2000 average) of each of 20 global climate models under two emissions scenarios.

Emissions Scenario	2020s (2010–2039 average)	2050s (2040–2069)
Higher (RCP 8.5)	+2.0°F (1.3–3.2)	+4.4°F (2.5–6.0)
Lower (RCP 4.5)	+1.7°F (0.9–2.8)	+3.3°F (1.5–4.5)

Heat Waves

Extreme heat has become more frequent and intense worldwide since the 1950s, largely due to human-caused climate change (IPCC, 2021). The number, duration, and intensity of extreme heat events in Oregon is projected to increase due to continued warming temperatures. In fact, the temperature on the hottest days in summer is projected to increase even more than the mean summer temperature in the Northwest (Dalton *et al.*, 2017). Heat waves occur periodically as a result of natural variability, but human-caused climate change is increasing their severity (Vose *et al.*, 2017). In addition, evidence of increases in summer extreme heat events that are defined by nighttime minimum temperatures is stronger than evidence of increases in extreme heat events that are defined by maximum temperatures (Dalton and Fleishman, 2021).

Extreme heat can refer to days on which maximum or minimum temperatures are above a threshold, seasons in which temperatures are well above average, and heat waves, or multiple days on which temperature are above a threshold. This report presents projected changes in three metrics of extremes daytime heat (maximum temperature) and nighttime heat (minimum temperature) (Table 5).

Table 5. Metrics and definitions of heat extremes.

Metric	Definition
Hot Days	Number of days per year on which maximum temperature is 90°F or higher
Warm Nights	Number of days per year on which minimum temperature is 65°F or higher
Hottest Day	Highest value of maximum temperature per year
Warmest Night	Highest value of minimum temperature per year
Daytime Heat Waves	Number of events per year in which the maximum temperature on at least three consecutive days is 90°F or higher
Nighttime Heat Waves	Number of events per year in which the minimum temperature on at least three consecutive days is 65°F of higher

In Coos County, the number of hot days and warm nights, and the temperature on the hottest day and warmest night, are projected to increase by the 2020s (2010–2039) and 2050s (2040–2069) under both the lower (RCP 4.5) and higher (RCP 8.5) emissions scenarios (Table **6**, Figure 4, Figure 5). For example, by the 2050s under the higher emissions scenario, the number of hot days, relative to each GCM's 1971–2000 historical baseline, is projected to increase by 1–11. The average number of hot days per year is projected to be five more than the average historical baseline of one day. The average number of warm nights per year is projected to be two more than the average historical baseline of virtually zero days.

Similarly, under the higher emissions scenario, the temperature on the hottest day of the year is projected to increase by 2.1–8.3°F by the 2050s relative to the GCMs' historical baselines. The average projected increase in temperature on the hottest day is 5.2°F above the average historical baseline of 86.4°F. The average projected increase in temperature on the warmest night is 5.1°F above the average historical baseline of 59.3°F.

Under the higher emissions scenario, the numbers of daytime and nighttime heat waves are projected to increase by 0.2–1.6 and 0.0–0.7, respectively, by the 2050s relative to the GCMs' historical baselines. The average number of daytime and nighttime heat waves is projected to increase by 0.8 and 0.2, respectively, above the average historical baseline of 0.1 and zero (Table 6, Figure 6).

Table 6. Mean (and range) of projected future changes in extreme heat metrics in Coos County by the 2020s (2010–2039 average) and 2050s (2040–2069 average), relative to the historical baseline (1971–2000 average) of each of 20 global climate models (GCMs), under a lower (RCP 4.5) and higher (RCP 8.5) emissions scenario. The average historical baseline across the 20 GCMs and the average projected future change can be used to infer the average projected future absolute value of a given variable. However, the average historical baseline and the range of projected future changes cannot be used to infer the range of projected future absolute values.

	Average Historical Baseline	2020s		2050s	
		Lower	Higher	Lower	Higher
Hot Days	0.8 days	0.8 days (0.2-1.8)	1.1 days (0.2-2.1)	2.9 days (0.9-5.7)	5 days (1-10.8)
Warm Nights	0.1 days	0.1 days (0-0.3)	0.2 days (0-0.8)	0.7 days (0.1-2.4)	1.6 days (0.2-5.7)
Hottest Day	86.4°F	1.7°F (0.1-2.7)	2.2°F (0.4-3.9)	4.1°F (2-7)	5.2°F (2.1-8.3)
Warmest Night	59.3°F	1.8°F (0.4-3.2)	2.2°F (0.6-3.5)	3.9°F (1.9-6.3)	5.1°F (2.8-8.1)
Daytime Heat Waves	0.1 events	0.1 events (0-0.2)	0.2 events (0-0.3)	0.4 events (0.1-0.9)	0.8 events (0.2-1.6)
Nighttime Heat Waves	0 events	0 events (0-0)	0 events (0-0.1)	0.1 events (0-0.3)	0.2 events (0-0.7)

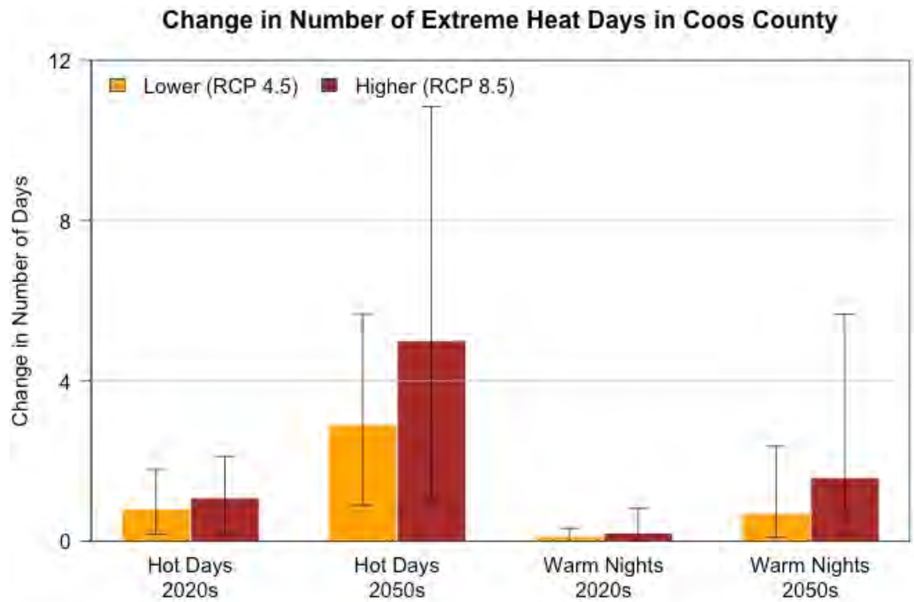


Figure 4. Projected changes in the number of hot days (left two sets of bars) and warm nights (right two sets of bars) in Coos County by the 2020s (2010–2039 average) and 2050s (2040–2069 average), relative to the historical baseline (1971–2000 average), under two emissions scenarios. The bars and whiskers represent the mean and range, respectively, of changes across 20 global climate models relative to each model's historical baseline. Hot days are those on which the maximum temperature is 90°F or higher; warm nights are those on which the minimum temperature is 65°F or higher.

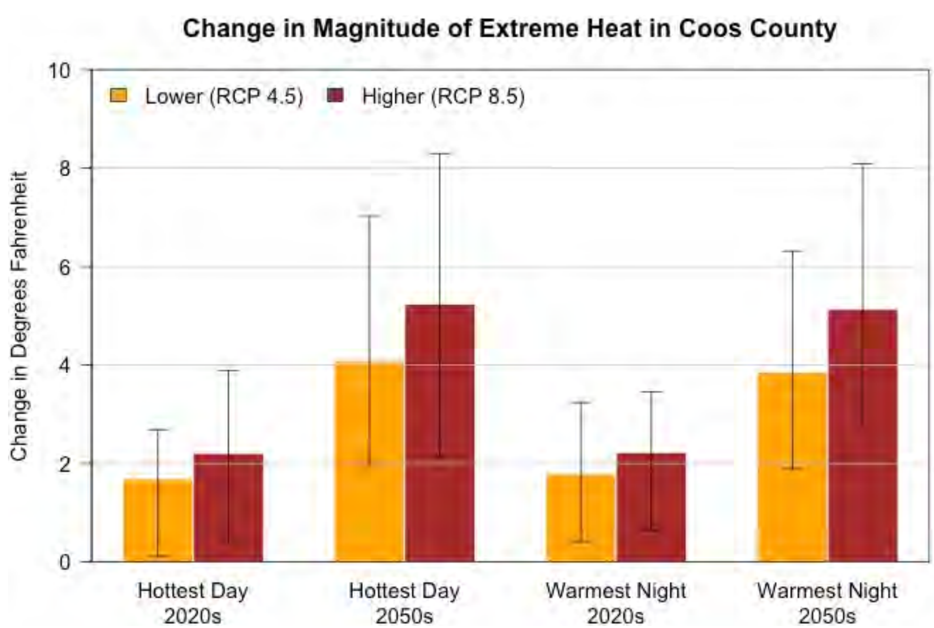


Figure 5. Projected changes in the temperature on the hottest day of the year (left two sets of bars) and warmest night of the year (right two sets of bars) in Coos County by the 2020s (2010–2039 average) and 2050s (2040–2069 average), relative to the historical baseline (1971–2000 average), under two emissions scenarios. The bars and whiskers represent the mean and range, respectively, of changes across 20 global climate models relative to each model's historical baseline.

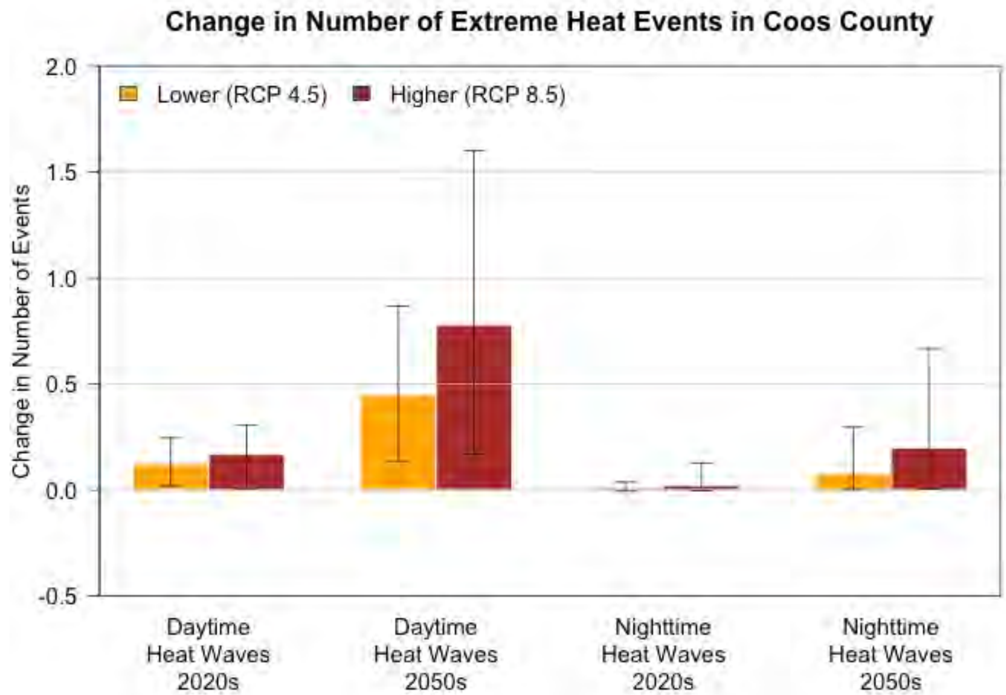


Figure 6. Projected changes in the number of daytime heat waves (left two sets of bars) and nighttime heat waves (right two sets of bars) in Coos County by the 2020s (2010–2039 average) and 2050s (2040–2069 average), relative to the historical baseline (1971–2000 average), under two emissions scenarios. The bars and whiskers represent the mean and range, respectively, of changes across 20 global climate models relative to each model's historical baseline. Daytime heat waves are defined as three or more consecutive days on which the maximum temperature is 90°F or higher; nighttime heat waves are three or more consecutive days on which the minimum temperature is 65°F or higher.

Key Messages

⇒ The number, duration, and intensity of extreme heat events is expected to increase as temperatures continue to warm.

⇒ In Coos County, the number of extremely hot days (days on which the temperature is 90°F or higher) and the temperature on the hottest day of the year are projected to increase by the 2020s and 2050s under both the lower (RCP 4.5) and higher (RCP 8.5) emissions scenarios.

⇒ In Coos County, the number of days per year with temperatures 90°F or higher is projected to increase by an average of 5 days (range 1–11 days) by the 2050s, relative to the 1971–2000 historical baselines, under the higher emissions scenario.

⇒ In Coos County, the temperature on the hottest day of the year is projected to increase by an average of about 5°F (range 2–8°F) by the 2050s, relative to the 1971–2000 historical baselines, under the higher emissions scenario.

Cold Waves

Over the past century, cold extremes have become less frequent and severe in the Northwest and worldwide. This trend is driven by human-caused climate change and is expected to continue (Vose *et al.*, 2017; IPCC, 2021). This report presents projected changes in three metrics of extreme daytime cold (maximum temperature) and nighttime cold (minimum temperature) (Table 7).

Table 7. Metrics and definitions of cold extremes.

Metric	Definition
Cold Days	Number of days per year on which the maximum temperature is 32°F or lower
Cold Nights	Number of days per year on which the minimum temperature is 0°F or lower
Coldest Day	Lowest value of maximum temperature per year
Coldest Night	Lowest value of minimum temperature per year
Daytime Cold Waves	Number of events per year in which maximum temperature on at least three consecutive days is 32°F or lower
Nighttime Cold Waves	Number of events per year in which minimum temperature on at least three consecutive days is 0°F or lower

In Coos County, the temperatures on the coldest day and night are projected to increase by the 2020s and 2050s under both emissions scenarios (Table 8, Figure 8). For example, by the 2050s under the higher emissions scenario, the temperature on the coldest night of the year is projected to increase by 1.5–8.4°F relative to the GCMs' historical baselines. The average projected increase in the temperature on the coldest night is 4.5°F above the average historical baseline of 23.8°F. The average projected increase in the temperature on the coldest day is 4.2°F above the average historical baseline of 39.0°F. However, cold days and nights and daytime and nighttime cold waves are rare in Coos County (Table 8, Figure 7, Figure 9).

Table 8. Mean (and range) of projected future changes in extreme cold metrics in Coos County by the 2020s (2010–2039 average) and 2050s (2040–2069 average), relative to the historical baseline (1971–2000 average) of each of 20 global climate models (GCMs), under a lower (RCP 4.5) and higher (RCP 8.5) emissions scenario. The average historical baseline across the 20 GCMs and the average projected future change can be used to infer the average projected future absolute value of a given variable. However, the average historical baseline and the range of projected future changes cannot be used to infer the range of projected future absolute values.

	Average Historical Baseline	2020s		2050s	
		Lower	Higher	Lower	Higher
Cold Days	0.2 days	0 days (-0.1 - 0.4)	0 days (-0.2 - 0.3)	-0.1 days (-0.2 - 0.1)	-0.1 days (-0.2 - 0.1)
Cold Nights	0 days	0 days (0 - 0)	0 days (0 - 0)	0 days (0 - 0)	0 days (0 - 0)
Coldest Day	39°F	1°F (-2.1 - 3.1)	1.9°F (-0.9 - 3.3)	3.1°F (0.3 - 5)	4.2°F (0.8 - 6.6)
Coldest Night	23.8°F	1.1°F (-1.4 - 3.4)	2.2°F (-0.1 - 4.2)	3.5°F (1.3 - 6.4)	4.5°F (1.5 - 8.4)
Daytime Cold Waves	0 events	0 events (0 - 0.1)	0 events (0 - 0.1)	0 events (0 - 0)	0 events (0 - 0)
Nighttime Cold Waves	0 events	0 events (0 - 0)	0 events (0 - 0)	0 events (0 - 0)	0 events (0 - 0)

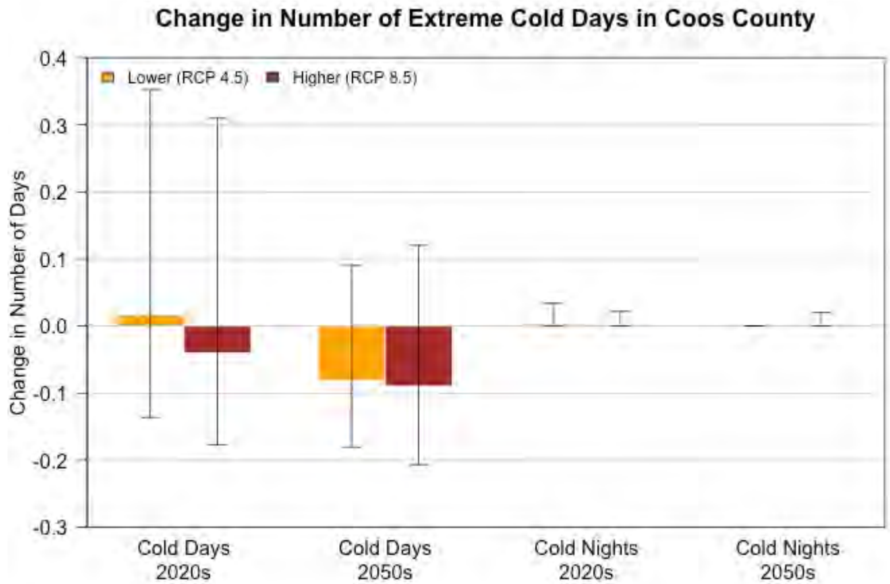


Figure 7. Projected changes in the number of cold days (left two sets of bars) and cold nights (right two sets of bars) in Coos County by the 2020s (2010–2039 average) and 2050s (2040–2069 average), relative to the historical baseline (1971–2000 average), under two emissions scenarios. The bars and whiskers represent the mean and range, respectively, of changes across 20 global climate models relative to each model's historical baseline. Cold days are those on which the maximum temperature is 32°F or lower; cold nights are those on which the minimum temperature is 0°F or lower.

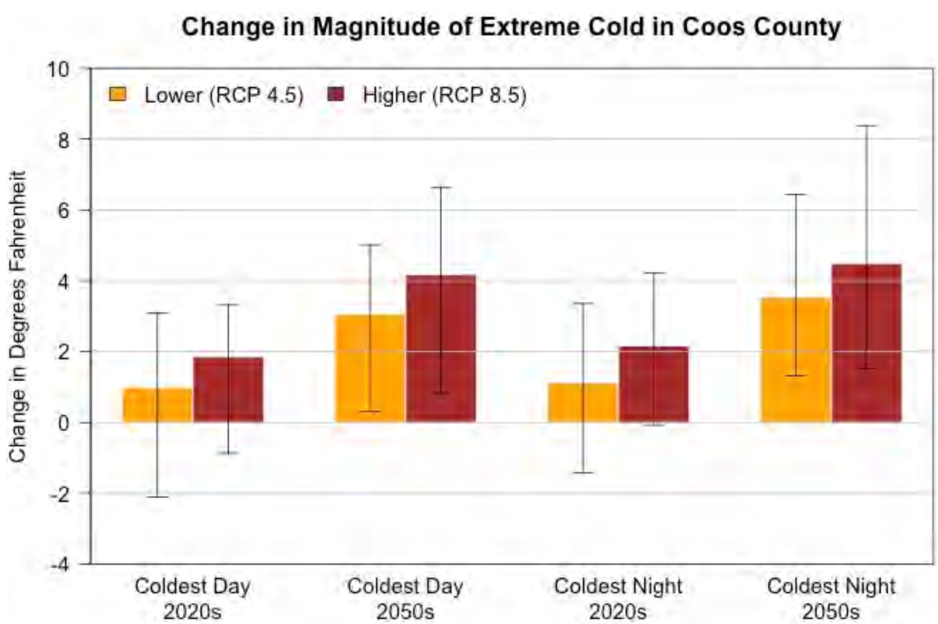


Figure 8. Projected changes in the temperature on the coldest day of the year (left two sets of bars) and coldest night of the year (right two sets of bars) in Coos County by the 2020s (2010–2039 average) and 2050s (2040–2069 average), relative to the historical baseline (1971–2000 average), under two emissions scenarios. The bars and whiskers represent the mean and range, respectively, of changes across 20 global climate models relative to each model's historical baseline.

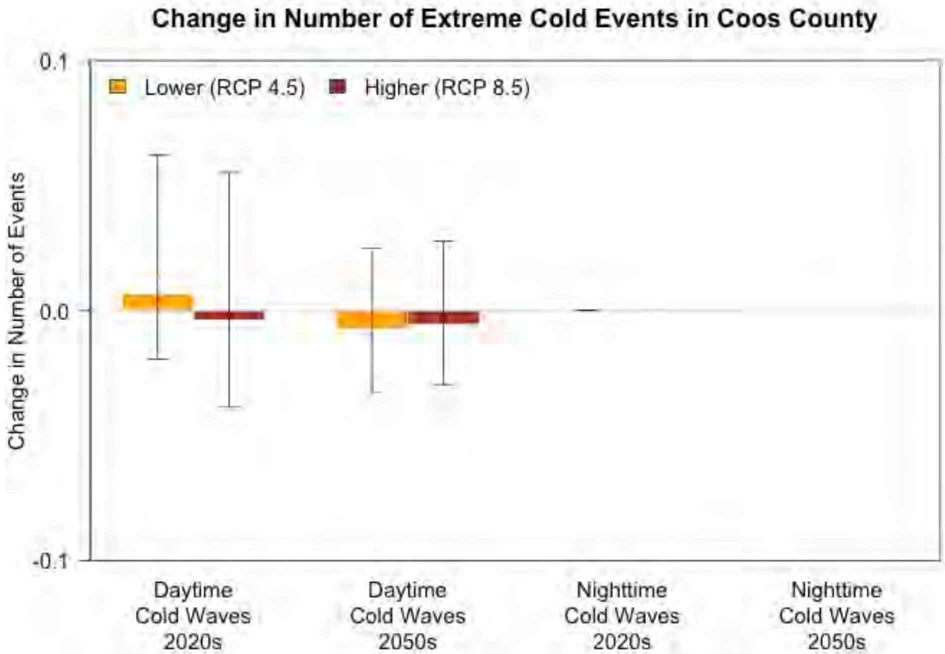


Figure 9. Projected changes in the number of daytime cold waves (left two sets of bars) and nighttime cold waves (right two sets of bars) in Coos County by the 2020s (2010–2039 average) and 2050s (2040–2069 average), relative to the historical baseline (1971–2000 average), under two emissions scenarios. The bars and whiskers represent the mean and range, respectively, of changes across 20 global climate models relative to each model's historical baseline. Daytime cold waves are defined as three or more consecutive days on which the maximum temperature is 32°F or lower; nighttime cold waves are three or more consecutive days on which the minimum temperature is 0°F or lower.

Key Messages

⇒ Cold extremes will become less frequent and intense as the climate warms.

⇒ In Coos County, the temperature on the coldest night of the year is projected to increase by an average of 4.5°F (range 2–8°F) by the 2050s, relative to the 1971–2000 historical baselines, under the higher emissions scenario.

Heavy Rains

There is greater uncertainty in projections of future precipitation than projections of future temperature. Precipitation has high natural variability, and the atmospheric patterns that influence precipitation are represented differently among GCMs. Global mean precipitation is likely to decrease in many dry regions in the subtropics and mid-latitudes and to increase in many mid-latitude wet regions (IPCC, 2013; Stevenson *et al.*, 2022). Because the location of the boundary between mid-latitude increases and decreases in precipitation varies among GCMs, some models project increases and others decreases in precipitation in Oregon (Mote *et al.*, 2013).

Observed annual precipitation in Oregon has high year-to-year variability and has not changed significantly; future trends in annual precipitation are expected to be dominated by natural variability (Dalton *et al.*, 2017; Dalton and Fleishman, 2021). On average, summers in Oregon are projected to become drier and other seasons to become wetter, resulting in a slight increase in annual precipitation by the 2050s. However, some models project increases and others decreases in each season (Dalton *et al.*, 2017).

Extreme precipitation events in the Northwest are governed by atmospheric circulation and its interaction with complex topography (Parker and Abatzoglou, 2016). Atmospheric rivers—long, narrow swaths of warm, moist air that carry large amounts of water vapor from the tropics to mid-latitudes—generally result in extreme precipitation events across large areas west of the Cascade Range. By contrast, low pressure systems that are not driven by westerly flows from offshore often lead to locally extreme precipitation east of the Cascade Range (Parker and Abatzoglou, 2016).

The frequency and intensity of heavy precipitation has increased across most land areas worldwide since the 1950s (IPCC, 2021). Observed trends in the frequency of extreme precipitation events across Oregon vary among locations, time periods, and metrics, but overall, the frequency has not changed substantially. As the atmosphere warms, it holds more water vapor. As a result, the frequency and intensity of extreme precipitation, including atmospheric rivers, is expected to increase (Dalton *et al.*, 2017; Kossin *et al.*, 2017; Dalton and Fleishman, 2021). Atmospheric rivers are associated with the majority of fall and winter extreme precipitation events in Oregon. Climate models project an increase in the number of days on which an atmospheric river is present, and they project that atmospheric rivers will account for an increasing proportion of total annual precipitation across the Northwest (Dalton and Fleishman, 2021). In addition, regional climate models project that the rain shadow effect over the Cascade Range in winter will weaken, resulting in relatively larger increases in seasonal precipitation and precipitation extremes east of the Cascade Range and smaller increases west of the Cascade Range (Mote *et al.*, 2019). This report presents projected changes in four metrics of precipitation extremes (Table 9).

Table 9. Metrics and definitions of precipitation extremes.

Metric	Definition
Wettest Day	Highest one-day precipitation total per water year (1 October–30 September)
Wettest Five Days	Highest consecutive five-day precipitation total per water year
Wet Days	Number of days per water year on which precipitation exceeds 0.75 inches
Landslide Risk Days	Number of days per water year that exceed the landslide threshold developed by the US Geological Survey for Seattle, Washington (see https://pubs.er.usgs.gov/publication/ofr20061064). P3/(3.5-.67*P15)>1, where P3 = Precipitation accumulation on prior days 1–3 ▪ P15 = Precipitation accumulation on prior days 4–18

In Coos County, the amount of precipitation on the wettest day and wettest consecutive five days is projected to increase on average by the by the 2020s (2010–2039) and 2050s (2040–2069), relative to the 1971–2000 historical baseline, under both the lower (RCP 4.5) and higher (RCP 8.5) emissions scenarios (Table 10, Figure 10). However, some models project decreases in these metrics for certain time periods and scenarios.

Climate models project that by the 2050s under the higher emissions scenario, the amount of precipitation on the wettest day of the year, relative to each GCM's 1971–2000 historical baseline, will change by -2.3–25.4% (Figure 10). The average projected amount of precipitation on the wettest day of the year is 12.3% greater than the average historical baseline of about 3 inches.

Climate models project that by the 2050s under the higher emissions scenario, the amount of precipitation on the wettest consecutive five days of the year will change by - 5.3–22.5% (Figure 10). The average projected amount of precipitation on the wettest consecutive five days is 9.1% above the average historical baseline of 7.4 inches.

The average number of days per year on which precipitation exceeds 0.75 inches is not projected to change substantially (Figure 11). For example, by the 2050s under the higher emissions scenario, the number of wet days per year is projected to change by 0.2 (range -4.4–4.1). The historical baseline is an average of 30 days per year.

Landslides are often triggered by rainfall when the soil becomes saturated. As a surrogate measure of landslide risk, this report presents a threshold based on recent rainfall (cumulative precipitation over the previous 3 days) and antecedent precipitation (cumulative precipitation on the 15 days prior to the previous 3 days). In Coos County, by the 2050s under the higher emissions scenario, the average number of days per year on which the landslide risk threshold is exceeded is projected to remain about the same, with a change of -0.5 days (range -4.6–4.4 days) (Figure 11). The historical baseline is an average of 31 days per year. Landslide risk depends on multiple site-specific factors, and this metric does not reflect all aspects of the hazard. The landslide risk threshold was developed for Seattle, Washington, and may be less applicable to other locations.

Landslide risk also can become high when heavy precipitation falls on an area that burned within approximately the past five to ten years. By the year 2100, under the higher emissions scenario, the probability that an extreme rainfall event will occur within one year after an extreme fire-weather event in Oregon or Washington was projected to increase by 700% relative to 1980–2005 (Touma *et al.*, 2022). Similarly, projections suggest that by 2100, 90% of extreme fire-weather events across Oregon and Washington are likely to be succeeded within five years by three or more extreme rainfall events (Touma *et al.*, 2022). Although fire weather is not synonymous with wildfire, these results highlight the increasing likelihood of compounded climate extremes that elevate the risk of natural hazards.

Table 10. Mean (and range) of projected changes in extreme precipitation in Coos County by the 2020s (2010–2039 average) and 2050s (2040–2069 average), relative to the historical baseline (1971–2000 average) of each of 20 global climate models (GCMs), under a lower (RCP 4.5) and higher (RCP 8.5) emissions scenario. The average historical baseline across the 20 GCMs and the average projected future change can be used to infer the average projected future absolute value of a given variable. However, the average historical baseline and the range of projected future changes cannot be used to infer the range of projected future absolute values.

	Average Historical Baseline	2020s		2050s	
		Lower	Higher	Lower	Higher
Wettest Day	3 inches	6.2% (-8.8-19.6)	6.1% (-9.6-27.4)	10.5% (-6.1-24.3)	12.3% (-2.3-25.4)
Wettest Five-Days	7.4 inches	3.4% (-8.7-13.9)	3.2% (-5.6-15.9)	7.8% (-2.6-24)	9.1% (-5.3-22.5)
Wet Days	29.6 days	0.1 days (-2.4-3)	-0.3 days (-4-2.2)	0.3 days (-3.5-3)	0.2 days (-4.4-4.1)
Landslide Risk Days	30.8 days	-0.5 days (-4.9-3.8)	-0.6 days (-3.5-3.7)	-1.6 days (-4.9-2)	-0.5 days (-4.6-4.4)

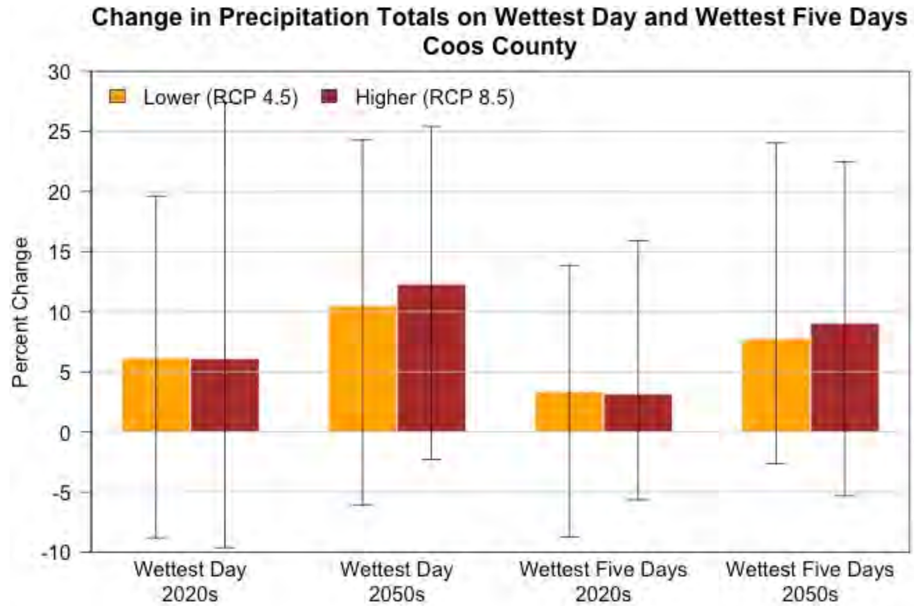


Figure 10. Projected percent changes in the amount of precipitation on the wettest day of the year (left two sets of bars) and wettest consecutive five days of the year (right two sets of bars) in Coos County by the 2020s (2010–2039 average) and 2050s (2040–2069 average), relative to the historical baseline (1971–2000 average), under two emissions scenarios. The bars and whiskers represent the mean and range, respectively, of changes across 20 global climate models relative to each model's historical baseline.

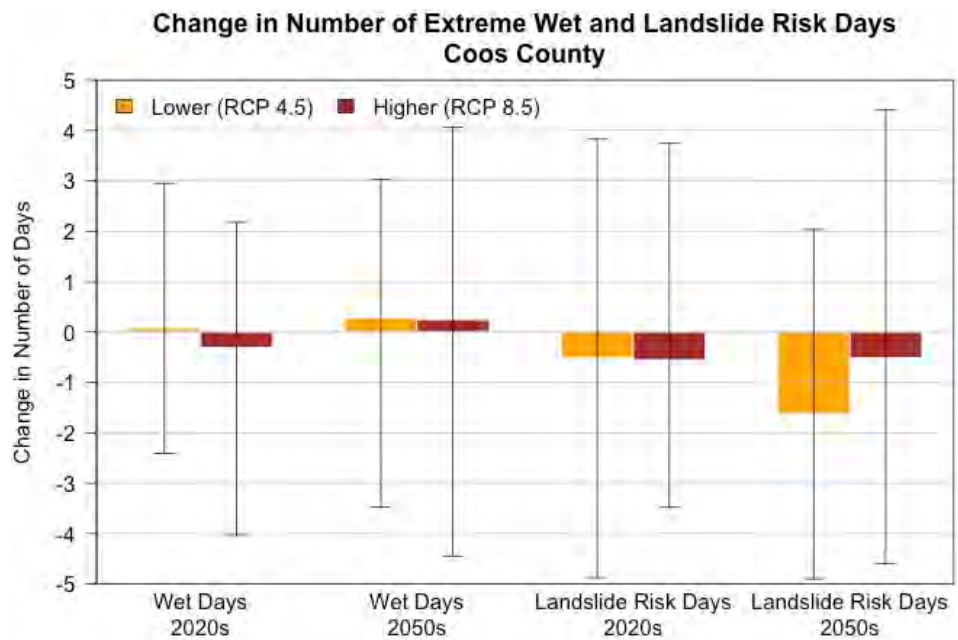


Figure 11. Projected changes in the number of wet days (left two sets of bars) and landslide risk days (right two sets of bars) in Coos County by the 2020s (2010–2039 average) and 2050s (2040–2069 average), relative to the historical baseline (1971–2000 average), under two emissions scenarios. The bars and whiskers represent the mean and range, respectively, of changes across 20 global climate models relative to each model's historical baseline.

Key Messages

⇒ The intensity of extreme precipitation is expected to increase as the atmosphere warms and holds more water vapor.

⇒ In Coos County, the number of days per year with at least 0.75 inches of precipitation is not projected to change substantially. However, by the 2050s, the amount of precipitation on the wettest day and wettest consecutive five days per year is projected to increase by an average of 12% (range -2–25%) and 9% (range -5–23%), respectively, relative to the1971–2000 historical baselines, under the higher emissions scenario.

⇒ In Coos County, the number of days per year on which a threshold for landslide risk, which is based on prior 18-day precipitation accumulation, is exceeded is not projected to change substantially. However, landslide risk depends on multiple factors, and this metric does not reflect all aspects of the hazard.

River Flooding

Streams in the Northwest are projected to shift toward higher winter runoff, lower summer and fall runoff, and earlier peak runoff, particularly in snow-dominated regions (Raymondi *et al.*, 2013; Naz *et al.*, 2016). These changes are expected to result from increases in the intensity of heavy precipitation; warmer temperatures that cause more precipitation to fall as rain and less as snow, in turn causing snow to melt earlier in spring; and increasing winter precipitation and decreasing summer precipitation (Dalton *et al.*, 2017; Mote *et al.*, 2019; Dalton and Fleishman, 2021).

Warming temperatures and increasing winter precipitation are expected to increase flood risk in many basins in the Northwest, particularly mid- to low-elevation mixed rain-and-snow basins in which winter temperatures are near freezing (Tohver *et al.*, 2014). The greatest projected changes in peak streamflow magnitudes are at intermediate elevations in the Cascade Range and Blue Mountains (Safeeq *et al.*, 2015). Recent regional hydroclimate models project increases in extreme high flows throughout most of the Northwest, especially west of the Cascade crest (Salathé *et al.*, 2014; Najafi and Moradkhani, 2015; Naz *et al.*, 2016). One study, which used a single climate model, projected an increase in flood risk in fall due to earlier, more extreme storms, including atmospheric rivers; and an increase in the proportion of precipitation falling as rain rather than snow (Salathé *et al.*, 2014). Rainfall-driven floods are more sensitive to increases in precipitation than snowmelt-driven floods. Therefore, the projected increases in total precipitation, and in rain relative to snow, likely will increase flood magnitudes in the region (Chegwidden *et al.*, 2020). Streamflow in rain-dominant watersheds reflects the seasonal pattern of precipitation, with peak flows occurring during winter and low flows occurring during summer. Few peer-reviewed publications have addressed potential future changes in streamflow in coastal rain-dominated watersheds, such as those in Coos County. Generally, future changes in rain-dominant basins are expected to be similar to changes in seasonal precipitation, with increases in winter peak flows and decreases in summer low flows.

Across much of the western United States, major floods—peak flow magnitudes associated with 100-year and 25-year return periods (1% and 4% probability that this daily flow magnitude would be exceeded in a given year)—are projected to increase by 2070–2099, compared to the 1971–2000 historical baseline, under the higher emissions scenario (Maurer *et al.*, 2018). Peak flow magnitudes with 25-year and 100-year return periods along the South Fork Coquille River at Powers are projected to increase by 15% and 14%, respectively, by 2070–2099 relative to the historical baseline. In effect, the magnitudes of floods currently corresponding to 25-year and 100-year peak flow events will become magnitudes corresponding to 15-year and 48-year events, respectively (Maurer *et al.*, 2018).

Some of the Northwest's highest floods occur when large volumes of warm rain from atmospheric rivers fall on a deep snowpack, resulting in rain-on-snow floods (Safeeq *et al.*, 2015). The frequency and amount of moisture transported by atmospheric rivers is projected to increase along the West Coast in response to increases in air temperature (Kossin *et al.*, 2017), which in turn increase the likelihood of flooding (Konrad and

Dettinger, 2017).

Future changes in the frequency of rain-on-snow events likely will vary along an elevational gradient. At lower elevations, the frequency is projected to decrease due to decreasing snowpack, whereas at higher elevations the frequency is projected to increase due to the shift from snow to rain (Surfleet and Tullos, 2013; Safeeq *et al.*, 2015; Musselman *et al.*, 2018). How such changes in frequency of rain-on-snow events are likely to affect streamflow varies. For example, projections for the Santiam River, Oregon, indicate an increase in annual peak daily flows at return intervals less than 10 years, but a decrease in annual peak daily flows at return intervals greater than or equal to 10 years (Surfleet and Tullos, 2013). Average runoff from rain-on-snow events in watersheds in northern coastal Oregon is projected to decline due to depletion of the snowpack (Musselman *et al.*, 2018), which may imply that the driver of floods in these areas shifts from rain-on-snow events to extreme rainfall that exceeds soil capacity (Berghuijs *et al.*, 2016; Musselman *et al.*, 2018). Shifts in vegetation and wildfire occurrences that affect soil properties also will likely affect water transport, but hydrological models generally have not accounted for these processes (Bai *et al.*, 2018; Wang *et al.*, 2020).

Key Messages

⇒ Winter flood risk in coastal rain-dominated watersheds in Coos County is projected to increase as winter temperatures increase. The temperature increase will lead to an increase in the percentage of precipitation falling as rain rather than snow.

Drought

Drought is common in the Northwest. The incidence, extent, and severity of drought has increased over the last 20 years relative to the twentieth century, and this trend is expected to continue under future climate change (Dalton and Fleishman, 2021). Drought can be defined in many ways (Table 11), but most fundamentally is insufficient water to meet needs (Redmond, 2002; Dalton and Fleishman, 2021).

Table 11. Definitions and characteristics of various drought classes. (Source: Dalton and Fleishman, 2021; Fleishman *et al*., unpublished)

Drought Class	Definition and Characteristics
Meteorological	• lack of precipitation • evaporative demand that exceeds precipitation • minimum period of time for consideration operationally is 90 days
Hydrological	• prolonged meteorological drought affects surface or subsurface water supply, such as streamflow, reservoir and lake levels, or groundwater levels • tends to evolve more slowly than meteorological drought, with extents longer than six months
Agricultural	• occurs when meteorological and hydrological drought impacts agricultural production • reflects precipitation shortages, differences between actual and potential evapotranspiration, soil water deficits, and reduced availability of irrigation water
Socioeconomic	• occurs when meteorological, hydrological, or agricultural drought reduces the supply of some economic or social good or service • often affects state and federal drought declarations
Ecological	• undesirable changes in ecological state caused by deficits in water availability • usually caused by meteorological or hydrological drought • sensitivity to water limitation varies among species and life stages
Flash	• relatively short periods of warm surface temperatures, low relative humidities and precipitation deficits, and rapidly declining soil moisture • tends to develop and intensify rapidly within a few weeks, and may be generated or magnified by prolonged heat waves
Snow	• snowpack—or snow water equivalent (SWE)—is below average for a given point in the water year, traditionally 1 April • often followed by summers with low river and stream flows • warm snow drought—low snowpack with above average precipitation and temperature • dry snow drought—low snowpack and low precipitation

Summers in Oregon are expected to become warmer and drier, and mountain snowpack is projected to decline due to warmer winter temperatures (Dalton and Fleishman, 2021). Across the western United States, the decline in mountain snowpack is projected to reduce summer soil moisture in the mountains (Gergel *et al.*, 2017). Climate change is expected to result in lower summer streamflows in snow-dominated basins across the Northwest as snowpack melts earlier due to warmer temperatures and decreases in summer precipitation (Dalton *et al.*, 2017; Mote *et al.*, 2019). As mountain snowpack declines, seasonal drought will become less predictable and snow droughts will increase the likelihood of meteorological and hydrological drought in subsequent seasons (Dalton and Fleishman, 2021).

Because watersheds in Coos County are largely rain-dominated, the drivers of drought and water scarcity are different than across much of the western United States, where mountain snowpack contributes to streamflow (Dalton *et al.*, 2017; Mote *et al.*, 2019). In Coos County, like much of the Pacific Northwest, winters are wet and summers are dry. Severe drought is rare during the rainy winters on the Oregon coast, but the region is prone to periods of summertime water scarcity, especially when precipitation is lower than average in spring and fall. This scarcity is exacerbated by the lack of natural storage in the snowpack) and built storage in reservoirs. Changes in landcover due to forest management practices that affect shading and water demand, climate-driven shifts in vegetation, and wildfires will likely exacerbate the effects of drought.

This report presents projected changes in four variables indicative of drought: low spring snowpack (snow drought), low summer soil moisture from the surface to 55 inches below the surface (agricultural drought), low summer runoff (hydrological drought), and low summer precipitation (meteorological drought). Drought is presented in terms of a change in the probability of exceeding the magnitude of seasonal drought conditions for which the historical annual probability of exceedance was 20% (5-year return period) (Figure 12).

In Coos County, summer (June–August) soil moisture, summer runoff, and summer precipitation are projected to decline by the 2050s under both lower (RCP 4.5) and higher (RCP 8.5) emissions scenarios. Therefore, seasonal drought conditions will occur more frequently by the 2050s under both emissions scenarios (Figure 12). By the 2050s under the higher emissions scenario, the annual probability of low summer soil moisture and low summer runoff is projected to be about 45% (2.2-year return period). The annual probability of low summer precipitation is projected to be 32% (3.1-year return interval). Spring snowpack is not a major determinant of drought conditions in low-elevation coastal watersheds, such as those in Coos County. Drought projections for the 2020s were not evaluated due to data limitations, but drought magnitudes in the 2020s likely will be smaller than those in the 2050s.

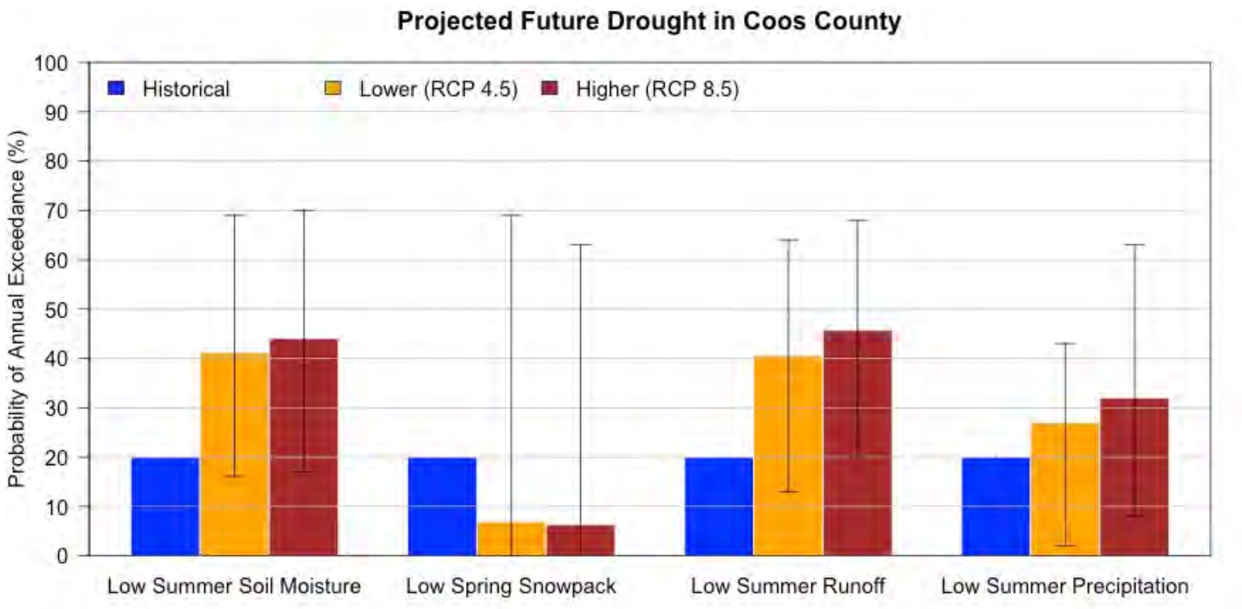


Figure 12. Projected probability of exceeding the magnitude of seasonal drought conditions for which the historical annual probability of exceedance was 20%. Projections are for the 2050s (2040–2069), relative to the historical baseline (1971–2000), under two emissions scenarios. Seasonal drought conditions include low summer soil moisture (average from June through August), low spring snowpack (April 1 snow water equivalent), low summer runoff (total from June through August), and low summer precipitation (total from June through August). The bars and whiskers represent the mean and range across ten global climate models. (Data Source: Integrated Scenarios of the Future Northwest Environment, https://climate.northwestknowledge.net/IntegratedScenarios/)

Key Messages

⇒ Drought, as represented by low summer soil moisture, low summer runoff, and low summer precipitation, is projected to become more frequent in Coos County by the 2050s.

Wildfire

Human activities have modified fire dynamics in the western United States through clearance of native vegetation for agriculture and urbanization, fragmentation and exploitation of forests and other natural land-cover types, human population growth and increased recreational activities, introduction of highly flammable, non-native annual grasses, and replacement of indigenous or natural fires by extensive fire suppression and vegetation management. From 1985 through 2017, the annual area burned by high-severity fires across forests in the western United States increased eightfold (Parks and Abatzoglou, 2020), although not along the Pacific Northwest coastlines that support naturally cool moist rainforests which, undisturbed under recent past conditions, would only support wildfires every few centuries.

Over the last several decades, warmer and drier summers have contributed to an increase in vegetation dryness and promoted pest outbreaks causing widespread mortality that enabled more-frequent large wildfires exacerbated by longer wildfire seasons across the western United States (Dennison *et al.*, 2014; Jolly *et al.*, 2015; Westerling, 2016; Williams and Abatzoglou, 2016). The lengthening of the wildfire season has been largely due to warmer springs causing earlier spring snowmelt and an overall decline in mountain snowpack mostly due to warmer winters (Westerling, 2016).

Vegetation drought stress is also often caused by air dryness. Records of high values of vapor pressure deficit (VPD) corresponds to the difference, in terms of pressure, between the water vapor in the air, and the air's saturation point, which is the maximum amount the air can carry at its current temperature (dew point). This pressure difference is what drives transpiration from the plants' stomata. VPD, or evaporative demand, is more strongly associated with forest area burned than precipitation, drought indices, or temperature (Sedano and Randerson, 2014; Williams *et al.*, 2014; Seager *et al.*, 2015; Rao *et al.*, 2022). The area of forests burned annually is expected to increase exponentially with increases in VPD across the western United States (Zhuang *et al.*, 2021; Juang *et al.*, 2022). Futhermore, fires often generate their own weather patterns with extremely hot and dry air that can kill plants without consuming them creating more fuel for future fires.

CMIP6 climate model results suggest that human emissions of greenhouse gases can explain a large percentage of the observed VPD increase (Zhuang *et al.*, 2021). In the western United States from 1984 through 2015, about half of the observed increase in vegetation dryness—driven mainly by the dryness of the air—and 4.2 million hectares (16,000 square miles) of burned area were attributable to human-caused climate change (Abatzoglou and Williams, 2016).

Fire danger is generally evaluated on the basis of daytime conditions that may cause wildfires to spread. Historically, wildfires were less active overnight. However, nights have become hotter and drier, and the temperature and duration of wildfires is expected to increase as a result (Balch *et al.*, 2022). In the western United States, the number of nights during which atmospheric conditions are conducive to burning has increased by 45% since 1979 (Balch *et al.*, 2022). Vegetation can also amplify or dampen the effect of aridity on wildfires. The geographic co-occurrence of plants with high water sensitivity (e.g., plants that do not close their stomata, shallow-rooted plants on porous soils) and high VPD suggests that the distribution of vegetation in the western United States has amplified the effect of climate change on wildfire hazard (Rao *et al.*, 2022).

High temperatures contribute to the drying of dead vegetation, but high VPD reduces moisture in live vegetation (e.g., the tree canopy), increasing the likelihood that any source of ignition will create a wildfire. The interaction between continued development in areas with flammable vegetation and increases in VPD suggests that projections of changing wildfire risk in the western United States may be conservative (Rao *et al.*, 2022), especially given that over 80% of all ignitions in the United States are now human-caused (Balch *et al.*, 2017) and that human activities have extended both the temporal and geographic extent of the fire season (Balch *et al.*, 2017; Bowman *et al.*, 2020). Furthermore, extreme wildfires may correspond to concurrent weather extremes, including high temperatures, aridity, and wind speeds. Coincidence among these extremes is becoming more common (Abatzoglou *et al.*, 2021).

Projecting wildfire risk across the western United States in response to changes in climate and land use requires understanding the interactions among biology, climate, and human activity. The probability of wildfire occurrence in the Cascade Range of Oregon as a function of temperature and precipitation is projected to increase by 63% under the lower emissions scenario (RCP 4.5) and 122% under the higher emissions scenario (RCP 8.5) (Gao *et al.*, 2021). Multiple modeling approaches indicate future increases in forest area burned in the western United States (Abatzoglou *et al.*, 2021). Similarly, model simulations of a common fire index based on precipitation and temperature, the Keetch–Byram Drought Index, and a proxy for fuel availability, suggest that the number of days on which fire risk is extremely high will increase through the end of the twenty-first century (Brown *et al.*, 2021). Overall, wildfire frequency, intensity, and area burned are projected to continue increasing in the Northwest, even in climatologically wet areas in western Oregon (Dalton *et al.*, 2017; Mote *et al.*, 2019; Dalton and Fleishman, 2021)

This report considers the number of days with extreme values of 100-hour fuel moisture (FM100) and VPD as a proxy for wildfire risk. FM100 is a measure of the percentage of moisture in the dry weight of dead vegetation with 1–3 inch diameter, and commonly is used by the Northwest Interagency Coordination Center (https://gacc.nifc.gov/nwcc/) to predict fire danger. A majority of climate models project that fuel moisture will decline across Oregon by the 2050s (2040–2069) under the higher emissions scenario (Gergel *et al.*, 2017). Drying of vegetation leads to greater wildfire risk, especially when coupled with decreases in summer soil moisture and increases in evaporative demand. CMIP6 model simulations given a higher emissions scenario projected that warm season VPD over the next 30 years will increase at a rate similar to that observed across the western United States from 1980 through 2020 (Zhuang *et al.*, 2021). Increases in VPD also were projected by CMIP5 models to contribute substantially to wildfire risk in eastern Oregon (Ficklin and Novick, 2017; Chiodi *et al.*, 2021). Furthermore, observed increases in nighttime temperatures (Balch *et al.*, 2022) and in nighttime VPD (Chiodi *et al.*, 2021) have been linked to fires burning longer into the night and increasing in intensity much earlier in the morning, which reduces the window of opportunity for suppression.

In this report, the future change in wildfire risk is expressed as the increase in the average annual number of days on which fire danger is very high and VPD is extreme. Projections are presented for two future periods under two emissions scenarios compared to the historical baseline. A day on which fire danger is very high is defined as a day on which FM100 is lower (i.e., vegetation is drier) than the historical 10th percentile value. Historically, fire danger was very high on 36.5 days per year. A day on which VPD is extreme is defined as a day on which VPD exceeds the historical warm season (March–November) 90th percentile value.

In Coos County, the average number of days per year on which fire danger is very high is projected to increase by 11 days (range -6–30) by the 2050s, compared to the historical baseline, under the higher emissions scenario (Figure 13). The average number of days per year on which VPD is extreme is projected to increase by 30 days (range 9–56) by the 2050s, compared to the historical baseline, under the higher emissions scenario (Figure 14). The impacts of wildfire on air quality are discussed in the following section, Reduced Air Quality.

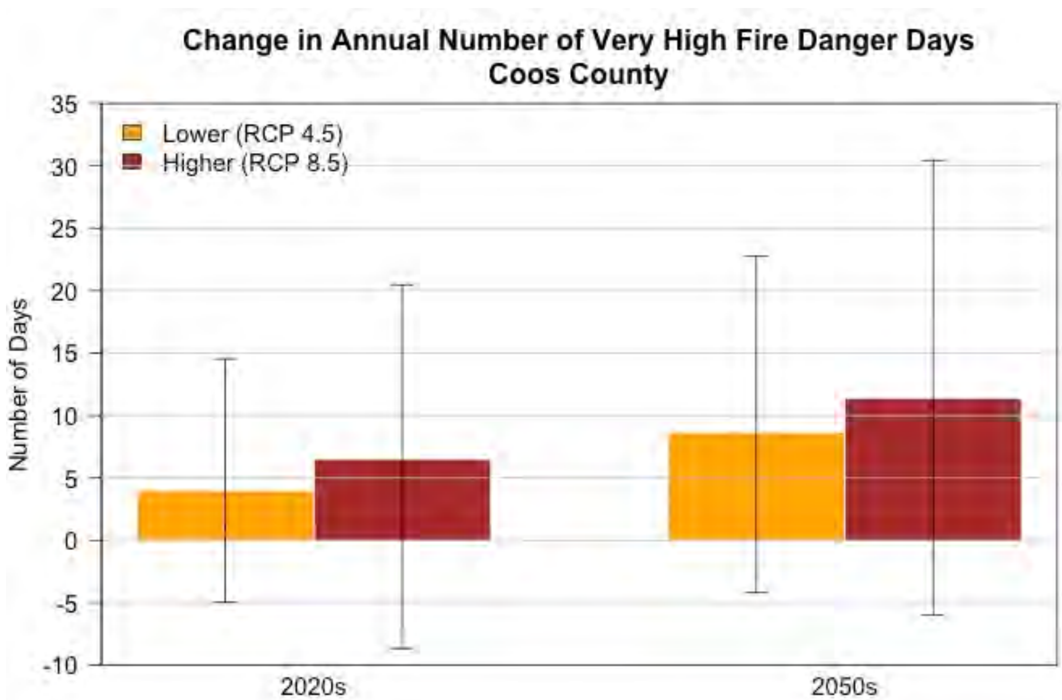


Figure 13. Projected changes by the 2020s (2010–2039 average) and 2050s (2040–2069 average), relative to the 1971–2000 historical baseline and under two emissions scenarios, in the number of days on which fire danger in Coos County is very high. The bars and whiskers represent the mean and range, respectively, of changes across 18 global climate models. (Data Source: Climate Toolbox, climatetoolbox.org/tool/Climate-Mapper)

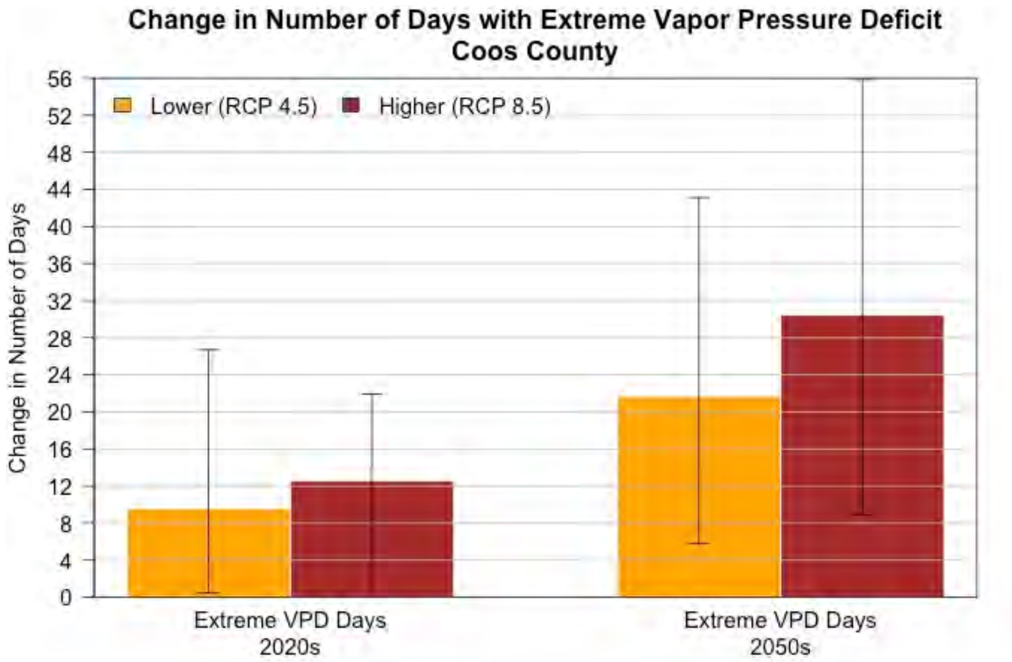


Figure 14. Projected changes by the 2020s (2010–2039 average) and 2050s (2040–2069 average), relative to the 1971–2000 historical baseline and under two emissions scenarios, in the number of days on which vapor pressure deficit in Coos County is extreme. The bars and whiskers represent the mean and range, respectively, of changes across 20 global climate models. (Data Source: Climate Toolbox, climatetoolbox.org/tool/Climate-Mapper)

Key Messages

⇒ Wildfire risk, expressed as the average number of days per year on which fire danger is very high, is projected to increase in Coos County by 11 days (range -6–30) by the 2050s, relative to the historical baseline, under the higher emissions scenario.

⇒ In Coos County, the average number of days per year on which vapor pressure deficit is extreme is projected to increase by 30 days (range 9–56) by the 2050s, compared to the historical baseline, under the higher emissions scenario.

Reduced Air Quality

Climate change is expected to reduce outdoor air quality. Warmer temperatures may increase ground-level ozone concentrations, increases in the number and size of wildfires may increase concentrations of smoke and particulate matter, and increases in pollen abundance and the duration of pollen seasons may increase aeroallergens. Such poor air quality is expected to exacerbate allergy and asthma conditions and increase the incidence of respiratory and cardiovascular illnesses and death (Fann *et al.*, 2016).

Over the past several decades, fire seasons have increased in length, and the intensity and severity of wildfires have increased; this trend is expected to continue as a result of complex factors including traditional forest management practices, increasing population density in fire risk zones, and climate change (Sheehan *et al.*, 2015). Large wildfires in the western United States created extensive smoke plumes that traveled at high altitudes over long distances and affected air quality not only near to but far from those wildfires. Hazardous levels of air pollution are most common near wildfires. Fires emit fine particulate matter (less than 2.5 micrometers in diameter [$PM_{2.5}$]), which exacerbates chronic cardiovascular and respiratory illnesses (Cascio, 2018). In addition, because exposure to $PM_{2.5}$ increases susceptibility to viral respiratory infections, exposure to wildfire smoke is likely to increase susceptibility to and the severity of reactions from Covid-19 (Henderson, 2020). Wildfire smoke also impairs visibility and can disrupt outdoor recreational and social activities, in turn affecting physical and mental health (Nolte *et al.*, 2018).

From 2000 through 2020, the frequency, duration, and area of co-occurrence of two air pollutants related to wildfire smoke, $PM_{2.5}$ and ozone, increased in the western United States (Kalashnikov *et al.*, 2022). Wildfires emit ozone precursors that in hot and sunny conditions react with other pollutants to increase the concentration of ozone. The area in which $PM_{2.5}$ and ozone co-occurred more than doubled during the past 20 years.

Wildfires are the primary cause of exceedances of air quality standards for $PM_{2.5}$ in western Oregon and parts of eastern Oregon (Liu *et al.*, 2016), although woodstove smoke and diesel emissions also contribute (Oregon DEQ, 2016). Fine particulate matter from vehicles, woodstoves, and power plants can be regulated, but it is much more difficult to control wildfires and, therefore, increasingly chronic smoke exposure that has potentially severe health consequences (Liu *et al.*, 2016). Across the western United States, $PM_{2.5}$ concentrations from wildfires are projected to increase 160% by 2046–2051, relative to 2004–2009, under a medium emissions scenario (SRES A1B) (Liu *et al.*, 2016). The SRES A1B scenario, which is from an earlier generation of emissions scenarios, is most similar to RCP 6.0 (Figure 2). CMIP6 models integrated with an empirical statistical model projected that $PM_{2.5}$ concentrations in August and September in the Northwest will double to triple by 2080–2100 under lower (SSP5-4.5) and higher (SSP5-8.5) emissions scenarios (Xie *et al.*, 2022).

This report presents projections of future air quality that are based on $PM_{2.5}$ from wildfire smoke. Smoke wave days are defined as two or more consecutive days on which simulated, county-averaged, wildfire-derived $PM_{2.5}$ values are in the highest 2% of simulated daily values from 2004 through 2009 (Liu *et al.*, 2016). Smoke wave intensity is defined as the concentration of $PM_{2.5}$ on smoke wave days. Mean number of smoke wave days and mean smoke wave intensity are projected for two six-year periods, 2004–2009 and 2046–2051, under a medium emissions scenario. More information about the methods underlying these projections of future air quality is in the Appendix. In Coos County, the number of smoke wave days is projected to decrease by 15%, whereas the intensity of smoke wave days is projected to increase by 69% (Figure 15).

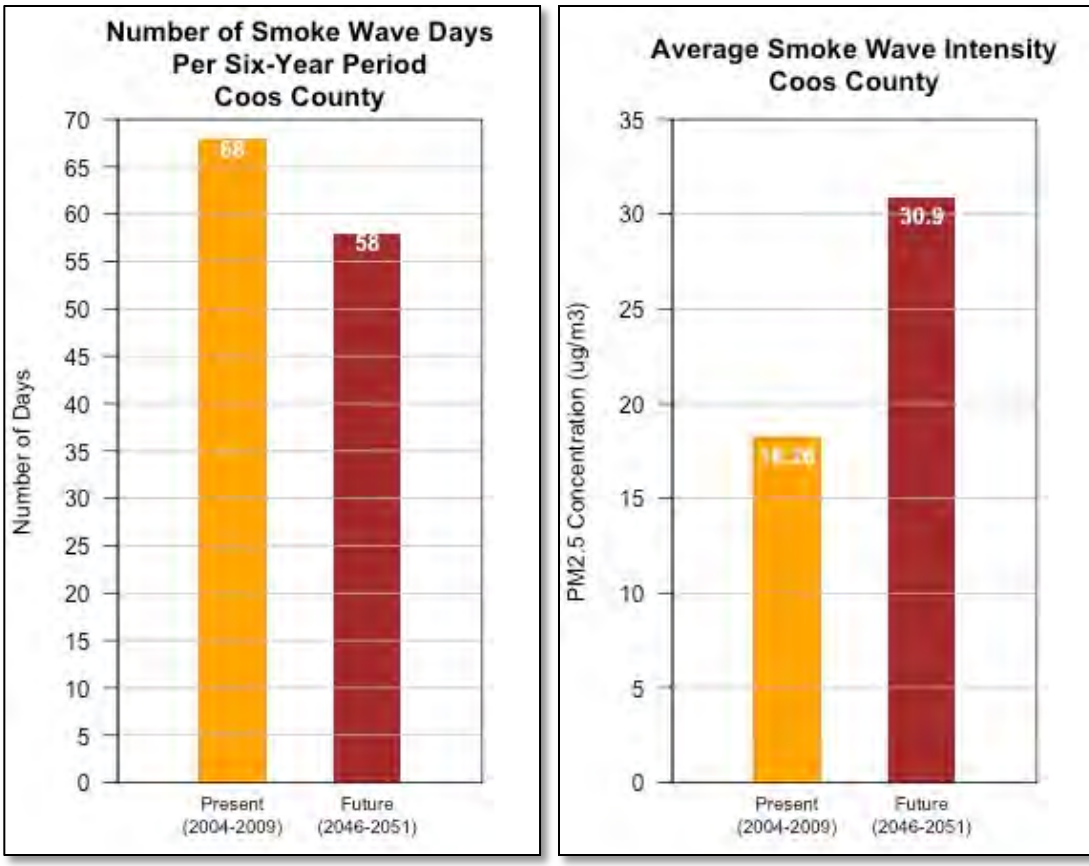


Figure 12. Simulated present (2004–2009) and future (2046–2051) number (left) and intensity (right) of smoke wave days in Coos County under a medium emissions scenario. Values represent the mean among 15 global climate models. (Data source: Liu et al. 2016, https://khanotations.github.io/smoke-map/)

Vegetation is also responding to changes in climate and atmospheric concentrations of carbon dioxide by producing more pollen, and by producing pollen earlier in the spring and for longer periods of time (Ziska *et al.*, 2009). From 1990 through 2018, pollen seasons increased by about 20 days and pollen concentration increased by 21% in the conterminous United States (Anderegg *et al.*, 2021), including northern California (Paudel *et al.*, 2021).

Fungal spores also could become more abundant following extreme floods or droughts, which are expected to become more common with climate change. The period during which outdoor airborne mold spores are detectable increased in the last 20 years as a result of increasing concentrations of carbon dioxide and changes in climate and land use (Paudel *et al.*, 2021). Furthermore, because both ozone and particulates affect the sensitivity of respiratory systems to airborne allergens, the combined effects of climate change, air pollution, and changes in vegetation phenology will likely increase the severity of respiratory diseases and allergies (D'Amato *et al.*, 2020).

Key Messages

⇒ The risk of wildfire smoke in Coos County is projected to increase.

⇒ In Coos County, the number of days per year on which the concentration of wildfire-derived fine particulate matter results in poor air quality is projected to decrease by 15%, and the concentration of fine particulate matter is projected to increase by 69%, from 2004–2009 to 2046–2051 under a medium emissions scenario.

Coastal Erosion and Flooding

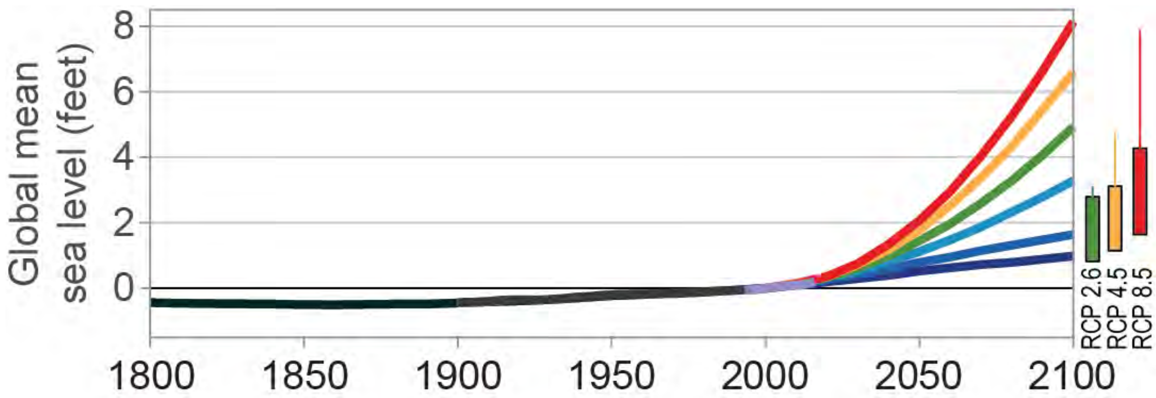
Variability in water levels associated with the El Niño–Southern Oscillation, tides, storm surges, and waves, especially in conjunction with relative sea level rise, can result in flooding and erosion along the Oregon coast. Projected changes in these processes and phenomena may increase their risks to coastal communities and, in some cases, ecosystems. Relative refers to the fact that sea level rise is calculated with respect to land elevations. Differences in the rate and direction of vertical land motions along the Oregon coast can affect relative sea level rise strongly.

Observed and Projected Trends in Sea Level

Global mean sea level has risen by about 7–8 inches since 1900, and recent observations suggest that rates of sea level rise have accelerated since 1993 (Nerem *et al.*, 2018). Global mean sea level is very likely to continue to rise by another 1–4 feet, relative to the year 2000, by the year 2100 (Sweet *et al.*, 2017a; Hayhoe *et al.*, 2018). Instabilities in Antarctic ice sheets that are plausible, but have low probability, could result in much higher (~8 feet) global sea level rise (Hayhoe *et al.*, 2018) (Figure 16).

Recent advances in sea level observations and modeling increased understanding of the processes that contribute to global and regional changes in sea level. These processes include changes in ice sheets and glaciers; changes in water storage on land; thermal expansion of sea water; changes in freshwater input; changes in vertical land motion; and changes in tides, storm surges, and waves (Hamlington *et al.*, 2020). Projected sea level rise varies along the Oregon coast, primarily due to variations in vertical land motions.

Local sea level at the National Oceanic and Atmospheric Administration (NOAA) water-level station at Charleston, Oregon rose about one inch from 1978–2013. Climate change is expected to accelerate sea level rise along the southern Oregon coast during the twenty-first century. Local sea level is projected to rise by 1.2–5.3 feet by 2100 (Climate Central, 2022) given the intermediate-low and intermediate-high global sea level scenarios used in the 2018 U.S. National Climate Assessment (Sweet *et al.*, 2017a) (Table 12). This range of sea level rise scenarios is similar to the *very likely* range projected under the higher emissions scenario (RCP 8.5) by 2100 (Figure 16). Additionally, median local sea level rise at Charleston, Oregon, was projected for each decade from 2030–2100, relative to the 1992 mean high tide line, given six scenarios of global sea level rise. These projections incorporated estimates of trends in vertical land movement derived from GPS measurements and tide gauge platforms (Sweet *et al.*, 2017b) (Table 12). Accordingly, the projections are relative to the future land position as opposed to the existing land position.



Scenario	RCP 2.6	RCP 4.5	RCP 8.5
Low (1 ft)	94%	98%	100%
Intermediate-Low (1.6 ft)	49%	73%	96%
Intermediate (3.3 ft)	2%	3%	17%
Intermediate-High (4.9 ft)	0.4%	0.5%	1.3%
High (6.6 ft)	0.1%	0.1%	0.3%
Extreme (8.2 ft)	0.05%	0.05%	0.1%

Figure 13. (Top) Global mean sea level rise from 1800 to 2100, based on tide gauge-based reconstruction (black), satellite-based reconstruction (purple), and six future scenarios (navy blue, royal blue, cyan, green, orange, red) used in the 2018 U.S. National Climate Assessment (NCA4). Colored boxes indicate the *very likely* ranges in 2100 given different RCPs. Lines augmenting the very likely ranges account for estimates of accelerated Antarctic ice-sheet melt. (Bottom) Probability of exceeding each NCA4 global mean sea level scenario in 2100 under three RCPs. (Source: Sweet et al., 2017a, https://science2017.globalchange.gov/chapter/12/)

Table 12. Median local sea level rise projections at the NOAA water level station at Charleston, Oregon, based on scenarios used in the 2018 U.S. National Climate Assessment. Sea level rise is feet above the 1992 baseline. Each scenario also has an associated likely range of sea level rise (not shown). Projections account for estimated trends in vertical land movement. (Source: Climate Central Surging Seas Risk Finder, https://riskfinder.climatecentral.org/county/coos-county.or.us?comparisonType=county&forecastType=NOAA2017_int_p50&level=4&unit=ft&zillowPlaceType=postal-code)

Scenario	2030	2040	2050	2060	2070	2080	2090	2100
Low	0.2	0.3	0.4	0.5	0.6	0.6	0.7	0.7
Intermediate-Low	0.3	0.4	0.5	0.7	0.8	0.9	1.1	1.2
Intermediate	0.5	0.8	1.0	1.3	1.7	2.1	2.6	3.1
Intermediate-High	0.7	1.1	1.5	2.1	2.8	3.5	4.4	5.3
High	1.0	1.5	2.3	3.1	4.0	5.2	6.5	8.0
Extreme	1.2	1.8	2.7	3.8	5.1	6.5	8.1	10.0

Anticipated Effects of Climate Change on Ocean Wave Climate

Wave climate refers to attributes of waves that are averaged over a given period of time in a given location. Wind waves can be dominant contributors to total water levels at the coastline via their influence on wave setup and swash (the movement of water that washes up on the beach after a wave breaks) (Melet *et al.*, 2020). Although significant uncertainties remain, along the mainland west coast of the United States, mean wave height is projected to decrease by approximately 2–20% (Hemer *et al.*, 2013; Wang *et al.*, 2014; Erikson *et al.*, 2015; Morim *et al.*, 2019), and mean wave period is projected to increase by approximately 2–5% (Hemer *et al.*, 2013; Erikson *et al.*, 2015; Morim *et al.*, 2019), by 2100. Mean wave direction is projected to shift anticlockwise (more waves from the south) by approximately 2–5% by 2100 (Hemer *et al.*, 2013; Erikson *et al.*, 2015; Morim *et al.*, 2019), likely due to a northward shift in storm tracks along the west coast of the United States. Projection of future deep-water wave conditions has progressed considerably. However, deep-water wave conditions must be downscaled to the nearshore to understand the local effects of these changes. Such local downscaling can be computationally demanding and time intensive. Because wave transformation across the shelf determines which storm events affect the coastline, the nearshore effects of a change in the deep-water wave climate may vary in space, even at nearby locations (Serafin *et al.*, 2019).

A simultaneous increase in wave period and decrease in wave height may have contrasting effects on a location's wave energy flux. Global wave power, which is the transport of wave energy, increased since 1948, most likely due to increases in temperatures of the upper ocean (Reguero *et al.*, 2019). However, average and extreme conditions may be modified by the future global climate in different ways. For example, although the annual average wave height may decrease across the west coast of the United States, annual maximum and winter wave heights may increase (Wang *et al.*, 2014). Ongoing research will continue to advance understanding of the impacts of alterations to the wave climate and will examine extreme and average conditions separately.

Coastal Erosion

Over the past 100 years (late 1800s through 2002), trends in beach erosion were statistically significant in only three of Oregon's 18 littoral cells (coastal compartments within which sediment movement is self-contained), Humbug, Heceta, and Netarts (Ruggiero *et al.*, 2013). However, in the shorter term (1967–2002), 10 of Oregon's littoral cells eroded at a statistically significant rate of 1–3.6 feet per year (Ruggiero *et al.*, 2013). This increase in rates of erosion along much of Oregon's coastline may be related to the effects of sea level rise and changes in storm patterns (Ruggiero *et al.*, 2013). In the Bandon littoral cell, which is along the coastline of Coos County between Cape Blanco and Cape Arago, the average annual rate of accretion across the shoreline was a statistically significant 0.7 feet, although 39% of the shoreline is eroding (Ruggiero *et al.*, 2013).

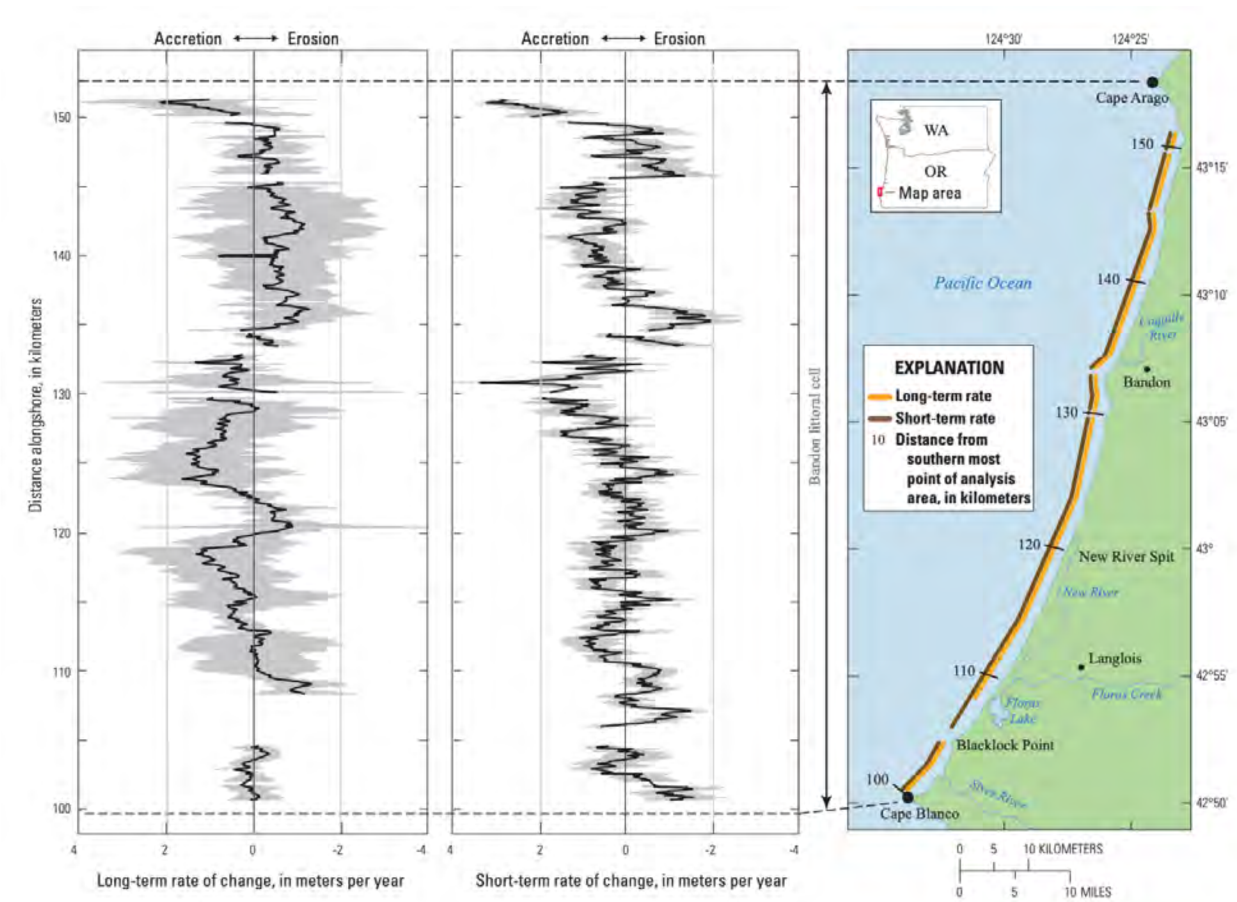


Figure 14. Long-term (1800s through 2002) and short-term (1960s through 2002) shoreline change rates (black lines on plots) in the Bandon littoral cell along the coastline of Coos County, Oregon. Shaded gray area behind long- and short-term rate lines represents uncertainty associated with rate calculation. (Source: Ruggiero et al., 2013)

Coastal Flooding

The projected increase in relative sea levels along the Oregon coast raises the starting point (still water level) for waves, storm surges, and high tides that can impinge on beaches and backshore areas. Possible changes to waves, storm surges, and tides have the potential to make coastal flooding in Oregon (which is associated with total water levels) more severe and more frequent in the future. A simple estimate of coastal flood risk combined projections of relative sea level rise and historic flood frequencies to estimate the multiple-year risk of flooding above a certain threshold (Climate Central, 2022). For example, one can project the likelihood that at least one coastal flood will exceed four feet above mean high tide by a given year (Table 13).

Assuming the intermediate-low to intermediate-high sea level scenarios for Charleston, Oregon (Table 12), the projected likelihood that at least one flood will exceed four feet above mean high tide was 4–34% by 2030, 25–100% by 2050, and 100% by 2100 (Climate Central, 2022) (Table 13). For historical perspective, the highest observed flood in the area from 1970 through 2015 was 3.56 feet above mean high tide in 1983, and the statistical 1-in-100 year flood height is 3.6 feet (Climate Central, 2022). As of 2010, 1062 people, 592 buildings, and $72 million in property value in Coos County are within zero to four feet above mean high tide and are not protected by levees or other features (Climate Central, 2022). These flood risk projections did not incorporate changes to wave dynamics or storm surges, which could result in a given coastal flood level occurring sooner.

Table 13. Percent likelihood that at least one flood will exceed four feet above mean high tide from 2016 through each year. Likelihoods are based on median projections of local sea level rise at Charleston, Oregon (Table 12). (Source: Climate Central Surging Seas Risk Finder, https://riskfinder.climatecentral.org/county/coos-county.or.us?comparisonType=county&forecastName=Basic&forecastType=NOAA2017_extreme_p50&level=4&unit=ft&zillowPlaceType=postal-code)

Scenario	2030	2040	2050	2060	2070	2080	2090	2100
Low	2	4	9	16	30	48	67	81
Intermediate-Low	4	11	25	47	73	92	99	100
Intermediate	14	45	85	99	100	100	100	100
Intermediate-High	34	85	100	100	100	100	100	100
High	64	100	100	100	100	100	100	100
Extreme	83	100	100	100	100	100	100	100

Relative sea level rise narrows the gap in elevations between commonly occurring high tides and the thresholds above which flooding begins. Coastal communities were developed with an understanding of this gap and the flooding that could occur under extreme conditions. When considering only long-term sea level trends (still water levels), the gap between high tide and flooding may be filled on the order of decades. When considering sea-level variability associated with waves (total water levels), flooding and its effects on the built and natural environment may become frequent much sooner, on the order of years (Mills *et al.*, 2018; Hamlington *et al.*, 2020). Incremental increases in relative sea level rise can produce exponential increases in coastal flood frequency (Taherkhani *et al.*, 2020). For example, on the west coast of the United States, approximately 2.1 inches of sea level rise doubles the odds of exceeding the present-day, 50-year water-level event (a flood level with a 2% annual probability of exceedance) (Taherkhani *et al.*, 2020). The odds of such extreme flooding double about every five years (Taherkhani *et al.*, 2020).

The Oregon Coastal Management Program (OCMP) estimated the exposure to sea level rise of Oregon's estuaries, including the Coquille River and Coos Bay estuaries in Coos County (Sepanik *et al.*, 2017). The OCMP sea level rise scenarios are taken from the upper range of projections for Newport, Oregon in *Sea-Level Rise for Coasts of California, Oregon, and Washington* (National Research Council, 2012). In this report for Coos County, OCCRI summarized the sea level rise and flooding scenarios considered by OCMP for Coos County and compared them to the sea level rise and flooding scenarios from the 2018 U.S. National Climate Assessment (2018 NCA) and Climate Central (Table 14) to place the OCMP analysis in the context of more-recent sea level rise scenarios (Table 12).

OCMP's scenarios for the 2030s and 2050s most closely align with the 2018 NCA's median intermediate-high scenario. OCMP's sea level rise scenario for 2100 most closely aligns with the lower end of the likely range of 2018 NCA's intermediate-high scenario (Table 14). The OCMP estimated that across the two major estuaries in Coos County, the mean flood levels coinciding with a 1% and 50% probability of exceedance in a given year were 3.72 feet and 2.45 feet, respectively (Sepanik *et al.*, 2017). These levels are similar to Climate Central's estimates for Charleston, Oregon's mild flood level (2.4 feet) and major flood level (3.6 feet) (Table 14).

Climate Central's projections of water levels resulting from combined effects of sea level rise and flooding, and associated likelihoods of flood risk, can be compared to OCMP's water-level scenarios (Table 14, Table 15). For example, the likelihood that flood levels will exceed four feet above mean high tide in any single year by 2050, similar to OCMP's 2050 + 50% scenario, is 56%, but the likelihood that four feet will be exceeded at some point between 2016 and 2050 is 100% (Table 15). The likelihood that flood levels will exceed seven feet above mean high tide in any single year by 2100, similar to OCMP's extreme scenario, 2100 + 1%, is 33%, whereas the likelihood that seven feet will be exceeded at some point between 2016 and 2100 is 82% (Table 15). The likelihood of exceeding seven feet by 2110, just a decade later, is 100% (Climate Central, 2022).

Table 14. Sea level rise (SLR) and flooding scenarios for a given year that were generated by the Oregon Coastal Management Program (OCMP), Climate Central, and 2018 U.S. National Climate Assessment (NCA). (Source: Sepanik et al., 2017; Climate Central Surging Seas Risk Finder for Coos County, Oregon, https://riskfinder.climatecentral.org)

OCMP SLR Scenario[2]	2018 NCA SLR Scenario[3]
2030: 0.75 feet	2030: 0.7 feet
2050: 1.57 feet	2050: 1.5 feet
2100: 4.66 feet	2100: 4.3 feet
OCMP Flood Scenario[4]	**Climate Central Flood Scenario[5]**
1% probability: 3.72 feet	major flood: 3.6 feet
50% probability: 2.45 feet	mild flood: 2.4 feet

Table 15. Scenarios of the combined effects of sea level rise (SLR) and flooding developed by the Oregon Coastal Management Program (OCMP) and Climate Central. Climate Central estimated the likelihood that water levels will exceed the given floor (the integer before the decimal; the floor of a flood of 4.4 feet is 4 feet) in any single year and at some point during the given time period. The OCMP water levels were averaged over the Coquille River and Coos Bay estuaries in Coos County. Water levels were derived from the applicable sea level rise and flood scenarios in Table 14. (Source: Sepanik et al., 2017; Climate Central Surging Seas Risk Finder for Coos County, Oregon, https://riskfinder.climatecentral.org)

OCMP SLR + Flood Scenarios	OCMP SLR + Flood Water Level (feet)	Climate Central Equivalent SLR + Flood Water Level (feet)	Climate Central Estimated Single Year Flood Risk (%)	Climate Central Estimated Multiple-Year Flood Risk (%)
2030 + 50%	3.2	3.1	70	100
2030 + 1%	4.5	4.3	6	34
2050 + 50%	4.0	4.0	56	100
2050 + 1%	5.3	5.1	2	7
2100 + 50%	7.1	6.7	95	100
2100 + 1%	8.4	7.8	33	82

[2] The OCMP analysis used the upper end of the range of sea level rise projections for Newport, Oregon (NRC, 2012).

[3] The 2018 NCA sea level rise scenario for Charleston, Oregon that most closely aligns with the OCMP 2030 and 2050 sea level rise scenarios is the median of the intermediate-high scenario. The NCA 2018 sea level scenario that most closely aligns with the OCMP 2100 scenario is the 17th percentile of the intermediate-high scenario.

[4] The OCMP analysis used NOAA's estimates of extreme water levels to calculate the 1% and 50% probability of exceedance in a given year. Values are averaged over two estuaries in Coos County.

[5] Extreme water levels at the NOAA water level station at Charleston, Oregon

Under the 2050 + 50% scenario, which is virtually certain to occur at least once by 2050, exposed assets in the Coos Bay and Coquille Rivers estuaries in Coos County include 4.3 miles of state highways, 6.6 miles of state, county and local roads, 9.4 miles of railways, 3 critical facilities, 2 municipal use drinking water facilities, 3 potential contaminant sources, and 715 buildings (Table 16). Under the 2100 + 1% scenario, which has an 82% likelihood of occurring at least once by 2100 and is virtually certain to occur at least once by 2110, exposed assets include 19.2 miles of state highways, 109.8 miles of state, county and local roads, 1 airport, 19.4 miles of railways, 6 critical facilities, 2 municipal use drinking water facilities, 2 waste water treatment plants, 7 potential contaminant sources, and 1894 buildings (Table 16). No electrical substations are exposed under either scenario.

Table 16. Assets exposed under OCMP's 2050 + 50% and 2100 + 1% sea level and flooding scenarios for two estuaries in Coos County. The exposure of the built infrastructure within the footprints of these estuaries to future flooding, relative to all estuaries along the Oregon coast, is moderately high for the Coos Bay estuary and low for the Coquille River estuary. (Source: Sepanik et al., 2017)

	2050 SLR + 50% Probability Flood (~4.0 feet)			2100 SLR + 1% Probability Flood (~8.4 feet)		
Assets	Coos Bay	Coquille River	Total	Coos Bay	Coquille River	Total
State Highways (miles)	4	0.3	4.3	18.1	1.1	19.2
State, County, and Local Roads (miles)	43	2.3	6.6	93.6	16.2	109.8
Airports (number)	0	0	0	1	0	1
Railways (miles)	9.4	0	9.4	18.3	1.1	19.4
Critical Facilities (number)	3	0	3	6	0	6
Municipal Use Drinking Water (number)	1	1	2	1	1	2
Wastewater Treatment Plants (number)	0	0	0	2	0	2
Electrical Substations (number)	0	0	0	0	0	0
Potential Contaminant Sources (number)	2	1	3	4	3	7
Buildings (number)	697	18	715	1722	172	1894

Key Messages

⇒ The risk of coastal erosion and flooding on the Oregon coast is expected to increase as climate changes due to sea level rise and changing wave dynamics.

⇒ In Coos County, local sea level is projected to rise by 1.2 to 5.3 feet by 2100. This projection is based on the intermediate-low to intermediate-high global sea level scenarios used in the 2018 U.S. National Climate Assessment. Because these local sea level projections account for estimated trends in vertical land movement, they are relative to the future land position.

⇒ Given these levels of sea level rise, the multiple-year likelihood of a flood reaching four feet above mean high tide is 4–34% by the 2030s, 25–100% by the 2050s, and 100% by 2100.

⇒ At risk within the four-foot inundation zone in Coos County as of the 2010 census are 1062 people, $72 million in property value, 10.9 miles of highways and roads, 9.4 miles of railways, 3 critical facilities, 2 municipal drinking water facilities, 3 potential contaminant sources, and 715 buildings.

Changes in Ocean Temperature and Chemistry

As a result of increasing human-caused emissions of carbon dioxide (CO_2) into the atmosphere, the world's oceans are warming, acidifying, and deoxygenating. These changes are leading to alterations in marine ecosystems that affect the economies and livelihoods of coastal communities across the globe (Pershing *et al.*, 2018).

The most direct and well-documented effect of climate change on the oceans is warming (Pershing *et al.*, 2018). More than 90% of the extra heat associated with carbon emissions has been captured by the oceans. The temperature of global ocean surface waters increased on average by 1.3 ± 0.1°F per century from 1900 through 2016 (Pershing *et al.*, 2018). Open-ocean, surface waters in the eastern North Pacific, offshore of the northwestern United States, warmed at a rate of 1.15 ± 0.54°F per century during the same period, and are projected to warm by 5.0 ± 1.1°F by 2080 relative to the period 1976–2005, under a higher emissions scenario (RCP 8.5) (Jewett and Romanou, 2017).

In addition to gradual ocean warming as a result of climate change, episodic severe events, known as marine heat waves, increasingly are being documented. One such event occurred from 2013 through 2017 in the waters of the eastern North Pacific (Harvey *et al.*, 2020). A warm water anomaly first appeared in the upper ocean during the winter of 2013–2014 (Bond *et al.*, 2015), then spread across the eastern North Pacific onto the Oregon shelf (Peterson *et al.*, 2017). By mid-September 2014, sea surface temperatures off central Oregon had risen by 8.1°F above regional averages, and the anomalously high temperature persisted within the region until early 2016 (Peterson *et al.*, 2017). The temperature continued to be anomalously high to depths of ~492 feet until at least late 2017 (Barth *et al.*, 2018; Fisher *et al.*, 2020). This event triggered a coast-wide harmful algal bloom that affected commercial, recreation, and tribal subsistence fisheries off the Northwest coast (May *et al.*, 2018). It is likely that marine heat waves will occur regularly as atmospheric and oceanic temperatures become more variable over the coming decades. Warming ocean temperatures affect marine ecosystems in a variety of ways, including but not limited to changing the metabolic rates of organisms, increasing the toxicity of harmful algal blooms, and causing species' ranges to shift (Somero *et al.*, 2016; Harvey *et al.*, 2020; Trainer *et al.*, 2020).

Warming ocean temperatures have profound effects on other aspects of ocean physics, particularly water density and stratification in the upper part of the water column, which in turn reduces transfer of oxygen among surface and deeper layers (Pershing *et al.*, 2018). Additionally, warm water holds less oxygen than cool water, so increasing water temperature directly decreases the concentration of dissolved oxygen. Trends in dissolved oxygen are difficult to detect given that oxygen concentration varies considerably due to periodic circulation patterns and interdecadal oscillations (e.g., seasonal coastal upwelling, seasonal coastal storm mixing, El Niño-Southern Oscillation, Pacific Decadal Oscillation) (Pierce *et al.*, 2012). Local coastal processes of decomposition further can lead to temporally and spatially variable low-oxygen or hypoxia events (oxygen concentration less than 1400 ppm of ocean water). On the shelf and adjacent slope, changes are already noticeable; oxygen levels off Newport, Oregon, decreased by 40% at 197–230 feet below the surface from 1960–1971 to 1998–2009 (Pierce *et al.*, 2012). These changes have led to an increasingly recognizable and severe late-summer hypoxia season in Oregon and throughout the Pacific Northwest (Chan *et al.*, 2008, 2019), that can cause extensive mortality and changes in the distribution of marine species (Chan *et al.*, 2019). The risk of an increasing number of hypoxia events is high given that average oxygen levels were projected to decline by 17% throughout the north Pacific Ocean by 2100, assuming RCP 8.5 (Jewett and Romanou, 2017; Pershing *et al.*, 2018).

Globally, over the last 150 years, surface ocean waters absorbed large amounts of anthropogenic CO_2 from the atmosphere and became 30% more acidic than prior to the Industrial Revolution (Jewett and Romanou, 2017; Osborne *et al.*, 2020). This process, referred to as ocean acidification, is caused by the chemical reactions that result from CO_2 entering the ocean, reacting with seawater to release hydrogen (H+) ions and altering the carbonate chemistry of the ocean. Multiple parameters are used to document and describe ocean acidification, including dissolved CO_2, pH, total alkalinity, and calcium carbonate (aragonite, Ω) concentrations (Doney *et al.*, 2020). Over the next 100 years, the surface ocean waters are projected to acidify by 100 to 150% (assuming RCP 8.5), resulting in a decrease of open ocean pH from 8.1 (current average) to as low as 7.8 by 2100 (Jewett and Romanou, 2017). Negative effects of ocean acidification, including toxicity of harmful algal blooms, reduced olfaction in fishes, and thinner shells in shellfish, are already evident in marine ecosystems worldwide (Doney *et al.*, 2020).

Along the West Coast, ocean acidification, and to some extent hypoxia, are correlated with seasonal and decadal changes in coastal upwelling (Chan *et al.*, 2008, 2019; Osborne *et al.*, 2020), which brings nutrient-rich, low-oxygen, and acidified deep waters up onto Oregon's coastal shelf (Jewett and Romanou, 2017). By 2100, coastal upwelling along Oregon's coast is projected to intensify in spring but weaken in summer, and about 23–40% fewer strong upwelling events are expected (Jewett and Romanou, 2017). Seasonal upwelling not only drives ocean circulation but affects species that rely on upwelling for nutrition, larval migration, and other ecological functions.

On the West Coast, ocean acidification and hypoxia tend to co-occur, and the aggregated effects of ocean acidification and hypoxia can be greater than the independent effects of either (Chan *et al.*, 2016). The West Coast of North America was one of the first places in the world in which the ecological, and economic consequences of ocean acidification and hypoxia were severe. The magnitude of regional ocean acidification and hypoxia in part reflects natural upwelling of CO_2-enriched, low-oxygen water along the continental shelf of the West Coast (Chan *et al.*, 2016). Ocean acidification is occurring globally, and reducing global levels of CO_2 emissions will be the most effective strategy to decrease the effects of ocean acidification (Chan *et al.*, 2016). However, reducing local inputs of nutrients and organic matter to the coastal environment may decrease the magnitude of ocean acidification and hypoxia (Chan *et al.*, 2016).

Changes in ocean temperature and chemistry are already transforming ocean ecosystems and the economies, coastal communities, cultures, and businesses that depend on them (Pershing *et al.*, 2018). Research is examining the differences in responses among taxa and the capacity of different taxa to adapt to changing ocean conditions (Menge *et al.*, 2022). Sessile species (e.g., macroalgae, eelgrasses, and some invertebrates, such as bivalves, barnacles, and sea anemones) and species with relatively low mobility (e.g., small phytoplankton and zooplankton, non-migratory fishes, and some invertebrates, such as crabs, shrimp, and sea stars) are the most affected by local or regional changes in ocean temperature and chemistry (Grantham *et al.*, 2004; Bednaršek *et al.*, 2020; Harvey *et al.*, 2020). In contrast, mobile species, such as migratory fishes, seabirds, and marine mammals, often can move away from localized stressors, and are more affected by extensive shifts in marine food webs (Cheung *et al.*, 2015; Cheung and Frölicher, 2020; Harvey *et al.*, 2020). Regardless of mobility, many species' reproductive cycles are tied to oceanographic and other environmental drivers (e.g., light, temperature, seasonality of spring and autumn ocean upwelling, freshwater inputs, and food or nutrients) (Chavez *et al.*, 2017; Harvey *et al.*, 2020). Ocean change is likely to affect foraging during species' migrations, including the location and timing of feeding and the types of prey available or selected, potentially reducing growth and population viability. Changes in oceanographic patterns may exceed species tolerances and disrupt reproductive cycles (Bakun *et al.*, 2015; Chavez *et al.*, 2017).

Key Messages

⇒ The open-ocean surface temperature off the Northwest coast increased by 1.2 ± 0.5°F since the year 1900 and is projected to increase by about another 5.0 ± 1.1°F by the year 2080. These changes in temperature may affect many other drivers of ocean change. For example, increases in temperature accelerate the rate of reduction of dissolved oxygen and increase the toxicity of harmful algal blooms. Ocean acidity is projected to increase by roughly 100–150%, resulting in a drop in open-ocean pH from 8.1 to 7.8. The change in pH is likely to affect shell formation in diverse species of commercial, recreational, and cultural value.

Loss of Wetlands

Climate change affects Oregon's coastal estuaries and tidal wetlands through rising sea levels and saltwater intrusion, increases in wave height and the intensity of coastal storms, increases in air and water temperatures, changes in precipitation patterns and freshwater runoff, and ocean acidification. These changes in climate interact with the direct and indirect effects of changes in land use, from construction of housing and infrastructure to increases in the distribution and abundance of non-native invasive species (ODFW, n.d.).

As the climate changes, biological, chemical, and physical processes in coastal wetlands may change, some species may move or become less viable (ODFW, n.d.). In addition, sea level rise is likely to alter the location and spatial extent of tidal wetlands. The locations of some tidal wetlands may not change if the rates of accretion and sea level rise are similar. If sea level rise exceeds accretion, wetlands may form further upslope if the landscape and lack of coastal development allow this migration (Brophy *et al.*, 2017).

Under scenarios of sea level rise of up to 2.5 feet, wetland area in 23 estuaries in Oregon is projected to increase slightly as tides inundate slightly higher land surfaces (Brophy *et al.*, 2017). However, projected tidal wetland area begins to decline sharply as sea level continues to rise, with a 21% reduction in area at 4.7 feet of sea level rise, 45% reduction at 8.2 feet, and 60% reduction at 11.5 feet (Brophy *et al.*, 2017). The 2.5 and 4.7 feet of sea level rise correspond to the upper end of the range of sea level rise projected by 2050 and 2100, respectively, for Newport, Oregon (National Research Council, 2012). The 2.5 feet sea level rise scenario corresponds to the level expected by the 2090s, 2070s, and 2050s under the 2018 NCA's intermediate, intermediate-high, and high sea level rise scenarios, respectively (Table 12). The 4.7 feet sea level rise scenario is similar to that projected by the 2090s under the 2018 NCA's intermediate-high sea level rise scenario and by the 2070s to 2080s under the high sea level rise scenario (Table 12).

Projected changes in tidal wetland area of three estuaries in Coos County (Coos Bay, Coquille River, and New River Area) were inconsistent with the general pattern of increases in potential tidal wetland area with relatively low levels of sea level rise followed by decreases with high levels of sea level rise. Potential tidal wetland area in the Coos Bay and Coquille estuaries is projected to decrease early and continuously under all sea level rise scenarios. Assuming 4.7 feet of sea level rise, tidal wetland area in the Coos Bay (Figure 18, Figure 19) and Coquille River (Figure 20) estuaries is projected to decrease by about 50% (Brophy *et al.*, 2017) (Table 17).

Tidal wetland area in the New River Area, which includes Twomile Creek South, Fourmile Creek, New River, and Floras Creek, is projected to increase by more than 2000%, from 81 to 1861 acres, with 4.7 feet of sea level rise (Table 17, Figure 21). However, in this area, the inland extent of tides is currently limited by a long sand spit on which waves consistently deposit sand. Whether future tides will push into the New River area is uncertain and depends on whether and how deposition of sediment and sand changes (Brophy *et al.*, 2017).

Table 17. Present-day baseline and potential future tidal wetland area (acres) of three estuaries in Coos County, and projected changes in area under two sea level rise (SLR) scenarios. (Source: Brophy et al. 2017).

Estuary	Present-Day Tidal Wetland Area (acres)	Future Tidal Wetland Area with 2.5 feet of SLR (acres)	Future Tidal Wetland Area with 4.7 feet of SLR (acres)	Change in Tidal Wetland Area with 2.5 feet of SLR (%)	Change in Tidal Wetland Area with 4.7 feet of SLR (%)
Coos Bay	6422	4740	3103	-26	-52
Coquille River	7758	6251	3946	-19	-49
New River Area	81	907	1861	1019	2196

Key Messages

⇒ The structure, composition, and function of coastal wetland ecosystems will be affected by rising sea levels and saltwater intrusion, coastal erosion and flooding, changes in temperature and precipitation, and ocean acidification.

⇒ Wetland area in the Coos Bay and Coquille River estuaries is projected to decrease with increasing sea levels. Under 4.7 feet of sea level rise, tidal wetland area in these estuaries is projected to decrease by about 50%. Tidal wetland area in the New River Area is projected to increase by more than 2000%, but whether future tides will push into this area is uncertain.

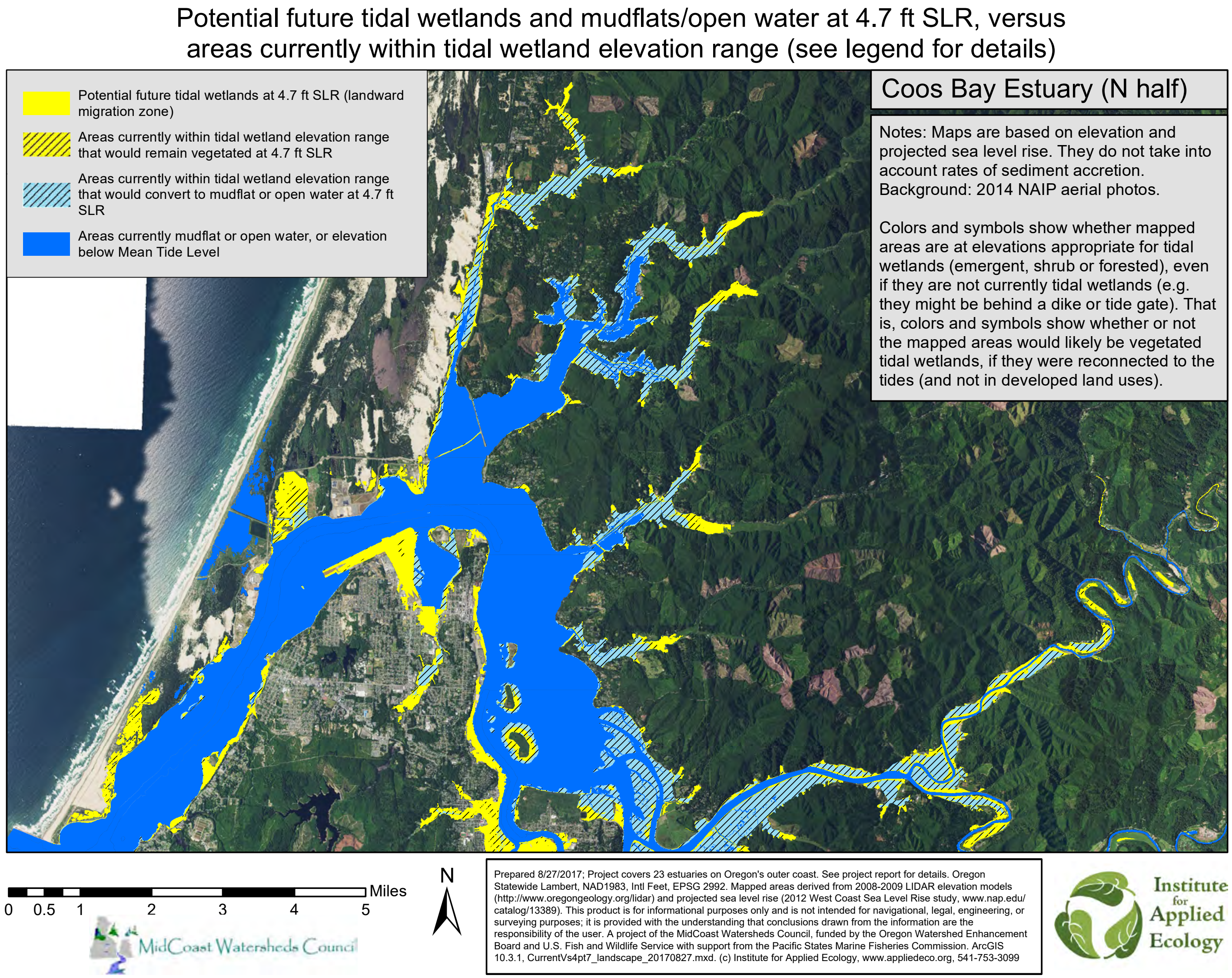


Figure 15. Potential tidal wetlands, mudflats, and open water at 4.7 feet sea level rise, versus areas currently within the elevation range of tidal wetlands, within the north half of the Coos Bay Estuary. (Source: Brophy et al., 2017)

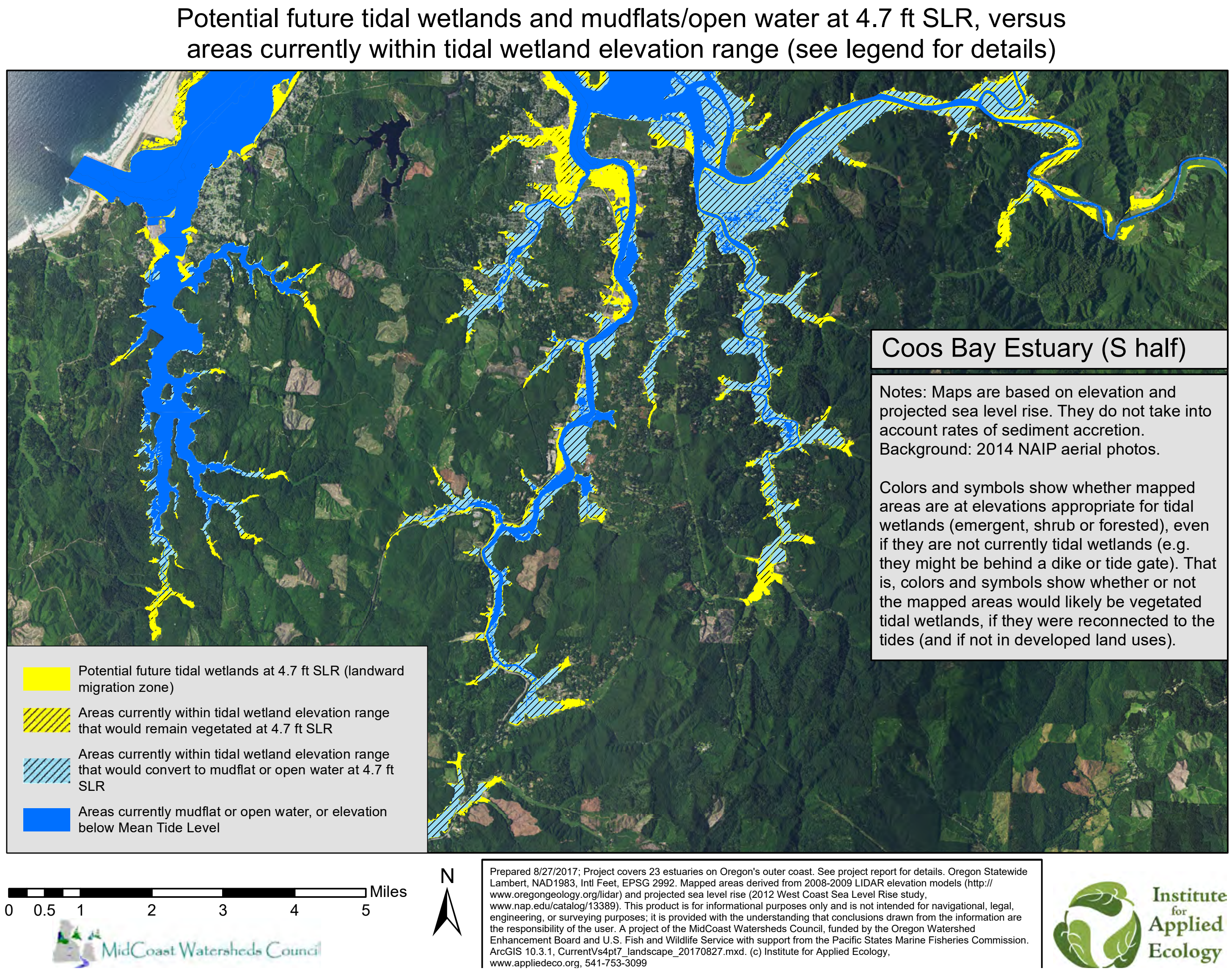


Figure 16. Potential tidal wetlands, mudflats, and open water at 4.7 feet sea level rise, versus areas currently within the elevation range of tidal wetlands, within the south half of the Coos Bay Estuary. (Source: Brophy et al., 2017)

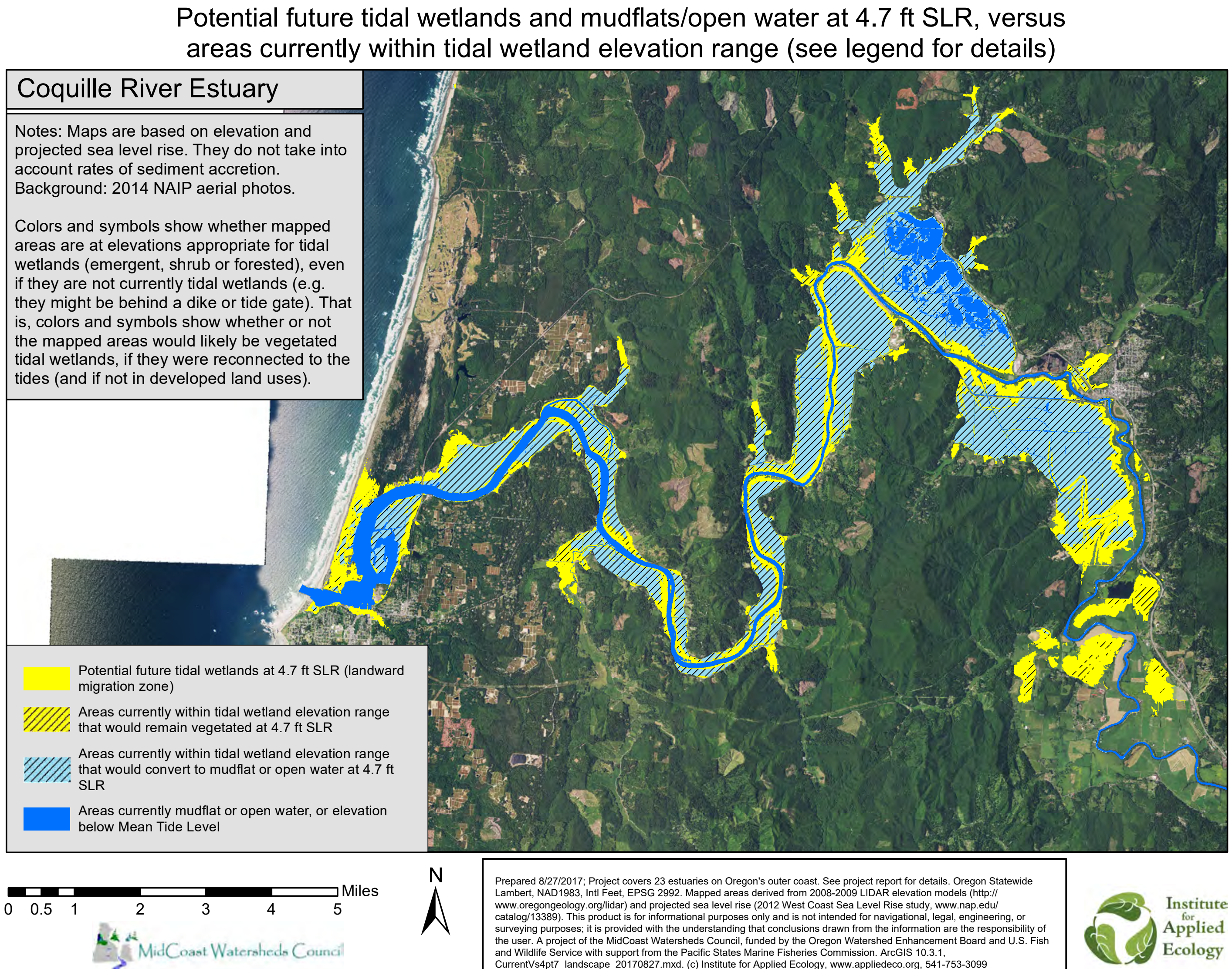


Figure 17. Potential tidal wetlands, mudflats, and open water at 4.7 feet sea level rise, versus areas currently within the elevation range of tidal wetlands, within the Coquille River Estuary. (Source: Brophy et al., 2017)

Potential future tidal wetlands and mudflats/open water at 4.7 ft SLR, versus areas currently within tidal wetland elevation range (see legend for details)

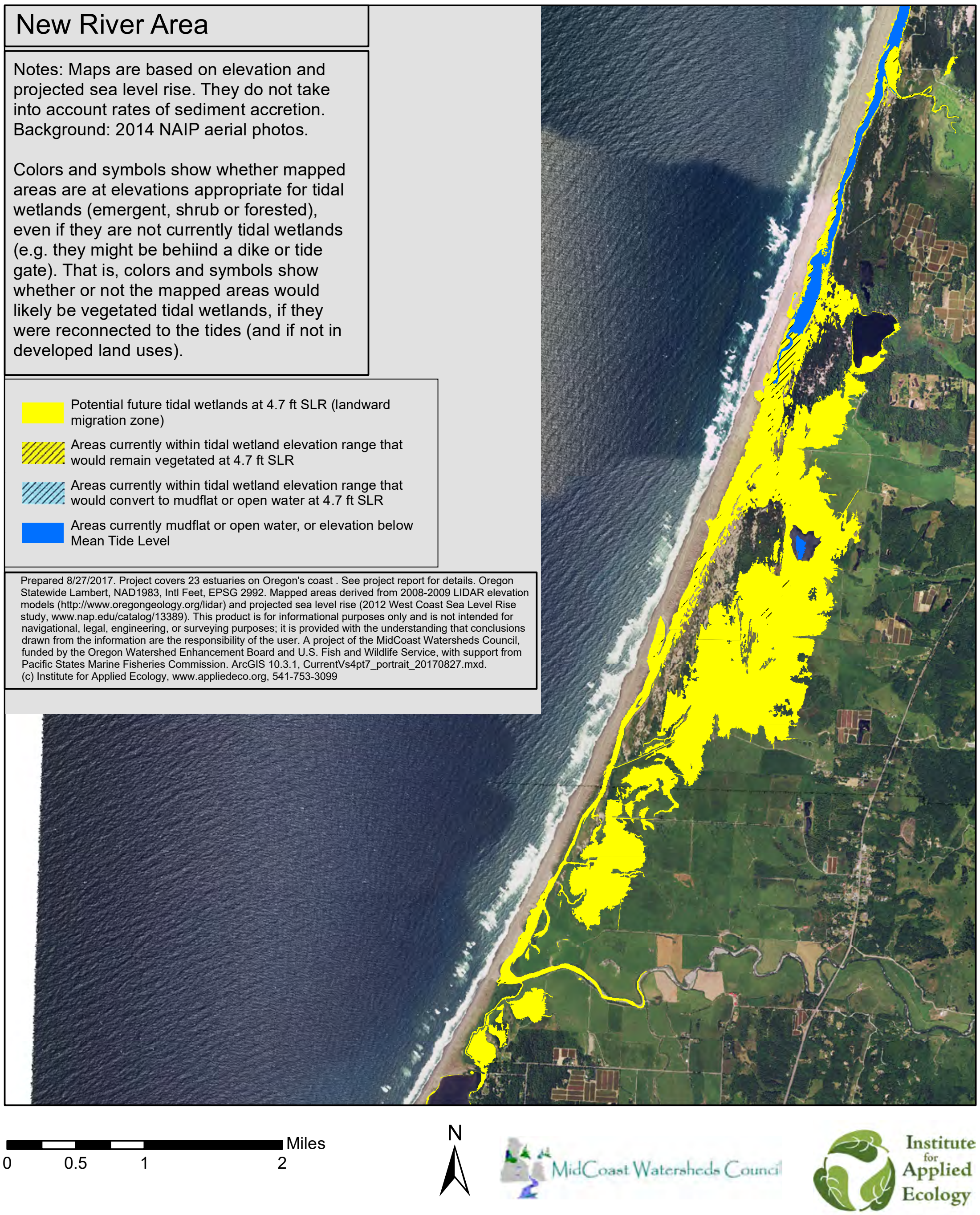


Figure 18. Potential tidal wetlands, mudflats, and open water at 4.7 feet sea level rise, versus areas currently within the elevation range of tidal wetlands, within the New River Area. (Source: Brophy et al., 2017)

Windstorms

Climate change has the potential to alter surface winds through changes in the global free atmospheric circulation and storm systems, and through changes in the connection between the free atmosphere and Earth's surface. West of the Cascade Range, changes in surface wind speeds tend to follow changes in upper atmosphere winds associated with extratropical cyclones (Salathé *et al.*, 2015). The trend in winter extratropical storm frequency in the northeast Pacific since 1950 was positive, although not statistically significant (Vose *et al.*, 2014). However, uncertainty in projections of future extratropical cyclone frequency is high (IPCC, 2013).

Future projections indicate a slight northward shift in the jet stream and extratropical cyclone activity in the North Pacific. Over the Northern Hemisphere, the frequency of the most intense extratropical cyclones generally is projected to decrease, although in the northern North Pacific the frequency is projected to increase (IPCC, 2021) Therefore, there is no consensus on whether extratropical storms (Vose *et al.*, 2014; Seiler and Zwiers, 2016; Chang, 2018) and associated extreme winds (Kumar *et al.*, 2015) will intensify or become more frequent along the Northwest coast under a warmer climate.

Key Messages

⇒ Limited research suggests little if any change in the frequency and intensity of windstorms in the Northwest as a result of climate change.

Expansion of Pests, Pathogens, and Non-native Invasive Species

Changes in climate and atmospheric concentrations of carbon dioxide can affect the distribution and population dynamics of native and non-native species of plants and animals that are considered to be invasive or pests in natural and agricultural systems. Increasing concentrations of carbon dioxide not only lead to increases in global temperature, but affect plants' primary productivity, water-use efficiency, and nutrient content. Changes in climate, ongoing human additions of nitrogen to the environment, and their interactions also affect the growth and competitive relations among plant and animal species (Greaver *et al.*, 2016). In general, invasive and pest species in Coos County are likely to become more prevalent in response to projected increases in temperature, especially minimum winter temperature, and increases in the frequency, duration, and severity of drought. However, many of these responses are uncertain, and are likely to vary locally. Moreover, the responses may change over time.

Species-environment relations are not static (MacDonald, 2010; Walsworth *et al.*, 2019). Therefore, even when the current ecology of a species is well understood, it often is difficult to predict with confidence how the species will respond to projected changes in climate, especially when climate change interacts with land-use change or other environmental changes. Species adapt not only in response to climate change but in response to all types of environmental change, including management actions (Thomas *et al.*, 1979; Skelly *et al.*, 2007; Winter *et al.*, 2016). These responses may be rapid, on the order of years or decades, especially when organisms have short generation times (Boughton, 1999; MacDonald *et al.*, 2008; Willis and MacDonald, 2011; Singer, 2017). Adaptive capacity also is affected by whether individuals can move freely or whether habitat fragmentation and other barriers impede movement (Thorne *et al.*, 2008; Willis and MacDonald, 2011; Fleishman and Murphy, 2012). Monocultures, dense populations, and even-aged populations of plants or animals generally are more susceptible to pests and pathogens than individuals in areas with higher species richness or populations with greater demographic diversity.

Sudden oak death (*Phytophthora ramorum*), which primarily affects tanoak (*Notholithocarpus densiflorus*), may colonize Coos County by the late 2020s, with negative effects on economic returns from the timber industry, recreation and tourism revenue, and property values (Buhl *et al.*, 2020). In 2021, a new genetic variant of sudden oak death was detected in tanoaks north of Port Orford, more than 20 miles north of the previously known northern extent of the pathogen. Sudden oak death generally is associated with warm, wet microclimates, and it is difficult to project how interactions between changes in temperature, trends in total water-year precipitation, and trends in drought will affect its incidence and virulence.

The Coos County Noxious Weed Control Advisory Board targets 15 of the species or taxa that it designates as weeds for prevention and control within the county. Although little is known about how several of these species may to respond to climate change, some evidence suggests how others may be affected. For example, biddy biddy (*Acaena novae-zelandiae*; a perennial forb), which generally is sensitive to frost (Gynn and Richards, 1985), and Japanese knotweed (*Fallopia japonica*; an herbaceous shrub), in which photosynthesis is reduced by freezing (Baxendale and Tessier, 2015), may become more widespread or abundant as autumn and winter temperatures increase. Given that biddy biddy is transported readily by humans, often on socks (Pickering *et al.*, 2011), increases in recreational activity could interact with climate change to facilitate its expansion. Much like biddy biddy, Scotch broom (*Cytisus scoparius*; a shrub) and English and Atlantic ivy (*Hedera helix* and *H. hibernica*; evergreen vines) usually are not highly tolerant of frost in autumn, although populations can become more frost-tolerant over time (Strelau *et al.*, 2018; Winde *et al.*, 2020). Increases in temperature throughout the year may lead to expansion of diffuse knapweed (*Centaurea diffusa*) (Li *et al.*, 2018).

There is some evidence that heat stress impairs photosynthesis and therefore growth of English and Atlantic ivy (Strelau *et al.*, 2018). Nevertheless, English and Atlantic ivy can benefit from increases in carbon dioxide concentrations, especially when temperatures are relatively warm (Manzanedo *et al.*, 2018). Experiments suggested that the photosynthetic rate and biomass of Canada thistle (*Cirsium arvense*), the number and length of the species' spines also are likely to increase as ambient concentrations of carbon dioxide increase throughout the twenty-first century, and may have increased during the previous century (Ziska, 2002). Whether the root biomass of Canada thistle also responds positively to increases in carbon dioxide concentrations, especially independent of increases in temperature, is unclear (Ziska *et al.*, 2004; Tørresen *et al.*, 2020), and may vary in space. Furthermore, both bull thistle (*Cirsium vulgare*) and Canada thistle can establish readily in soils that have been disturbed by high-severity wildfires, which may become more common as climate changes, or by logging (Reilly *et al.*, 2020).

Changes in the amount and timing of precipitation may contribute to expansion or contraction of different non-native invasive plants in Coos County. In forests in western Oregon, cover of *H. helix* was associated negatively with summer precipitation, and occurrence of bull thistle and Canada thistle was associated negatively with annual precipitation (Gray, 2005). Gorse (*Ulex europaeus*; an evergreen shrub) can spread after wildfire and generally is highly flammable. However, extreme precipitation following wildfire directly or indirectly may reduce seedling survival via movement of soil and litter, which can either expose or bury the small plants (Luís *et al.*, 2005). By contrast, increases in annual precipitation may facilitate expansion of French broom (*Genista monspessulana*; an evergreen shrub) (García *et al.*, 2014) and diffuse knapweed (*Centaurea diffusa*) (Blumenthal *et al.*, 2008).

Following experimental drought treatment in a seasonally flooded area, percent cover of bull thistle increased five to 13 times (Hogenbirk and Wein, 1991). Evidence of drought tolerance in Scotch broom is equivocal, especially in the field rather than in greenhouse experiments (Potter *et al.*, 2009; Hogg and Moran, 2020). The species' growth and survival may increase as snow depths decrease, especially during the winter after germination (Stevens and Latimer, 2015).

As tropospheric concentrations of ozone continue to increase, productivity of native and agricultural plants generally is expected to decrease. However, ozone tolerance in weedy, vegetatively reproducing species such as yellow nutsedge (*Cyperus esculentus*) may increase relatively quickly, allowing them to gain a competitive advantage over some crops (Grantz and Shrestha, 2006).

Key Messages

⇒ In general, invasive and pest species in Coos County are likely to become more prevalent in response to projected increases in temperature, especially minimum winter temperature, and increases in the frequency, duration, and severity of drought. However, many of these responses are uncertain, are likely to vary locally, and may change over time.

Appendix

Future Climate Projections Background

Read more about global climate models, emissions scenarios, and uncertainty in the Climate Science Special Report—Volume 1 of the Fourth National Climate Assessment (https://science2017.globalchange.gov).

Global climate models (GCMs) and downscaling: https://science2017.globalchange.gov/chapter/4#section-3

Emissions scenarios: https://science2017.globalchange.gov/chapter/4#section-2

Uncertainty: https://science2017.globalchange.gov/chapter/4#section-4

Coupled Model Intercomparison Project phase 6 (CMIP6) climate models and emissions scenarios: see section B. Possible Climate Futures, https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_SPM_final.pdf.

Climate and Hydrological Data

Statistically downscaled GCM outputs from the fifth phase of the Coupled Model Intercomparison Project (CMIP5) were the basis for projections of future temperature, precipitation, and hydrology in this report. The coarse resolution of the GCMs outputs (100–300 km) was downscaled to a resolution of about 6 km with the Multivariate Adaptive Constructed Analogs (MACA) statistical downscaling method, which is skillful in complex terrain (Abatzoglou and Brown, 2012). The MACA approach uses gridded observational data to train the downscaling. It applies bias corrections and matches the spatial patterns of observed coarse-resolution to fine-resolution statistical relations. For a detailed description of the MACA method see https://climate.northwestknowledge.net/MACA/MACAmethod.php.

MACA data are the inputs to integrated models of climate, hydrology, and vegetation run by the Integrated Scenarios of the Future Northwest Environment project (https://climate.northwestknowledge.net/IntegratedScenarios/). Snow dynamics were simulated by the Integrated Scenarios project, which applied the Variable Infiltration Capacity hydrological model (VIC version 4.1.2.l; Liang *et al.*, 1994 and updates) to a 1/16 x 1/16 degree (6 km) grid.

Simulations of daily maximum temperature, minimum temperature, and precipitation from 1950 through 2099 for 20 GCMs (Table 18) and two emissions scenarios (RCP 4.5 and RCP 8.5) are available. Hydrological simulations of snow water equivalent (SWE) are available for the 10 GCMs used as input to VIC. All available modeled outputs were obtained from the Integrated Scenarios data archives and included in this report to represent the mean and range of projections among the largest possible ensemble of GCMs.

Table 18. The 20 CMIP5 GCMs represented in this report. Asterisks indicate the ten GCMs used as inputs to the Variable Infiltration Capacity hydrological model.

Model Name	Modeling Center
BCC-CSM1-1 BCC-CSM1-1-M*	Beijing Climate Center, China Meteorological Administration
BNU-ESM	College of Global Change and Earth System Science, Beijing Normal University, China
CanESM2*	Canadian Centre for Climate Modeling and Analysis
CCSM4*	National Center for Atmospheric Research, USA
CNRM-CM5*	National Centre of Meteorological Research, France
CSIRO-Mk3-6-0*	Commonwealth Scientific and Industrial Research Organization/Queensland Climate Change Centre of Excellence, Australia
GFDL-ESM2G GFDL-ESM2M	NOAA Geophysical Fluid Dynamics Laboratory, USA
HadGEM2-CC* HadGEM2-ES*	Met Office Hadley Center, UK
INMCM4	Institute for Numerical Mathematics, Russia
IPSL-CM5A-LR IPSL-CM5A-MR* IPSL-CM5B-LR	Institut Pierre Simon Laplace, France
MIROC5* MIROC-ESM MIROC-ESM-CHEM	Japan Agency for Marine-Earth Science and Technology, Atmosphere and Ocean Research Institute (The University of Tokyo), and National Institute for Environmental Studies, Japan
MRI-CGCM3	Meteorological Research Institute, Japan
NorESM1-M*	Norwegian Climate Center, Norway

All simulated climate data and the streamflow data, with the exception of snow water equivalent, were bias-corrected with quantile mapping by the Integrated Scenarios project. Quantile mapping adjusts simulated values by comparing the cumulative probability distributions of simulated and observed values. In practice, the simulated and observed values of a variable (e.g., daily streamflow) over the historical time period are sorted and ranked, and each value is assigned a probability of exceedance. The bias-corrected value of a given simulated value is assigned the observed value that has the same probability of exceedance as the simulated value. The historical bias in the simulations is assumed to be constant. Therefore, the relations between simulated and observed values in the historical period were applied to the future scenarios. Climate data in the MACA data reflect quantile mapping relations for each non-overlapping 15-day window in the calendar year. Streamflow data reflect quantile mapping relations for each calendar month.

The Integrated Scenarios project simulated hydrology with VIC (Liang *et al.*, 1994) run on a 1/16 x 1/16 degree (6 km) grid. To generate daily streamflow estimates, daily runoff from VIC grid cells was routed to selected locations along the stream network. Where records of naturalized flow were available, the daily streamflow estimates were bias-corrected so their statistical distributions matched those of the naturalized streamflows.

Vapor pressure deficit and 100-hour fuel moisture were computed by the Integrated Scenarios project with the same MACA climate variables according to the equations in the National Fire Danger Rating System (NWCG, 2019).

Smoke Wave Data

Data from Liu et al. (2016) are available at https://khanotations.github.io/smoke-map/. Variables used in this report included "Total # of SW days in 6 yrs" and "Average SW Intensity". The former is the number of days within each time period on which the concentration of fine particulate matter ($PM_{2.5}$), averaged within each county, exceeded the 98th quantile of the distribution of daily, wildfire-specific $PM_{2.5}$ values from 2004 through 2009 (smoke wave days). The latter is the average concentration of $PM_{2.5}$ across smoke wave days within each time period. Liu et al. (2016) used 15 GCMs from the third phase of the Coupled Model Intercomparison Project under a medium emissions scenario (SRES-A1B) as inputs to a fire prediction model and the GEOS-Chem three-dimensional global chemical transport model. The available data include only the multiple-model mean value (not the range), which should be interpreted as the direction of projected change rather than the actual expected value.

Sea Level Rise and Coastal Flooding Data

In this report, we used the sea level rise projections for the United States (Sweet *et al.*, 2017b) that were developed for the 2018 U.S. National Climate Assessment (Sweet *et al.*, 2017a). We accessed the projections from the Climate Central Surging Seas Risk Finder (riskfinder.climatecentral.org). The magnitude of global mean sea level rise by 2100 (GMSL) defines each scenario. The Risk Finder provides the corresponding local projections from NOAA, which vary due to local factors such as rising or sinking land. Low, middle, and high sub-scenarios yield a range of possible local sea level rise outcomes (17th, 50th and 83rd percentiles) given each main scenario. The low scenario assumes that sea level rise rates during the last 30 years remains stable, whereas the extreme scenario assumes accelerated loss of the Antarctic ice sheet. Flood likelihoods and assets at risk were based on these sea level change scenarios and accessed directly from the Climate Central Surging Seas Risk Finder's data visualization tools (riskfinder.climatecentral.org).

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2. Natural Hazard Risk Report for Coos County

This report forms the basis of the risk assessment for the 2023 Coos County Multi-Jurisdictional Natural Hazard Mitigation Plan Update. It is cited as Williams et al, 2021 within this document.

Williams, M. C., Anthony, L. H., and Fletcher E. O'Brien. (2021). *Natural hazard risk report for Coos County, Oregon, including the Cities of Bandon, Coos Bay, Coquille, Lakeside, Myrtle Point, North Bend, and Powers, and Tribal Lands of the Confederated Tribes of Coos, Lower Umpqua, and Siuslaw Indians and the Coquille Indian Tribe, and the unincorporated communities of Bunker Hill, Charleston, Glasgow, Green Acres, Hauser, and Millington. Portland, OR.*

What's in this report?

This report describes the methods and results of a natural hazard risk assessment for Coos County communities. The risk assessment can help communities better plan for disaster.

Executive Summary (excerpt):

This report describes the methods and results of the natural hazard risk assessments performed in 2018 by the Oregon Department of Geology and Mineral Industries (DOGAMI) for the communities of Coos County. The purpose of this project is to provide communities in Coos County detailed risk assessments of natural hazards that affect them and to enable communities to compare hazards and act to reduce their risk. The risk assessments contained in this project quantify the impacts of natural hazards to these communities and enhance the decision-making process in planning for disaster

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

OPEN-FILE REPORT O-21-04

NATURAL HAZARD RISK REPORT FOR COOS COUNTY, OREGON

INCLUDING THE CITIES OF BANDON, COOS BAY, COQUILLE, LAKESIDE, MYRTLE POINT, NORTH BEND AND POWERS, AND TRIBAL LANDS OF THE CONFEDERATED TRIBES OF COOS, LOWER UMPQUA, AND SIUSLAW INDIANS AND THE COQUILLE INDIAN TRIBE, AND THE UNINCORPORATED COMMUNITIES OF BUNKER HILL, CHARLESTON, GLASGOW, GREEN ACRES, HAUSER, AND MILLINGTON

by Matt C. Williams[1], Ian Madin[1], Lowell H. Anthony[1], and Fletcher O'Brien[1]

2021

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Cover photo: Mouth of the Coos River and North Spit near the City of Coos Bay, Oregon.
Credit: Oregon ShoreZone, made available under a Creative Commons "CC-BY-SA" license.

WHAT'S IN THIS REPORT?

This report describes the methods and results of a natural hazard risk assessment for Coos County communities. The risk assessment can help communities better plan for disaster.

Oregon Department of Geology and Mineral Industries Open-File Report O-21-04
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Appendix E

GEOGRAPHIC INFORMATION SYSTEM (GIS) DATA

See the digital publication folder for files.
Geodatabase is Esri® version 10.2 format. Metadata are embedded in the geodatabase and are also provided as separate .xml format files.

Coos_County_Risk_Report_Data.gdb

Feature dataset: Asset_Data

feature classes:

- Building_footprints (polygons)
- UDF_points (points)
- Communities (polygons)

Raster data: Hazard_Data

- FL_Depth_10
- FL_Depth_50
- FL_Depth_100
- FL_Depth_500

Metadata in .xml file format:

Each dataset listed above has an associated, standalone .xml file containing metadata in the Federal Geographic Data Committee Content Standard for Digital Geospatial Metadata format

EXECUTIVE SUMMARY

This report was prepared for the communities of Coos County, Oregon, with funding provided by the Federal Emergency Management Agency (FEMA). It describes the methods and results of the natural hazard risk assessment performed in 2018 by the Oregon Department of Geology and Mineral Industries (DOGAMI) within the study area. The purpose of this project was to provide communities with a detailed understanding of their risk from natural hazards, to give communities the ability to compare their risk across multiple hazards, and to prioritize and take actions that will reduce risk. The results of this study can also inform the natural hazard mitigation planning process.

We arrived at our findings and conclusions by completing three main tasks: compiling an asset database, identifying, and using best available hazard data, and performing natural hazard risk assessments.

To complete the first task, we created a comprehensive asset database for the entire study area by synthesizing assessor data, U.S. Census information, FEMA Hazus®-MH general building stock information, and building footprint data. This work resulted in a single dataset of building points and their associated building characteristics. Using this dataset, we were able to represent an accurate spatial location and vulnerability on a building-by-building basis.

The second task was to identify and use the most current and appropriate hazard datasets for the study area. Most of the hazard datasets used in this report were created by DOGAMI and some were produced using high-resolution lidar topographic data. While not all the data sources used in the report are countywide, each hazard dataset was the best available at the time the analysis was performed.

In the third task, we performed the risk assessment using Esri® ArcGIS Desktop® software. We used two risk assessment approaches: (1) estimated loss (in dollars) to buildings from flood (recurrence intervals) and earthquake scenarios using Hazus-MH methodology; and (2) calculated the number of buildings, their value, and associated populations exposed to earthquake, tsunami, flood, landslide, and wildfire hazards.

The findings and conclusions of this report show the potential impacts of hazards in communities within Coos County. A Cascadia Subduction Zone (CSZ) event (earthquake and tsunami) will cause extensive damage and losses throughout the county. Our findings indicate that most of the study area's critical facilities are at high risk from a CSZ event. We also found that the hazards with the highest potential of population displacement are earthquake, tsunami, and landslide hazards. We demonstrate the potential for the reduction in damages and losses from seismic retrofits through building code simulations in the Hazus-MH earthquake model. Flooding is a threat for some communities in the study area and we quantify the number of elevated structures that are less vulnerable to flood hazard. Our analysis shows that new landslide mapping based on improved methods and lidar information will increase the accuracy of future risk assessments. During the time of writing, the best available data show that wildfire risk is high for the upstream portions of the Coos River watershed. Lastly, we demonstrate that this risk assessment can be a valuable tool to local decisionmakers.

Results were broken out for the following geographic areas:

- Unincorporated Coos County (rural)
- Community of Charleston
- Community of Green Acres
- Community of Millington
- Confederated Tribes of Coos, Lower Umpqua, and Siuslaw Indians
- City of Coquille
- City of Lakeside
- City of North Bend
- Community of Bunker Hill
- Community of Glasgow
- Community of Hauser
- City of Bandon
- City of Coos Bay
- Coquille Indian Tribe
- City of Myrtle Point
- City of Powers

Selected countywide results
Total buildings: 42,550
Total estimated building value: $11.5 billion

Cascadia Subduction Zone (CSZ) Magnitude (Mw) 9.0 Earthquake[a]
Red-tagged buildings[b]: 9,689
Yellow-tagged buildings[c]: 3,659
Loss estimate: $3.5 billion

100-year Flood Scenario
Number of buildings damaged: 1,870
Loss estimate: $125 million

Wildfire Exposure (High Risk)
Number of buildings exposed: 1,050
Exposed building value: $217 million

CSZ Tsunami Inundation
Number of buildings exposed: 1,286
Exposed building value: $612 million

Landslide Exposure (High and Very High Susceptibility)
Number of buildings exposed: 7,123
Exposed building value: $1.6 billion

[a]Results reflect damages caused by earthquake to buildings outside of the tsunami zone. Earthquake and tsunami results combined estimate the total damages from a CSZ Mw 9.0 event.
[b]Red-tagged buildings are considered to be uninhabitable due to complete damage.
[c]Yellow-tagged buildings are considered to be of limited habitability due to extensive damage.

1.0 INTRODUCTION

A natural hazard is a naturally occurring phenomenon that can negatively impact humans, which is typically characterized as risk. A natural hazard risk assessment analyzes how a hazard could affect the built environment, population, the cost of recovery, and identifies potential risk. In natural hazard mitigation planning, risk assessments are the basis for developing mitigation strategies and actions. A risk assessment informs the decision-making process, so that steps can be taken to prepare for a potential hazard event.

Key Terms:

- *Vulnerability:* Characteristics that make people or assets more susceptible to a natural hazard.
- *Risk:* Probability multiplied by consequence; the degree of probability that a loss or injury may occur as a result of a natural hazard.

This is the first natural hazard risk assessment analyzing individual buildings and resident populations in Coos County. It is the most detailed and comprehensive analysis of natural hazard risk to date and provides a new, comparative perspective across hazards. In this report, we describe our assessment results, which quantify the various levels of risk that each hazard presents to Coos County communities.

The Oregon Coast, including its estuaries, and Oregon Coast Range are subject to several significant natural hazards, including riverine and coastal flooding, earthquake, tsunami, landslide, and wildfire. This region of the state is moderately developed, mostly in cities and unincorporated communities within the estuary of Coos Bay and along the Coos River. Natural hazards that pose a potential threat to development results in risk. The primary goal of the risk assessment is to inform communities of their vulnerability and risk to natural hazards and to be a resource for risk reduction actions.

1.1 Purpose

The purpose of this project is to help communities in the study area better understand their risk and increase resilience to natural hazards that are present in their community. This is accomplished by providing accurate, detailed, and up-to-date information about these hazards and by measuring the number of people and buildings at risk.

The main objectives of this study are to:

- compile and/or create a database of critical facilities, tax assessor data, buildings, and population distribution data,
- incorporate and use existing data from previous geologic, hydrologic, and wildfire hazard studies,
- perform exposure and Hazus–based risk analysis, and
- share this report widely so that all interested parties have access to its information and data.

The body of this report describes the methods and results for these objectives. We describe the methods for creating the building and population information used in this project. Two primary methods (Hazus-MH or exposure), depending on the type of hazard, were used to assess risk. Results for each hazard type are reported on a countywide basis within each hazard section, and community based results are reported in detail in **Appendix A: Community Risk Profiles**. **Appendix B** contains detailed risk assessment tables. **Appendix C** provides a more detailed explanation of the Hazus-MH methodology. **Appendix D** lists acronyms and definitions of terms used in this report. **Appendix E** contains tabloid-size maps showing county-wide hazard maps.

1.2 Study Area

The study area for this project is the entirety of Coos County, Oregon. Coos County is located in the south coast part of the state and is bordered by Curry County on the south, Douglas County on the east and south, and the Pacific Ocean on the west. The total area of Coos County is 1,626 square miles (4,211 square kilometers). A large percentage of the eastern part of Coos County is managed as industrial forest land.

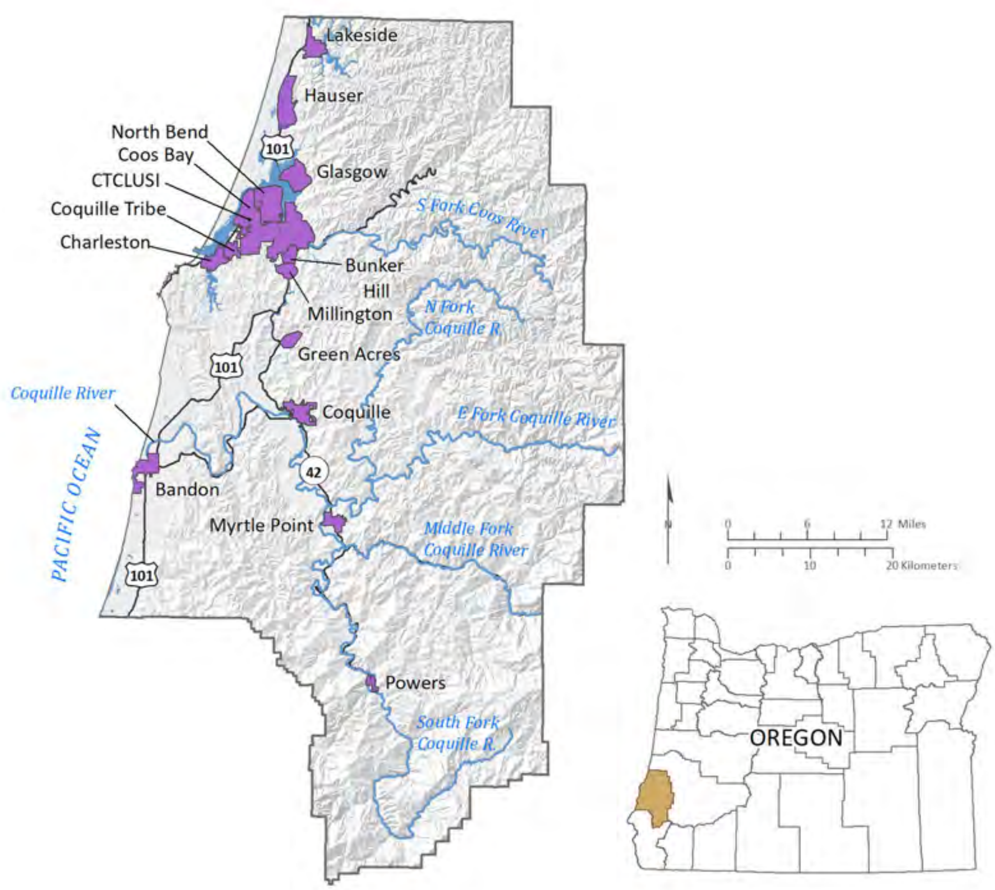
Coastal geography consists of rocky and irregular shores and dune-backed beaches, estuarine areas, and coastal lowlands. The heavily timbered interior of the county is very rugged and is comprised of portions of the Oregon Coast Range which transitions to the Klamath Mountains in the southern half of the county.

The population of Coos County is 63,043 according to the 2010 U.S. Census Bureau (2010a). The county seat is the City of Coos Bay, which is the largest city on the Oregon Coast. All the communities in the study, incorporated and unincorporated, are located near the Pacific Ocean or the Coos or Coquille rivers. The incorporated communities are Bandon, Coos Bay, Coquille, Lakeside, Myrtle Point, North Bend, and Powers (**Figure 1-1**). The unincorporated communities are Bunker Hill, Charleston, Glasgow, Green Acres, Hauser, and Millington.

The Confederated Tribes of Coos, Lower Umpqua, and Siuslaw Indians ("CTCLUSI") and the Coquille Indian Tribe are two federally recognized tribes and communities within the study area. The areas that comprise the tribal lands used in the analyses are made up of several noncontiguous areas within Coos County. The cities of Coos Bay and North Bend have tribal lands adjacent to and within them (**Figure 1-1)**. It is for this reason that areas within the cities of Coos Bay and North Bend that are tribal lands are included in total counts for buildings and population for either the CTCLUSI or the Coquille Indian Tribe communities. No buildings or permanent residents are double counted in any of the individual hazard analyses. Results and analyses for either the CTCLUSI or the Coquille Indian Tribe are for all areas considered tribal lands, including those within the incorporated boundaries of the cities of Coos Bay or North Bend.

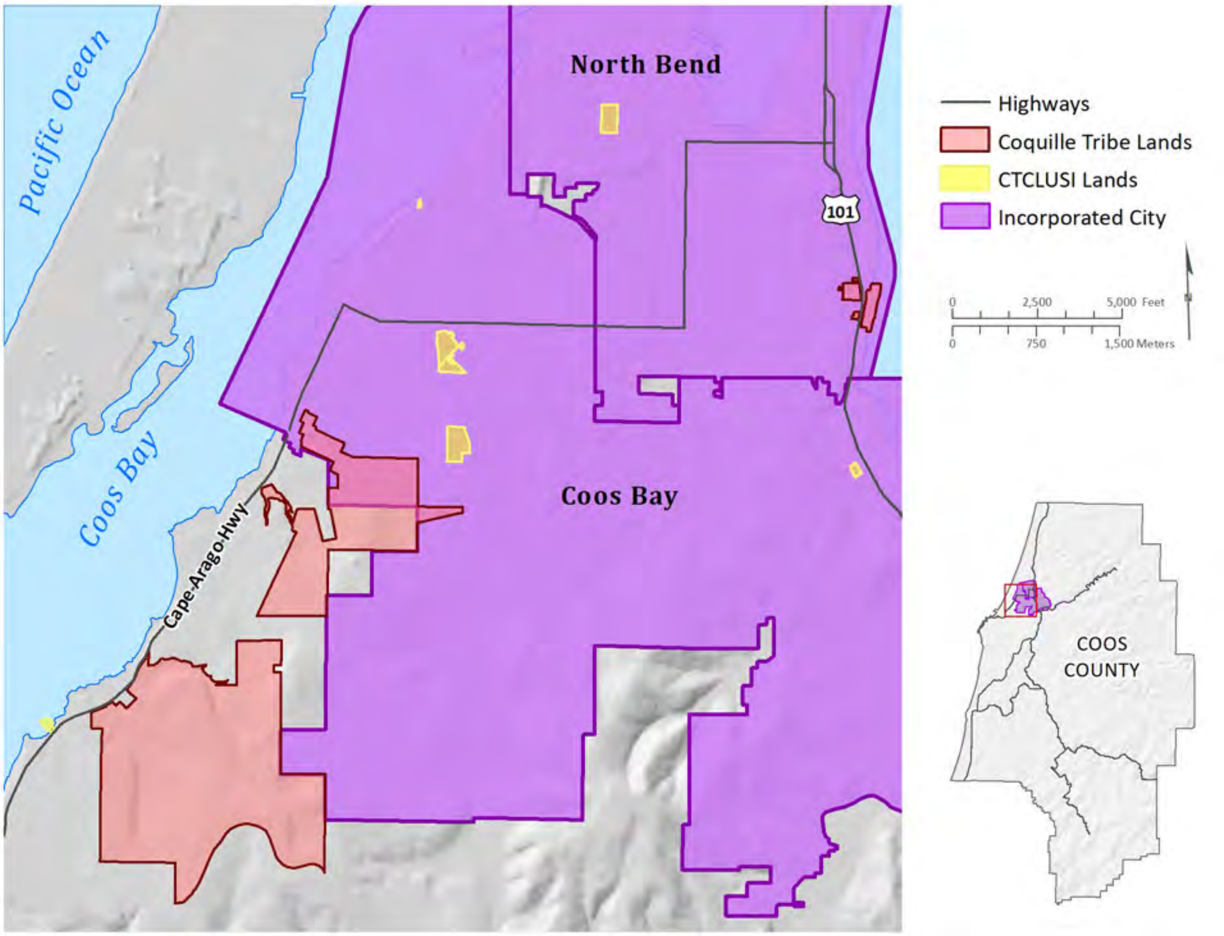
We selected these unincorporated communities on the basis of population size and density, which makes them distinct from the overall unincorporated county jurisdiction. We based the boundaries of these unincorporated communities primarily on the 2010 census block areas.

Figure 1-1. Study area: Coos County with communities in the study identified.



Note that "CTCLUSI" is the tribal community of the Confederated Tribes of Coos, Lower Umpqua, and Siuslaw Indians.

Figure 1-2. Cities of Coos Bay and North Bend with overlapping tribal lands.



Note that "CTCLUSI" is the tribal community of the Confederated Tribes of Coos, Lower Umpqua, and Siuslaw Indians.

1.3 Project Scope

For this risk assessment, we took a quantitative approach and applied it to buildings and population. We limited the project scope to buildings and population because of data availability, the strengths and limitations of the risk assessment methodology, and funding availability. We did not analyze impacts to the local economy, land values, or the environment. Depending on the natural hazard, we used one of two methodologies: loss estimation or exposure. Loss estimation was modeled using methodology from Hazus®-MH (Hazards U.S., Multi-Hazard), a tool developed by FEMA for calculating damage to buildings from flood and earthquake. Exposure is a simpler methodology, in which buildings are categorized based on their location relative to various hazard zones. To account for impacts on population (permanent residents only), 2010 U.S. census data (U.S. Census Bureau, 2010a) were associated with residential buildings.

A critical component of this risk assessment is a countywide building inventory developed from building footprint data and the Coos County tax assessor database. The other key component is a suite of datasets that represent the currently best available science for a variety of natural hazards. The geologic hazard scenarios were selected by DOGAMI staff based on their expert knowledge of the datasets; most datasets are DOGAMI publications. In addition to geologic hazards, we included wildfire hazard in this risk assessment. The following is a list of the natural hazards and the risk assessment methodologies that were applied. See **Table 1-1** for data sources.

Cascadia Subduction Zone (CSZ) Earthquake and Tsunami Risk Assessment

- Hazus-MH loss estimation from a CSZ earthquake magnitude (Mw) 9.0 event (includes liquefaction and coseismic landslides)
- Exposure to five potential CSZ tsunami scenarios

Flood Risk Assessment

- Hazus-MH loss estimation to four riverine recurrence intervals (10%, 2%, 1%, 0.2% annual chance) and one coastal recurrence interval (1%)
- Exposure to 1% annual chance recurrence interval

Landslide Risk Assessment

- Exposure based on landslide susceptibility (low to very high)

Wildfire Risk Assessment

- Exposure based on Fire Risk Index (low to high)

Table 1-1. Hazard data sources for Coos County.

Hazard	Scenario or Classes	Scale/Level of Detail	Data Source
Earthquake (includes liquefaction and coseismic landslides)	CSZ Mw 9.0	Statewide	DOGAMI (Madin and Burns, 2013)
Tsunami	Local Source: Small (300 yr) Medium (425-525 yr) Large (650-800 yr) Extra Large (1,050-1,200 yr) Extra Extra Large (1,200 yr)	Oregon Coast	DOGAMI (Priest and others, 2013)
Flood	Depth Grids: 10% (10-yr) 2% (50-yr) 1% (100-yr) 0.2% (500-yr)	Countywide	DOGAMI – derived from FEMA (2014) data, included in GIS data for this report
Landslide*	Susceptibility (Low, Moderate, High, Very High)	Statewide	DOGAMI (Burns and others, 2016)
Wildfire	Risk (Low, Moderate, High)	Regional (Western United States)	Oregon Department of Forestry (Sanborn Map Company, Inc., 2013)

CSZ Mw 9.0 is Cascadia Subduction Zone magnitude 9.0 earthquake.

*Landslide data comprise a composite dataset where the level of detail varies greatly from place to place within the state. Refer to Section 3.4.1 or the report by Burns and others (2016) for more information.

1.4 Previous Studies

One previous earthquake risk assessment has been conducted that included Coos County by DOGAMI. Wang and Clark (1999: DOGAMI Special Paper 29) ran two general level Hazus-MH earthquake analyses, a magnitude 8.5 CSZ earthquake and a 500-year probabilistic earthquake scenario, for the entire state of Oregon. In those analyses Coos County had a very high loss ratio relative to most counties in the state.

In 2010, DOGAMI updated FEMA's Flood Insurance Rate Maps (FIRM)s for Coos County. During this map update process, DOGAMI also produced a series of flood maps of the communities of Coos County that showed parcels and building exposure to the depth of flooding from a 1% annual-chance flood (Tilman, 2010: O-10-05, O-10-06, O-10-07, O-10-08, O-10-09, O-10-10, O-10-11). Exposure results were quantified by land value and real market value provided by the county assessor.

We did not compare the results of this project with the results of the previous studies because of limited time and funding and differences in methodologies.

2.0 METHODS

2.1 Hazus-MH Loss Estimation

"Hazus provides nationally applicable, standardized methodologies for estimating potential wind, flood, and earthquake losses on a regional basis. Hazus can be used to conduct loss estimation for floods and earthquakes [...]. The multi-hazard Hazus is intended for use by local, state, and regional officials and consultants to assist mitigation planning and emergency response and recovery preparedness. For some hazards, Hazus can also be used to prepare real-time estimates of damages during or following a disaster" (FEMA, 2012a, p. 1-1).

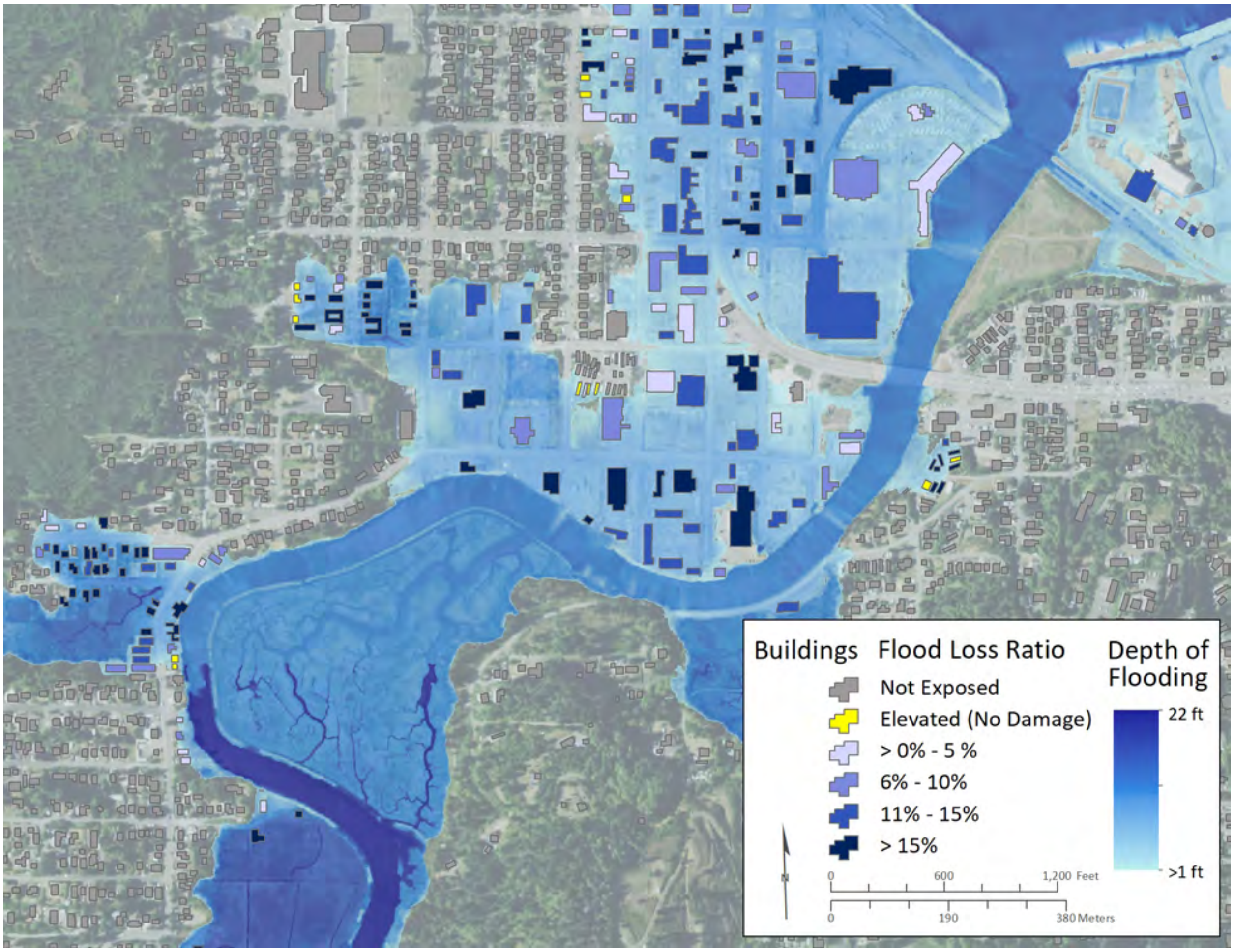
> ***Key Terms:***
> - *Loss estimation:* Damage that occurs to a building in an earthquake or flood scenario, as modeled with Hazus-MH methodology.
> - *Loss ratio:* Percentage of estimated loss relative to the total value.

Hazus-MH can be used in different modes depending on the level of detail required. Given the high spatial precision of the building inventory data and quality of the natural hazard data available for this study, we chose the user-defined facility (UDF) mode. This mode makes loss estimations for individual buildings relative to their "cost," which DOGAMI then aggregates to the community level to report loss ratios. Cost used in general building stock mode is associated with rebuilding using new materials, also known as replacement cost. Replacement cost is based on a method called RSMeans valuation (Charest, 2017) and is calculated by multiplying the building square footage by a standard cost per square foot. These standard rates per square foot are in tables within the default Hazus-MH database.

Damage functions are at the core of Hazus-MH. The damage functions stored within the Hazus-MH data model were developed and calibrated from the observed results of past disasters. Estimates of loss are made by intersecting building locations with natural hazard layers and applying damage functions based on the hazard severity and building characteristics. **Figure 2-1** illustrates the range of building loss estimates from Hazus-MH flood analysis.

DOGAMI used Hazus-MH version 3.0 (FEMA, 2015), which was the latest version available when we began this risk assessment.

Figure 2-1. 100-year flood zone and building loss estimates example in the City of Coos Bay.



2.2 Exposure

> ***Key Terms:***
> - *Exposure:* Determination of whether a building is within or outside of a hazard zone. No loss estimation is modeled.
> - *Building value:* Total monetary value of a building. This term is used in the context of exposure.

Exposure methodology is calculating the buildings and population that are within a natural hazard zone. This is an alternative for natural hazards that do not have readily available damage functions and, therefore, loss estimation is not possible. It provides a way to easily quantify what is and what is not threatened. Exposure results are communicated in terms of total building value exposed, rather than loss estimate because the loss ratio is unknown. For example, **Figure 2-2** shows buildings that are exposed to different tsunami scenarios.

Exposure is used for tsunami, landslide, and wildfire to quantify buildings and residents at risk. For comparison with loss estimates, exposure is also used for the 1% annual chance flood.

Figure 2-2. Tsunami inundation scenarios and building exposure example in the community of Charleston.

Note that larger scenarios include the buildings of the smaller scenarios.

2.3 Building Inventory

A key piece of the risk assessment is the countywide building inventory. This inventory consists of all buildings larger than 500 square feet (152 square meters), as determined from existing building footprints or tax assessor data. **Figure 2-3** shows an example of building inventory occupancy types used in the Hazus-MH and exposure analyses in Coos County. See also **Plate 1** and **Plate 2.**

To use the building inventory within the Hazus-MH methodology, we converted the building footprints to points and migrated them into a UDF database with standardized field names and attribute domains. The UDF database formatting allows for the correct damage function to be applied to each building. Hazus-MH version 2.1 technical manuals (FEMA, 2012b, c) provide references for acceptable field names, field types, and attributes. The fields and attributes used in the UDF database (including building seismic codes) are discussed in more detail in **C.2.2**.

Figure 2-3. Building occupancy types, portion of City of Bandon.

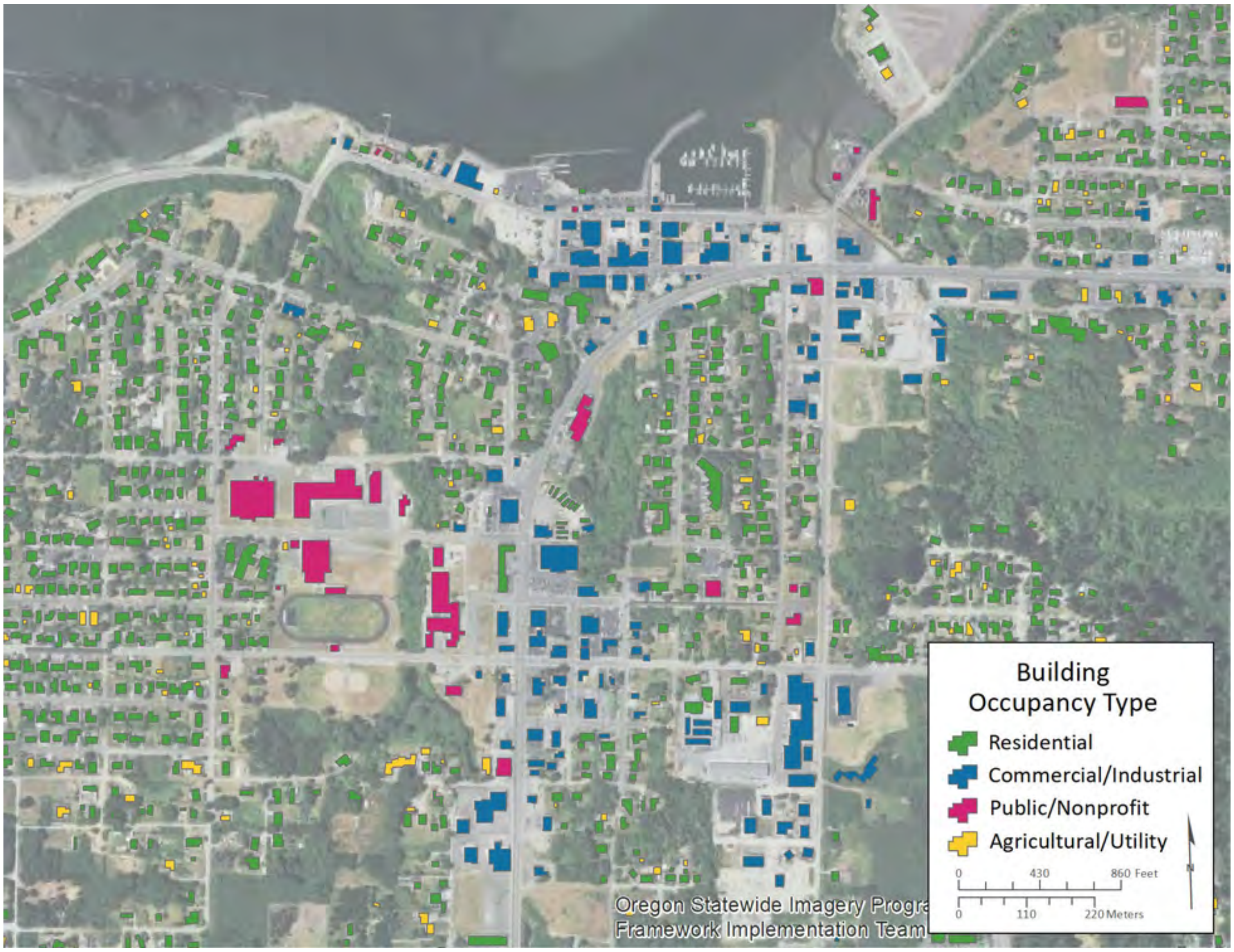


Table 2-1 shows the distribution of building count and value within the UDF database for Coos County. A table detailing the occupancy class distribution by community is included in **Appendix B: Detailed Risk Assessment Tables**.

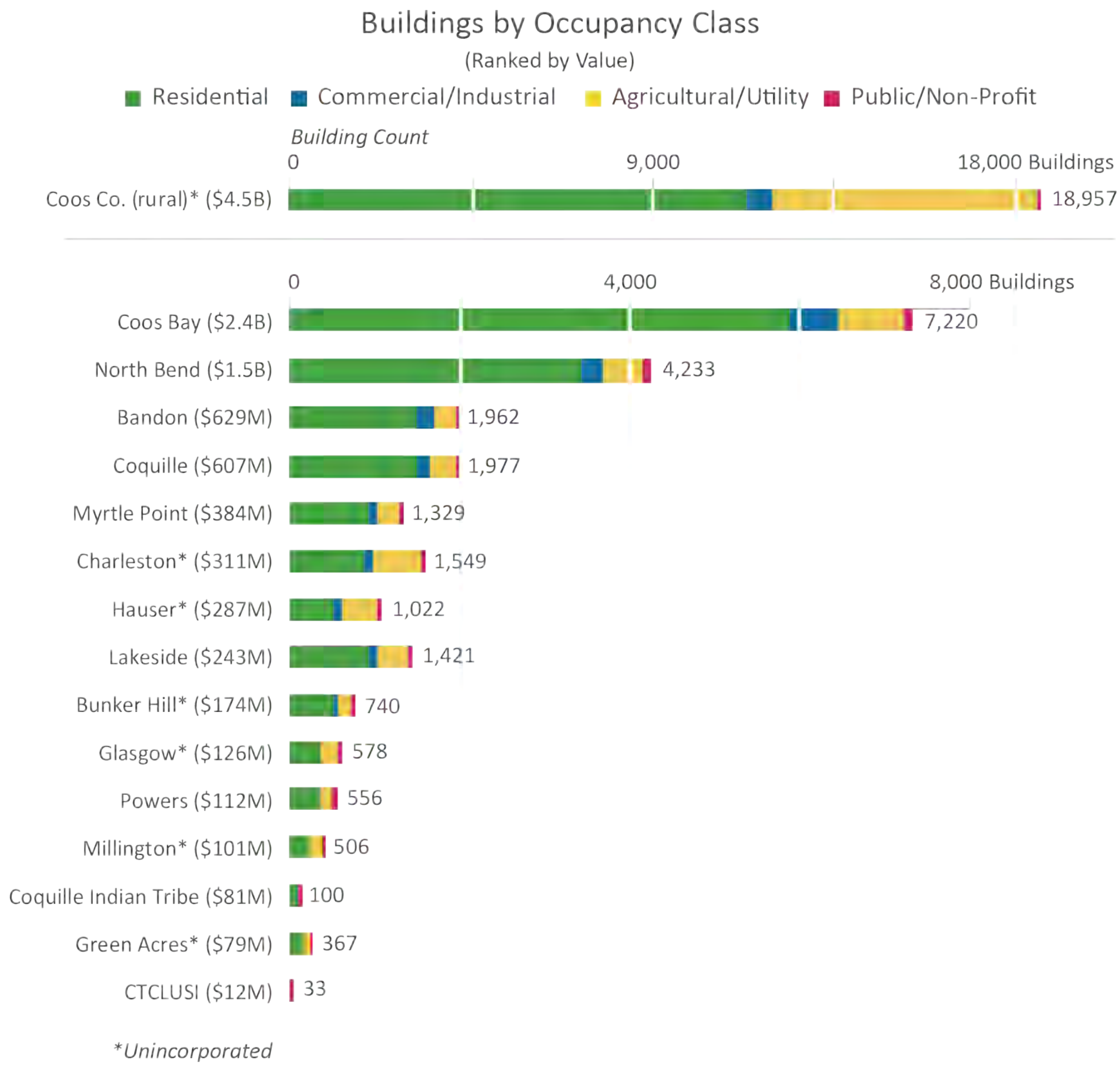
Table 2-1. Coos County building inventory.

Community	Total Number of Buildings	Percentage of Buildings of Coos County	Total Estimated Building Value ($)	Percentage of Building Value of Coos County
Unincorp. County (rural)	18,957	45%	4,476,885,000	39%
Bunker Hill	740	1.7%	173,872,000	1.5%
Charleston	1,549	3.6%	310,927,000	2.7%
Glasgow	578	1.4%	125,629,000	1.1%
Green Acres	367	0.9%	79,090,000	0.7%
Hauser	1,022	2.4%	286,877,000	2.5%
Millington	506	1.2%	100,571,000	0.9%
Total Unincorp. County	23,719	56%	5,553,851,000	48%
Bandon	1,962	4.6%	629,445,000	5.5%
CTCLUSI	33	0.1%	12,470,000	0.1%
Coos Bay	7,220	17%	2,420,579,000	21%
Coquille	1,977	4.6%	606,670,000	5.3%
Coquille Indian Tribe	100	0.2%	80,721,000	0.7%
Lakeside	1,421	3.3%	242,768,000	2.1%
Myrtle Point	1,329	3.1%	383,743,000	3.3%
North Bend	4,233	9.9%	1,494,790,000	13%
Powers	556	1.3%	111,516,000	1.0%
Total Coos County	42,550	100%	11,536,553,000	100%

The building inventory was developed from several data sources and was refined for use in loss estimation and exposure analyses. A database of building footprints for a significant portion of Coos County was already available from a previous DOGAMI project (Priest and others, 2013). Building footprints in the database were digitized from high-resolution lidar collected in 2009 (South Coast project, Oregon Lidar Consortium; see http://www.oregongeology.org/lidar/collectinglidar.htm). The building footprints provide a spatial location and 2D representation of a structure. The total number of buildings within the study area was 42,550.

Coos County supplied assessor data that we formatted for use in the risk assessment. The assessor data contains an array of information about each improvement (i.e., building). Tax lot data, which contains property boundaries and other information regarding the property, was obtained from the county assessor and was used to link the buildings with assessor data. The linkage between the two datasets resulted in a database of UDF points that contain attributes for each building. These points are used in the risk assessment for both loss estimation and exposure analysis. **Figure 2-4** illustrates the variation of building value and occupancy across the communities of Coos County.

Figure 2-4. Community building value in Coos County by occupancy class.



Note that "Coos Co. (rural)" excludes incorporated communities, tribal lands, Bunker Hill, Charleston, Glasgow, Green Acres, Hauser, and Millington.

We attributed critical facilities in the UDF database so that they could be highlighted in the results. Critical facilities data came from the DOGAMI Statewide Seismic Needs Assessment (SSNA; Lewis, 2007). We updated the SSNA data by reviewing Google Maps™ data. The critical facilities we attributed include hospitals, schools, fire stations, police stations, emergency operations, and military facilities. In addition to these standard building types, we considered other building types based on local input or special considerations that are specific to the study area that would be essential during a natural hazard event, such as public works and water treatment facilities. Critical facilities are important to note because these facilities play a crucial role in emergency response efforts. Communities that have critical facilities that can function during and immediately after a natural disaster are more resilient than those with critical facilities that are inoperable after a disaster. **Table 2-2** shows the critical facilities on a community basis. Critical facilities are listed for each community (see **Community Risk Profiles**).

Table 2-2. Coos County critical facilities inventory.

Community	Hospital & Clinic		School		Police/Fire		Emergency Services		Military		Other*		Total	
	Count	Value ($)	Count	Value ($)	Count	Value ($)	Count	Value ($)	Count	Value ($)	Count	Value ($)	Count	Value ($)
	(all dollar amounts in thousands)													
Unincorp. County (rural)	0	0	0	0	14	17,574	0	0	0	0	7	49,986	21	67,560
Bunker Hill	0	0	1	9,335	0	0	0	0	0	0	0	0	1	9,335
Charleston	0	0	0	0	1	783	0	0	1	3,551	0	0	2	4,333
Glasgow	0	0	0	0	1	1,754	0	0	0	0	0	0	1	1,754
Green Acres	0	0	0	0	1	815	0	0	0	0	0	0	1	815
Hauser	0	0	1	17,261	1	1,886	0	0	0	0	0	0	2	19,147
Millington	0	0	0	0	1	1,099	0	0	0	0	0	0	1	1,099
Total Unincorp. County	0	0	2	26,596	19	23,911	0	0	1	3,551	7	49,986	29	104,043
Bandon	1	7,414	3	38,553	2	3,813	0	0	0	0	2	1,024	8	50,804
CTCLUSI	0	0	0	0	0	0	0	0	0	0	1	3,164	1	3,164
Coos Bay	1	32,309	8	104,239	5	16,535	0	0	2	4,846	6	23,977	22	181,906
Coquille	1	7,858	3	44,644	2	3,300	1	2,647	0	0	1	6,424	8	64,872
Coquille Indian Tribe	0	0	0	0	0	0	0	0	0	0	1	3,315	1	3,315
Lakeside	0	0	0	0	1	1,628	0	0	0	0	2	2,476	3	4,103
Myrtle Point	0	0	2	29,743	1	1,882	0	0	0	0	3	3,650	6	35,275
North Bend	0	0	4	75,399	5	9,657	0	0	1	8,782	2	28,906	12	122,745
Powers	0	0	2	9,355	2	1,782	0	0	0	0	0	0	4	11,136
Total Coos County	3	47,581	24	328,529	37	62,508	1	2,647	4	17,179	25	122,922	94	581,363

Note: Facilities with multiple buildings were consolidated into one building.

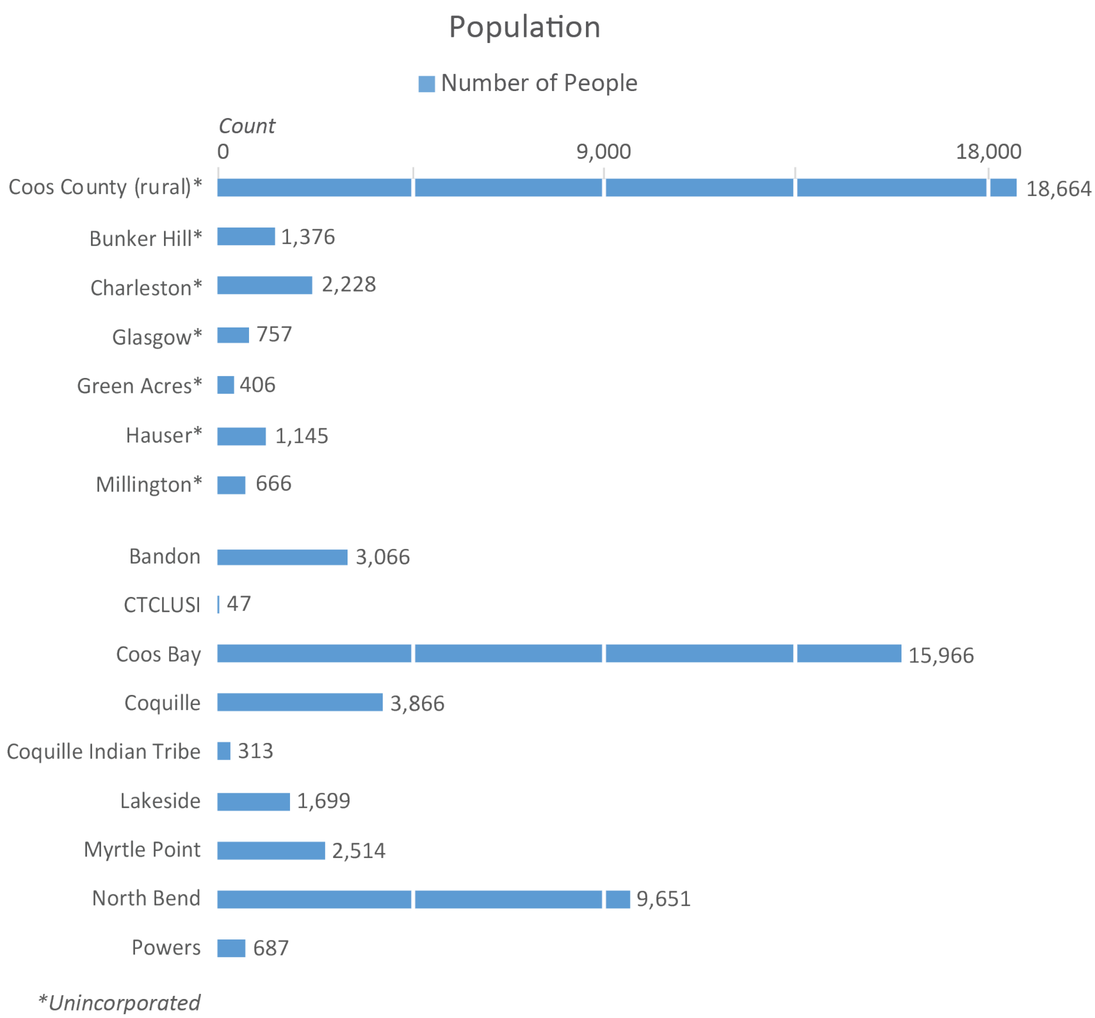
*Category includes buildings that are not traditional (emergency response) critical facilities but considered critical during an emergency based on input from local stakeholders (e.g. water treatment facilities or airports).

2.4 Population

Within the UDF database, the population of permanent residents reported per census block was distributed among residential buildings and pro-rated based on square footage (**Figure 2-5**). We did not examine the impacts of natural hazards on nonpermanent populations (e.g., tourists), whose total numbers fluctuate seasonally. Due to lack of information within the assessor and census databases, the distribution includes vacation homes, which in many coastal communities make up some of the total residential building stock. From information reported in the 2010 U.S. Census, American FactFinder regarding vacation rentals within the county and coastal communities, it is estimated that approximately 4% of residential buildings are vacation rentals in Coos County (U. S. Census Bureau, 2010b).

From the census data, DOGAMI analyzed the 63,043 residents within the study area who could be affected by a natural hazard scenario. For each natural hazard, with the exception of the CSZ Mw 9.0 earthquake scenario, a simple exposure analysis was used to find the number of potentially displaced residents within a hazard zone. For the CSZ Mw 9.0 earthquake scenario the potentially displaced residents were based on a combination of residents exposed to tsunami and those in buildings estimated to be significantly damaged by the earthquake.

Figure 2-5. Population by Coos County community.



3.0 ASSESSMENT OVERVIEW AND RESULTS

This risk assessment considers five natural hazards (earthquake, tsunami, flood, landslide, and wildfire) that pose a risk to Coos County. The assessment describes both localized vulnerabilities and the widespread challenges that impact all communities. The loss estimation and exposure results, as well as the rich dataset included with this report, can lead to greater understanding of the potential impact of disasters. Communities can use the results to update plans as part of the work toward becoming more resilient to future disasters.

3.1 Hazards and Countywide Results

In this section, results are presented for the study area. The study area includes all unincorporated areas, tribal lands, unincorporated communities, and cities within Coos County. Individual community results are in **Appendix A: Community Risk Profiles**.

3.2 Cascadia Subduction Zone Earthquake

> **Understanding the connection between CSZ earthquakes and tsunamis**
>
> During a large CSZ earthquake, the sudden uplift of the North American plate along the CSZ margin is likely to displace enough water to produce a tsunami that will have an impact along the Oregon coast. The proximity of the CSZ to the coastal areas of Oregon make them especially threatened by earthquakes and tsunamis (Madin and Burns, 2013).
>
> Although we discuss CSZ earthquakes and tsunamis as separate hazards in this report, these hazards are closely associated. Their widespread effects and almost simultaneous occurrence present a challenge to planners.

An earthquake is a sudden movement of rock on each side of a fault in the earth's crust that abruptly releases strain accumulated over a long period of time. The movement along the fault produces waves of strong shaking that spread in all directions. If an earthquake occurs near populated areas, it may cause causalities, economic disruption, and extensive property damage (Madin and Burns, 2013).

Just off Oregon's coast, the Juan de Fuca tectonic plate slides under the North American plate. This area of interaction between the two plates is known as the Cascadia subduction zone (CSZ). The pressure and friction created by this convergent motion builds potential energy at the plate boundary until the overriding plate suddenly slips, releasing energy that manifests as strong shaking spread over a wide area. Earthquakes as large as Mw 8-9 occur along the CSZ on average every 230-540 years (Goldfinger and others, 2012, 2017).

Two earthquake-induced hazards are liquefaction and landslides. Liquefaction occurs when saturated soils substantially lose bearing capacity due to ground shaking, causing the soil to behave like a liquid; this action can be a source of tremendous damage. Coseismic landslides are mass movement of rock, debris, or soil induced by ground shaking. All earthquake damages in this report include damages derived from shaking, liquefaction, and landslide factors.

Another risk factor associated with the CSZ event is coseismic subsidence. According to Peterson and others (1997), a CSZ earthquake can result in coastal subsidence of up to 10 feet (1–3 meters). Low-lying developed areas near beaches and estuaries are most susceptible to this long-term hazard. A significant and permanent lowering of coastal terrain would expose buildings and infrastructure to tidal inundation in low-lying coastal areas that were formerly above high tide (Madin and Burns, 2013). Analysis of this potentially significant hazard is beyond the scope of this project.

3.2.1 Data sources

Most of the hazard data inputs for our Hazus-MH earthquake analysis were originally created for the 2012 Oregon Resilience Plan (ORP) for Cascadia Subduction Zone Earthquakes (Madin and Burns, 2013). In conducting their vulnerability assessment, the ORP seismic workgroup chose an earthquake scenario of Mw 9.0 off the coast of Oregon along the subduction zone.

Hazus-MH offers two methods for estimating loss from earthquake, probabilistic and deterministic (FEMA, 2012b). A probabilistic scenario uses U.S. Geological Survey (USGS) National Seismic Hazard Maps, which are derived from seismic hazard curves calculated on a grid of sites across the United States that describe the annual frequency of exceeding a set of ground motions as a result of all possible earthquake sources (USGS, 2017). A deterministic scenario is based on a specific seismic event, which in this case is the CSZ Mw 9.0 event. We selected the deterministic scenario method because the CSZ event is the most likely large earthquake to impact this area (Goldfinger and others, 2012, 2017). We used this method along with the UDF database so that loss estimates could be calculated on a building-by-building basis.

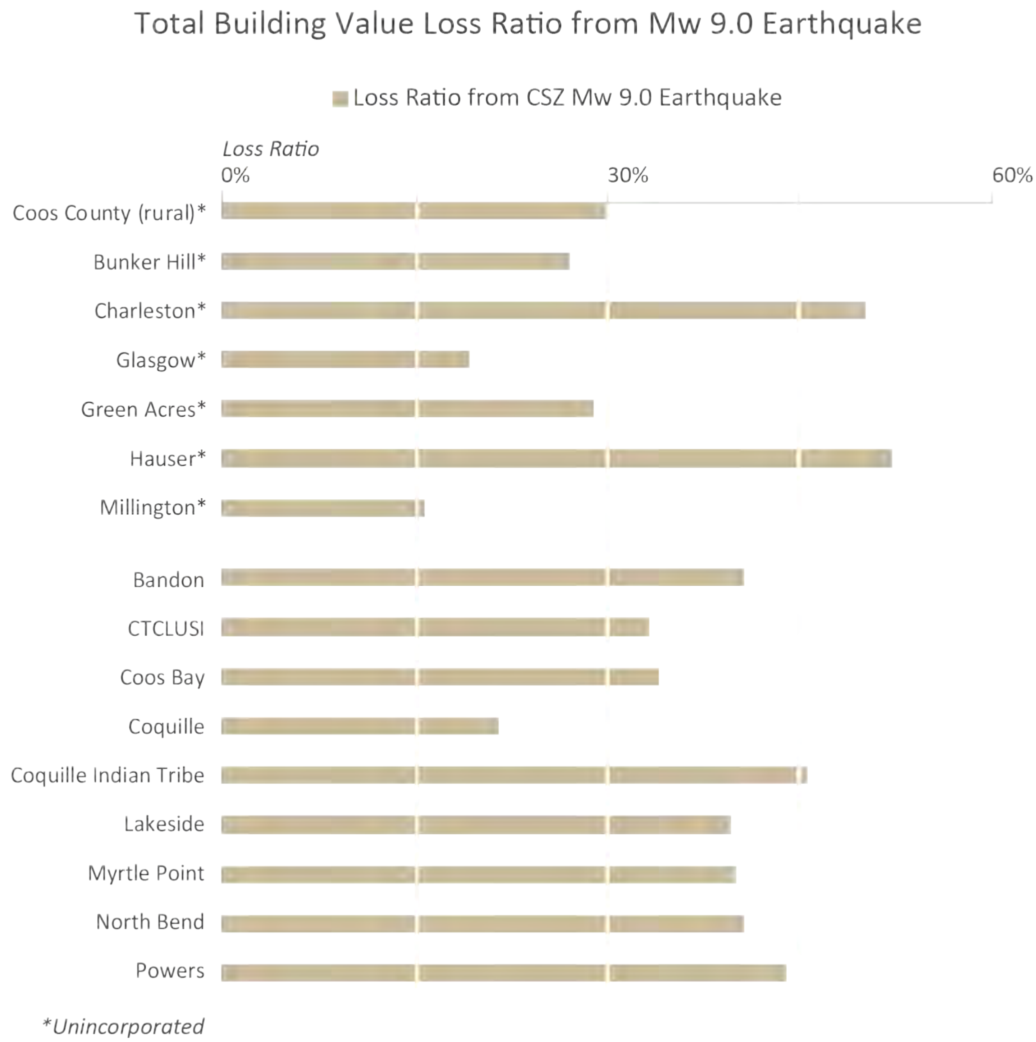
The following hazard layers used for our loss estimation are derived from work conducted by Madin and Burns (2013): National Earthquake Hazard Reduction Program (NEHRP) soil classification, peak ground acceleration (PGA), peak ground velocity (PGV), spectral acceleration at 1.0 second period and 0.3 second period (SA10 and SA03), and liquefaction susceptibility. We also used landslide susceptibility data derived from the work of Burns and others (2016). The liquefaction and landslide susceptibility layers together with PGA were used by the Hazus-MH tool to calculate probability and magnitude of permanent ground deformation.

While the loss estimates and exposure results of the earthquake and tsunami presented in this report both describe a single CSZ scenario, the hazard data used in these analyses are the product of different sources that equates to a slightly different event magnitude. The Medium-sized tsunami scenario was modeled with a CSZ Mw 8.9 earthquake (Priest and others, 2013). The earthquake bedrock ground motions from a Mw 9.0 CSZ earthquake were produced by Arthur Frankel of the USGS (personal communication, 2012) and then modified to include site class soil factors (Madin and Burns, 2013). While the tsunami scenario is associated with a specific amount of slip needed to generate a tsunami, the earthquake model is independent of slip with the earthquake energy distributed over the rupture zone. Irrespective of these differences, the two scenarios represent similar levels of severity and was a determining factor for their use in this report.

3.2.2 Countywide results

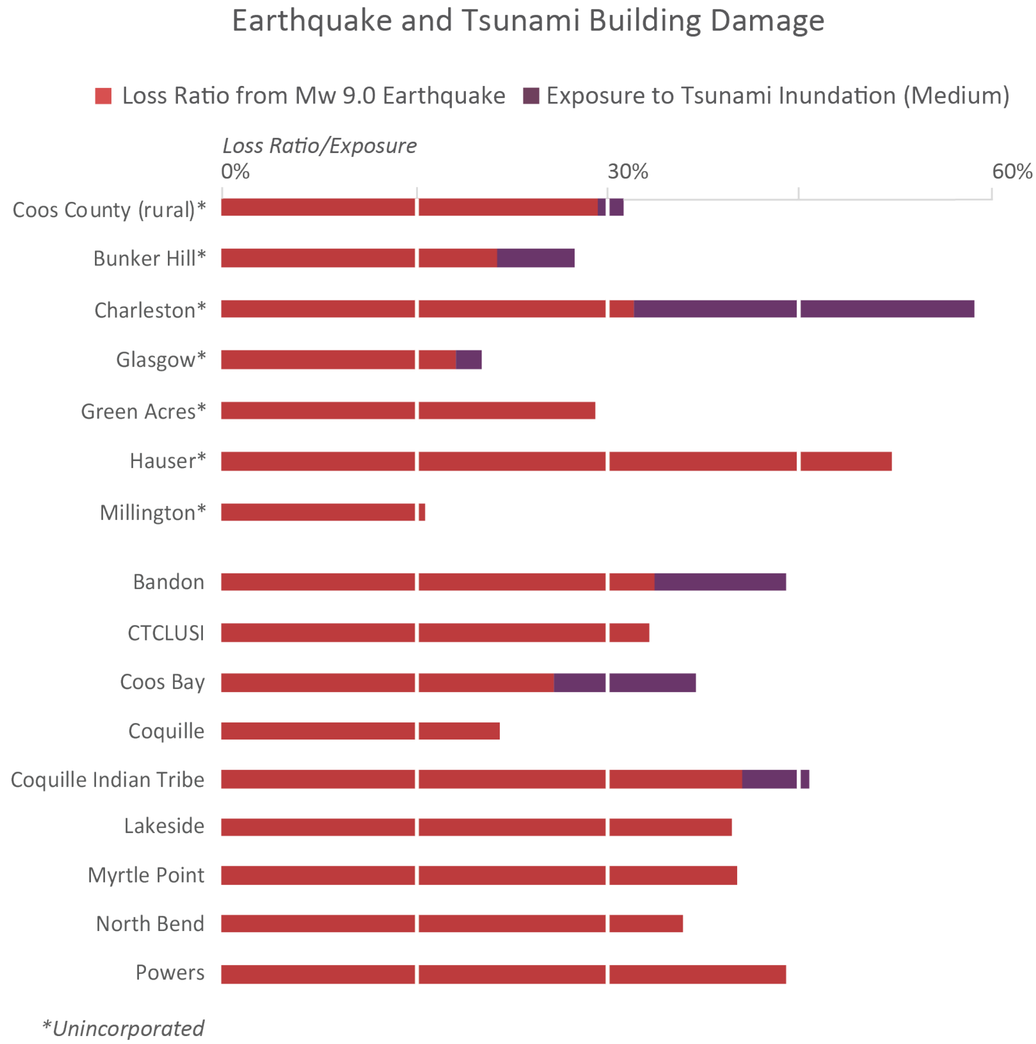
The CSZ event will produce severe ground shaking and ground failure, as well as a large and swift moving tsunami (Madin and Burns, 2013). Due to the nearly simultaneous timing of these two natural hazards, we have parsed loss estimate results to avoid double counting. That is, buildings within the (Medium-sized) tsunami zone are reported on the basis of exposure only, while buildings outside the tsunami zone are reported on the basis of Hazus-MH earthquake loss estimates. Based on recent tsunami events in Japan, Sumatra, and Chile, we assumed that tsunami losses to buildings are complete within the inundation area (Bauer and others, 2020). Tsunami results are provided in the subsequent tsunami section. **Figure 3-1** shows the loss estimates by community for Coos County from a CSZ Mw 9.0 event without the effects from tsunami.

Figure 3-1. Earthquake loss ratio by Coos County community.



Because an earthquake can affect a wide area, it is unlike other hazards in this report—every building in Coos County, to some degree, will be shaken by a CSZ Mw 9.0 earthquake (see Appendix E, **Plate 3**). Hazus-MH loss estimates (see **Table B-2**) for each building are based on a formula where coefficients are multiplied by each of the five damage state percentages (none, low, moderate, extensive, and complete). These damage states are correlated to loss ratios that are then multiplied by the building dollar value to obtain a loss estimate (FEMA, 2012b). Loss estimates reported for earthquake are for buildings *outside* the (Medium-sized) tsunami inundation zone. **Figure 3-2** shows loss ratios from the CSZ event (both tsunami and earthquake) for the communities of Coos County.

Figure 3-2. CSZ Mw 9.0 event loss ratio in Coos County, for both earthquake and tsunami inundation.



Note: Due to the nearly simultaneous timing of a Cascadia subduction zone earthquake and tsunami, loss estimate results have been parsed to avoid double counting. That is, buildings within the (Medium-sized) tsunami zone are reported on the basis of tsunami exposure only, while buildings outside the tsunami zone are reported on the basis of Hazus-MH earthquake loss estimates. Tsunami losses to buildings are assumed to be complete within the inundation area.

In keeping with earthquake damage reporting conventions, we used the ATC-20 post-earthquake building safety evaluation color-tagging system to represent damage states (Applied Technology Council, 2015). Red-tagged buildings correspond to a Hazus-MH damage state of "complete," which means the building is uninhabitable. Yellow-tagged buildings are in the "extensive" damage state, indicating limited habitability. The number of red or yellow-tagged buildings in each community is based on an aggregation of probabilities and does not represent individual buildings (FEMA, 2012b).

Critical facilities were considered nonfunctioning if the Hazus-MH earthquake analysis showed that a building or complex of buildings had a greater than 50% chance of being at least moderately damaged (FEMA, 2012b). Because building specific information is more readily available for critical facilities and due to their importance after a disaster, we chose to report the results of these buildings individually. The number reported for nonfunctioning critical facilities is only for buildings outside the (Medium-sized) tsunami inundation zone.

The number of potentially displaced residents from the CSZ Mw 9.0 earthquake is based on the number of red-tagged and 90% of yellow-tagged residences that were determined in the Hazus-MH earthquake analysis results (FEMA, 2012b). The number reported for potentially displaced residents is only for residences outside the (Medium-sized) tsunami inundation zone. Displaced residents due to a tsunami are discussed in the CSZ tsunami hazard section.

Coos countywide CSZ Mw 9.0 earthquake results (not including buildings or population within the Medium-sized tsunami zone):

- Number of red-tagged buildings: 9,689
- Number of yellow-tagged buildings: 3,659
- Loss estimate: $3,516,968,000
- Loss ratio: 30%
- Nonfunctioning critical facilities: 70
- Potentially displaced population: 11,999

The results indicate that Coos County would incur significant losses (30%) due to a CSZ Mw 9.0 earthquake. These results are strongly influenced by the overall average age of the building stock, which is an important factor in earthquake vulnerability. The first seismic building codes were implemented in Oregon in the 1970s (Judson, 2012). By the 1990's modern seismic building codes were being enforced; more than 80% of Coos County's buildings were built before this time. Communities within Coos County that are composed of older buildings are expected to experience more damage from earthquake than newer ones.

Moderate to high susceptibility liquefaction zones exist throughout the county and in the densest populated areas, which increases the risk from earthquake. Liquefaction could also present difficulties for evacuation from the subsequent tsunami, since liquefaction areas correspond closely with the most likely tsunami inundation zone (Priest and others, 2015). This factor, as well as the overall age of the building stock, along with the proximity of Coos County to the CSZ, results in high levels of damage.

While damage caused by coseismic landslides was not specifically looked at in this report, it likely contributes a significant amount of the estimated damage from the earthquake hazard in Coos County. Landslide exposure results show that 14% of buildings in Coos County are within a very high or high susceptibility zone. This indicates that a similar percentage of the loss estimate calculated in this study may be due to coseismic landslide rather than earthquake shaking alone.

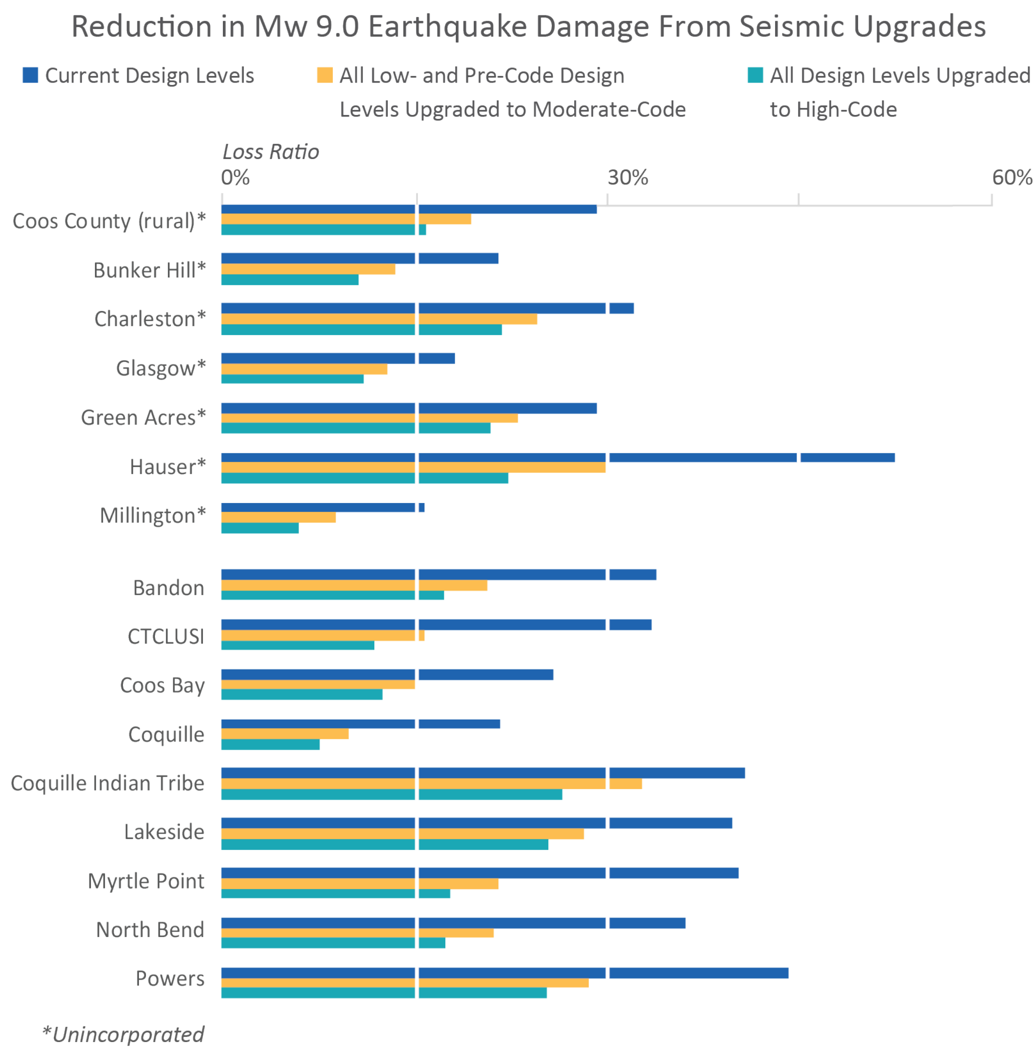
If buildings could be seismically retrofitted to moderate or high code standards, the impact of this event would be greatly reduced. In a simulation by DOGAMI, Hazus-MH earthquake analysis shows that loss ratios drop from 30% to 19%, when all buildings are upgraded to at least moderate code level. While retrofits can decrease earthquake vulnerability, for areas of high landslide or liquefaction, additional geotechnical mitigation may be necessary to have an effect on losses. **Figure 3-3** illustrates the reduction in loss estimates from a CSZ Mw 9.0 earthquake through two simulations where all buildings are upgraded to at least moderate code standards and then all buildings to high code standards.

Key Terms:

- *Seismic retrofit:* Structural modification to a building that improves its resilience to earthquake.
- *Design level:* Hazus-MH terminology referring to the quality of a building's seismic building code (i. e. pre, low, moderate, and high). Refer to Error! Reference source not found. for

Communities that are mostly within the tsunami hazard zone may need additional tsunami mitigation to reduce vulnerability.

Figure 3-3. CSZ Mw 9.0 earthquake loss ratio in Coos County, with simulated seismic building code upgrades.



Note: Loss ratios shown are for buildings outside the tsunami zone only and are reported on the basis of Hazus-MH earthquake loss estimates. Tsunami losses to buildings are assumed to be complete within the inundation area.

3.2.3 Areas of vulnerability or risk

We identified locations within the study area that are comparatively more vulnerable or at greater risk to CSZ Mw 9.0 earthquake hazard:

- Very high liquefaction soils are found throughout most of the populated estuarine portions of Coos County, which include the communities of Bandon, Bunker Hill, Charleston, Coos Bay, Millington, and North Bend.
- Building inventory for the cities of Coquille and Myrtle Point are relatively older than other communities in Coos County, which implies lower seismic building design codes and are more

vulnerable to damage during an earthquake. Myrtle Point's estimated loss ratio from a CSZ earthquake alone is 40%. Building code upgrade simulations show that Myrtle Point would benefit the most from seismic retrofits, loss estimates go from 40% to 22% when pre- and low-code buildings are upgraded to moderate code.

- Because of the liquefaction and landslides, communities will likely be "islands" disconnected from other communities by severed transportation routes. With losses up to 52%, it is very important for a community to be able to respond to emergencies with its own resources.
- Nearly all of the critical facilities (87%) in the communities of Coos County could be nonfunctioning due to a CSZ earthquake.

3.3 Cascadia Subduction Zone Tsunami

Tsunamis are a natural hazard threat that exists for many of the communities along the Oregon coast. The tsunami addressed in this report is caused by the abrupt movement of the seafloor accompanying an earthquake. In a megathrust earthquake, like the CSZ event, the sudden uplift of seafloor is converted into wave energy (Priest and others, 2013). While not included in this report, other important processes that may trigger a tsunami include landslides that start below the water surface and landslides that enter a deep body of water from above the water surface (Witter and others, 2011). Tsunamis can travel thousands of miles across oceans, so that a particular coastal area may be susceptible to two different types of tsunami hazard (Priest and others, 2013):

- Tsunamis caused by distant sources and that travel across the ocean basin, and
- Tsunamis caused by local sources such as the CSZ and that occur immediately adjacent to a coast.

During a CSZ earthquake, the sudden uplift of a portion of the North American plate along the CSZ margin is likely to produce a tsunami that will have an impact along the Oregon coast. This locally generated tsunami poses a significant risk to low-lying coastal and estuarine developed areas in Coos County due to the limited warning time of an approaching tsunami. Tsunami inundation zone maps created by DOGAMI can serve as a tool for planning and mitigation efforts. We chose the "Medium" tsunami scenario shown on these maps to describe the level of risk to communities, because, according to Priest and others (2013), the Medium scenario tsunami are the most likely to occur from a CSZ event.

3.3.1 Data sources

The tsunami hazard data used in this report are from Priest and others (2013). Priest and others modeled areas of expected inundation from five local (CSZ) tsunami scenarios and two distant source scenarios and created a series of inundation maps. The distant source tsunami scenarios were not used in this report. The local tsunami scenarios used in this report for exposure analysis were CSZ "t-shirt" sizes of Small (Sm), Medium (M), Large (L), Extra Large (XL), and Extra-Extra Large (XXL).

The slip deficit time intervals for each local source tsunami scenario is as follows (Priest and others, 2013):

- XXL 1,200 years
- XL 1,050–1,200 years
- L 650–800 years
- M 425–525 years
- Sm 300 years

The estimated recurrence rates are from Witter and others (2013) and are:

- XXL = unknown (not seen in 10,000-year record)
- XL = <1/10,000 = <0.01%
- L = 1/3,333 = 0.03%
- M = 1/1,000 = 0.1%
- Sm = 1/2,000 = 0.05%

For this risk assessment, DOGAMI compared the locations of buildings and critical facilities to the geographic extent of the local source tsunami inundation zones to assess the exposure for each community. The exposure results shown below are for the Medium scenario only (see **Table B-3** for all scenarios). The total dollar value of exposed buildings was summed for the study area and is reported below. We were also able to estimate the number of people at risk to tsunami hazard. See **Appendix B: Detailed Risk Assessment Tables** for cumulative multi-scenario analysis results.

3.3.2 Countywide results

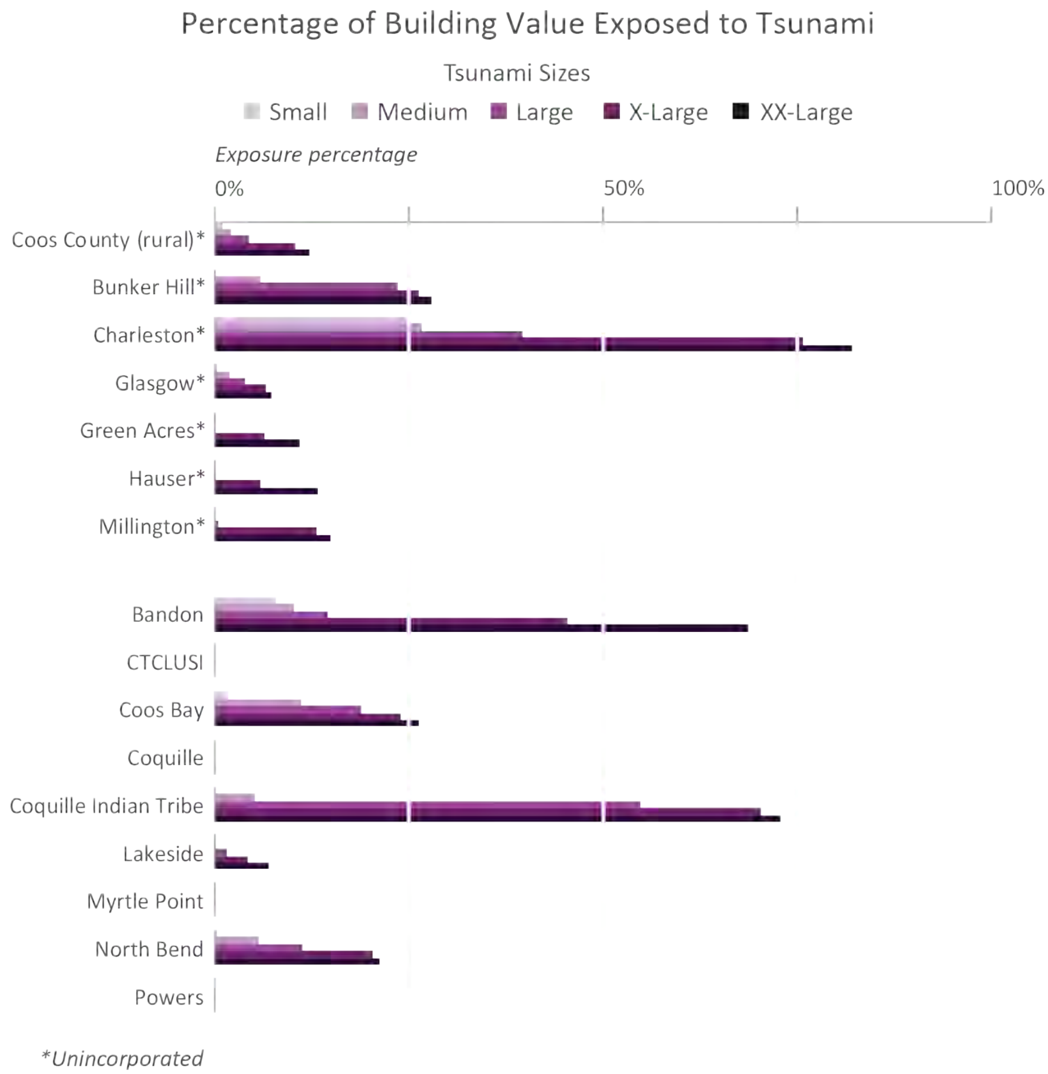
Most of the inhabited areas in Coos County are relatively near the Pacific Ocean and nearly all communities of the study area would be affected by the largest of the DOGAMI calculated tsunami scenarios. However, the Medium-sized tsunami was chosen as the primary scenario to describe the level of risk because that category represents the most likely to occur. Coos County's communities built along the open coast are at a higher risk to tsunami hazard than communities along the Coos River and Coquille River estuaries.

Coos countywide CSZ tsunami exposure (Medium tsunami scenario):

- Number of buildings exposed: 1,286
- Exposure value: $611,536,000
- Percentage of exposure value: 5.3%
- Critical facilities exposed: 13
- Potentially displaced population: 1,274

Many areas of development along Coos Bay and near the mouth of the Coquille River will be inundated by a tsunami. These areas could see exposure to the Medium-sized scenario as high as 25%. More than 1,200 permanent residents could be impacted from a CSZ tsunami event and require medical and shelter services. Because there is high risk of tsunami along the entire coast and estuarine areas of Coos County, awareness is important for the emergency response immediately after the event and for future planning and mitigation efforts in these areas (**Figure 3-4**).

Figure 3-4. Tsunami inundation exposure by Coos County community.



3.3.3 Areas of vulnerability or risk

We identified locations within the study area that are comparatively more vulnerable or at greater risk to CSZ Mw 9.0 tsunami hazard:

- The City of Bandon is expected to be impacted by a tsunami originating from a CSZ event. Exposure percentage is as high as 10% for the Medium tsunami scenario.
- Developments all along Coos Bay are exposed to tsunami hazard, with Charleston being the most exposed to this hazard.
- The developed area around the Highway 101 bridge near Lakeside is expected to be inundated by a tsunami.

3.4 Flooding

In its most basic form, a flood is an accumulation of water over normally dry areas. Floods become hazardous to people and property when they inundate an area where development has occurred, causing losses. Floods are a frequently occurring natural hazard in Coos County, and have the potential to create public health hazards, public safety concerns, close and damage major highways, destroy railways, damage structures, and cause major economic disruption. Flood issues like flash flooding, ice jams, post-wildfire floods, and dam safety were not looked at in this report.

A typical method for determining flood risk is to identify the probability of flooding and the impacts of flooding. The annual probabilities calculated for flood hazard used in this report are 10%, 2%, 1%, and 0.2%, henceforth referred to as 10-year, 50-year, 100-year, and 500-year scenarios, respectively. The ability to assess the probability of a flood, and the level of accuracy of that assessment is influenced by modeling methodology advancements, a greater understanding of flood hazard, and longer periods of record for the stream or water body in question.

The major rivers within the county are the Coos, Coquille, East Fork Coquille, Middle Fork Coquille, North Fork Coquille, South Fork Coos, and South Fork Coquille rivers. All the listed rivers are subject to flooding and can cause damage to buildings within the floodplain. In addition to riverine flooding, there are lakes within the coastal margin that are subject to flooding, including North Tenmile Lake, Saunders Lake, and Tenmile Lake. Other flooding effects for low-lying coastal developments are due to coastal flooding from the Pacific Ocean and the Coos River and Coquille River estuaries.

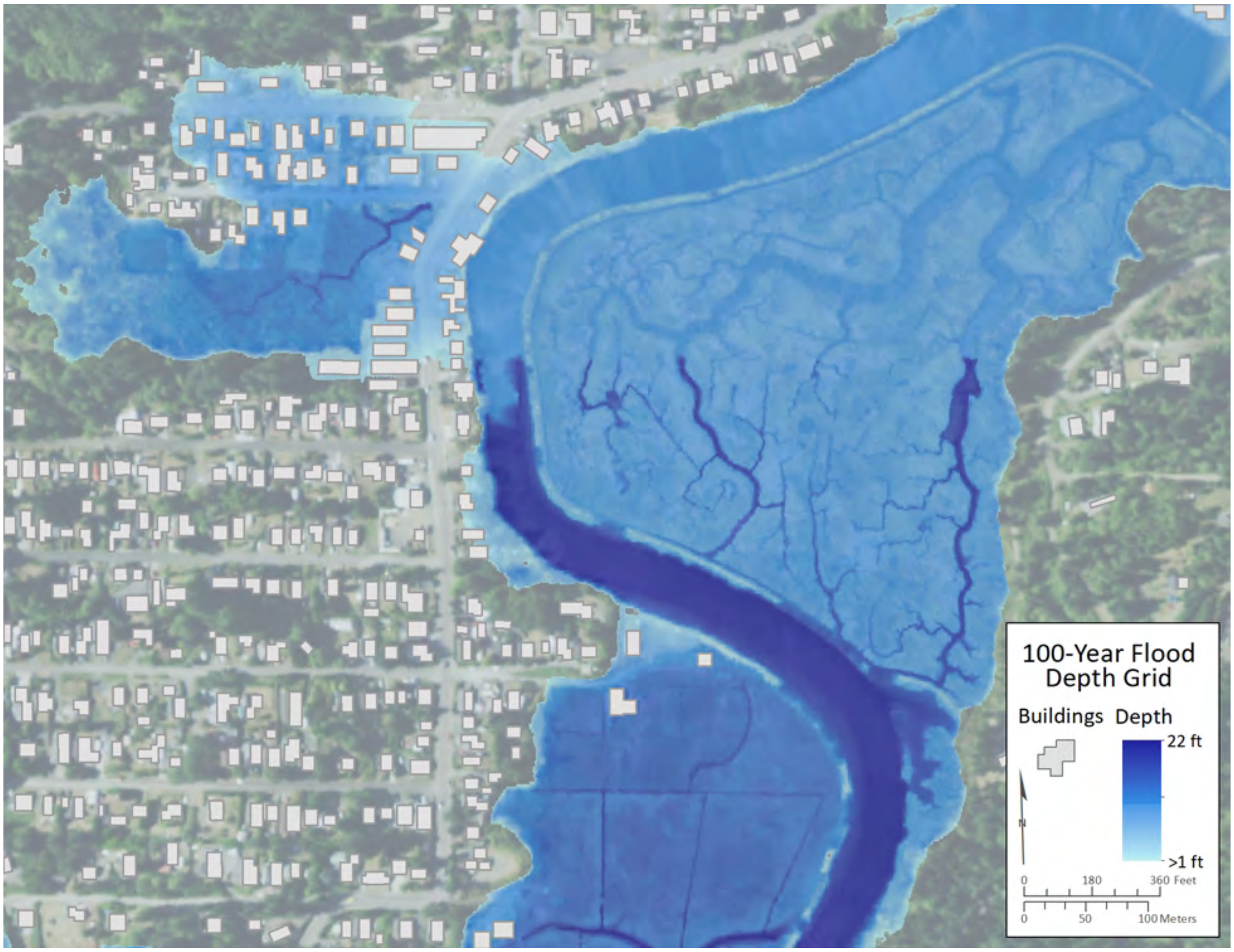
The impacts of flooding are determined by adverse effects to human activities within the natural and built environment. Through strategies such as flood hazard mitigation these adverse impacts can be reduced. Examples of common mitigating activities are to elevate structures above the expected level of flooding or by removing the structure through FEMA's property acquisition ("buyout") program.

3.4.1 Data sources

The Flood Insurance Study (FIS) and Flood Insurance Rate Maps (FIRMs) for Coos County were updated in 2012 (FEMA, 2014) and included a recently completed study of coastal flooding (Allan and others, 2012); these were the primary data sources for the flood risk assessment in this report. These studies were adopted as effective flood maps for the communities of Coos County in 2014. Further information regarding the National Flood Insurance Program (NFIP) can be found on the FEMA website: https://www.fema.gov/flood-insurance. These were the only flood data sources that DOGAMI used in the analysis, but flooding does occur in areas outside of the detailed mapped areas.

Depth grids, developed by DOGAMI in 2018 and based on the effective map data, were used in this risk assessment to determine the level to which buildings are impacted by flooding. Depth grids are raster GIS datasets where each digital pixel value represents the depth of flooding at that location within the flood zone **(Figure 3-5)**. Though considered draft at the time of this analysis, the depth grid data are the best available flood hazard data. Depth grids for four flooding scenarios (10-, 50-, 100-, and 500-year) were used for loss estimations and, for comparative purposes, exposure analysis. The 100-year depth grid included coastal flood modeling that was not available for the other scenarios.

Figure 3-5. Flood depth grid example, portion of the City of Coos Bay.



Building loss estimates are determined in Hazus-MH by overlaying building data over a depth grid. Hazus-MH uses individual building information, specifically the first-floor height above ground and the presence of a basement, to calculate the loss ratio from a particular depth of flood.

For Coos County, occupancy type and basement presence attributes were available from the assessor database for most buildings. Where individual building information was not available from assessor data, we used oblique imagery and street level imagery to estimate these important building attributes. Only buildings in a flood zone or within 500 feet (152 meters) of a flood zone were examined closely to attribute buildings with more accurate information for first-floor height and basement presence. Because our analysis accounted for building first-floor height, buildings that have been properly elevated above the flood level were not given a loss estimate—but we did count residents in those structures as displaced. We did not look at the duration that residents would be displaced from their homes due to flooding. For information about structures exposed to flooding but not damaged, please see the **Exposure analysis** section below.

3.4.2 Countywide results

For this risk assessment, we imported the countywide UDF data and depth grids into Hazus-MH and ran a flood analysis for each of the four flood scenarios (10-, 50-, 100-, and 500-year). We used the 100-year flood scenario as the primary scenario for reporting flood results (also see Appendix E. **Plate 5**). The 100-year flood has traditionally been used as a reference level for flooding and is the standard probability that FEMA uses for regulatory purposes (FEMA, 2013). See **Table B-4** for multi-scenario cumulative results.

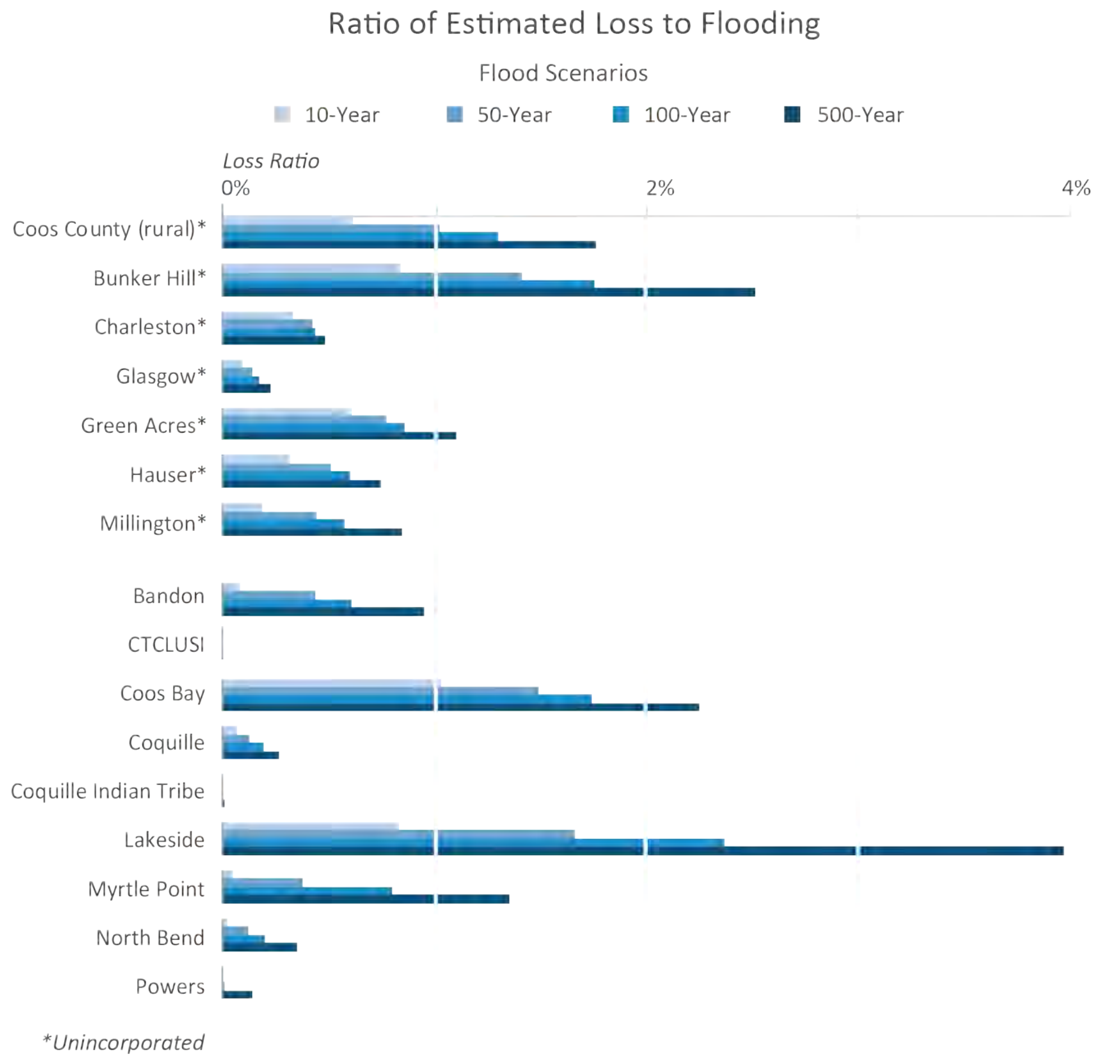
Coos countywide 100-year flood losses:

- Number of buildings damaged: 1,870
- Loss estimate: $125,349,000
- Loss ratio: 1.1%
- Damaged critical facilities: 13
- Potentially displaced population: 2,116

3.4.3 Hazus-MH analysis

The Hazus-MH loss estimate for the 100-year flood scenario for the entire county is approximately $125 million. Flooding in riverine and estuarine areas has the potential to significantly impact communities in Coos County. Most of the built environment along Coos Bay is potentially at risk to flooding hazard. A large concentration of buildings at risk to flooding is in the downtown portion of the City of Coos Bay. Flooding from coastal sources is limited to a few areas, like the low-laying coastal area south of Bandon (**Figure 3-6**). The Hazus-MH analysis also provides useful flood data on individual communities so that planners can identify problems and consider which mitigating activities will provide the greatest resilience to flooding.

Figure 3-6. Ratio of flood loss estimates by Coos County community.



Note: In addition to the four riverine flood scenarios, coastal flooding information is available for the 100-year flood scenario for areas near of the mouth of the Coos and Coquille rivers.

3.4.4 Exposure analysis

Separate from the Hazus-MH flood analysis, we did an exposure analysis by overlaying building locations on the 100-year flood extent. We did this to estimate the number of buildings that are elevated above the level of flooding and the number of displaced residents. This was done by comparing the number of non-damaged buildings from Hazus-MH with the number of exposed buildings in the flood zone. We counted 2,055 of Coos County's buildings to be within designated flood zones, which was about 5% of the county's buildings. Of these buildings, 185 buildings were elevated above the height of the 100-year flood. Elevating more of these exposed structures would further reduce the potential damages sustained from flooding. This evaluation also estimates that 2,116 residents might have mobility or access issues due to surrounding water. See appendix **Table B-5** for community-based results of flood exposure.

3.4.5 Areas of vulnerability or risk

We identified locations within the study area that are comparatively more vulnerable or at greater risk to flood hazard:

- A large portion of the downtown area of the City of Coos Bay is prone to flooding. A large estimated loss ($42 million) could result from 100-year flooding in the City of Coos Bay.
- 100-year flooding from Tenmile Creek and Tenmile Lake would damage many buildings in the City of Lakeside. This community has the highest loss ratios from flooding of any community in the study area.
- The commercial area by the marina in the City of Bandon is at risk to flooding.
- Several buildings in the communities of Coquille and Myrtle Point along the Coquille River are at risk to flooding.

3.5 Landslide Susceptibility

Landslides are mass movements of rock, debris, or soil most commonly downhill. There are many different types of landslides in Oregon. In Coos County, the most common are debris flows and shallow- and deep-seated landslides. Landslides can occur in many sizes, at different depths, and with varying rates of movement. Generally, they are large, deep, and slow moving or small, shallow, and rapid. Some factors that influence landslide type are hillside slope, water content, and geology. Many triggers can cause a landslide: intense rainfall, earthquakes, or human-induced factors like excavation along a landslide toe or loading at the top. Landslides can cause severe damage to buildings and infrastructure. Fast-moving landslides may pose life safety risks and can occur throughout Oregon (Burns and others, 2016).

3.5.1 Data sources

The Statewide Landslide Information Layer for Oregon [SLIDO], release 3.2 [Burns and Watzig, 2014]) is an inventory of mapped landslides in the state of Oregon. SLIDO is a compilation of past studies; some studies were completed very recently using new technologies, like lidar-derived topography, and some studies were performed more than 50 years ago. Consequently, SLIDO data vary greatly in scale, scope, and focus and thus in accuracy and resolution across the state. Modern methodology and lidar-based elevation data were used to map areas in the developed western half of the county in 2011. The eastern and mostly uninhabited part of the county was mapped in the 1970s.

Burns and others (2016) used SLIDO inventory data along with maps of generalized geology and slope to create a landslide susceptibility overview map of Oregon that shows zones of relative susceptibility: Very High, High, Moderate, and Low. SLIDO data directly define the Very High landslide susceptibility zone, while SLIDO data coupled with statistical results from generalized geology and slope maps define the other relative susceptibility zones (Burns and others, 2016). Statewide landslide susceptibility map data have the inherent limitations of SLIDO and of the generalized geology and slope maps used to create the map. Therefore, the statewide landslide susceptibility map varies significantly in quality across the state, depending on the quality of the input datasets. Another limitation is that susceptibility mapping does not include some aspects of landslide hazard, such as runout, where the momentum of the landslide can carry debris beyond the zone deemed to be a high hazard area.

We used the data from the statewide landslide susceptibility map (Burns and others, 2016) in this report to identify the general level of susceptibility of given area to landslide hazards, primarily shallow and deep landslides. We overlaid building and critical facilities data on landslide susceptibility zones to assess the exposure for each community (see **Table B-6**). The total dollar value of exposed buildings was calculated for the study area and is reported below. We also estimated the number of people threatened by landslides. Land value losses due to landslides were not examined for this report, in addition to potentially hazardous unmapped areas that may pose real risk to communities.

3.5.2 Countywide results

Many Coos County communities have some exposure to landslide hazard. Communities that developed in terrain with moderate to steep slopes or at the base of steep hillsides may be at risk to landslides. The Coast Range and Klamath Mountains run through eastern and central Coos County, so much of the area is steep and landslide prone. The combination of rugged terrain, historically active landslides, large amounts of rainfall, and frequent large earthquakes make landslides a serious threat.

We combined high and very high susceptibility zones as the primary scenarios to provide a general sense of community risk for planning purposes (see Appendix E, **Plate 6**). It was useful to combine exposure for both susceptibility zones to best communicate the level of landslide risk to communities. The high and very high susceptibility zones represent areas most prone to landslides and with the highest impact to the community.

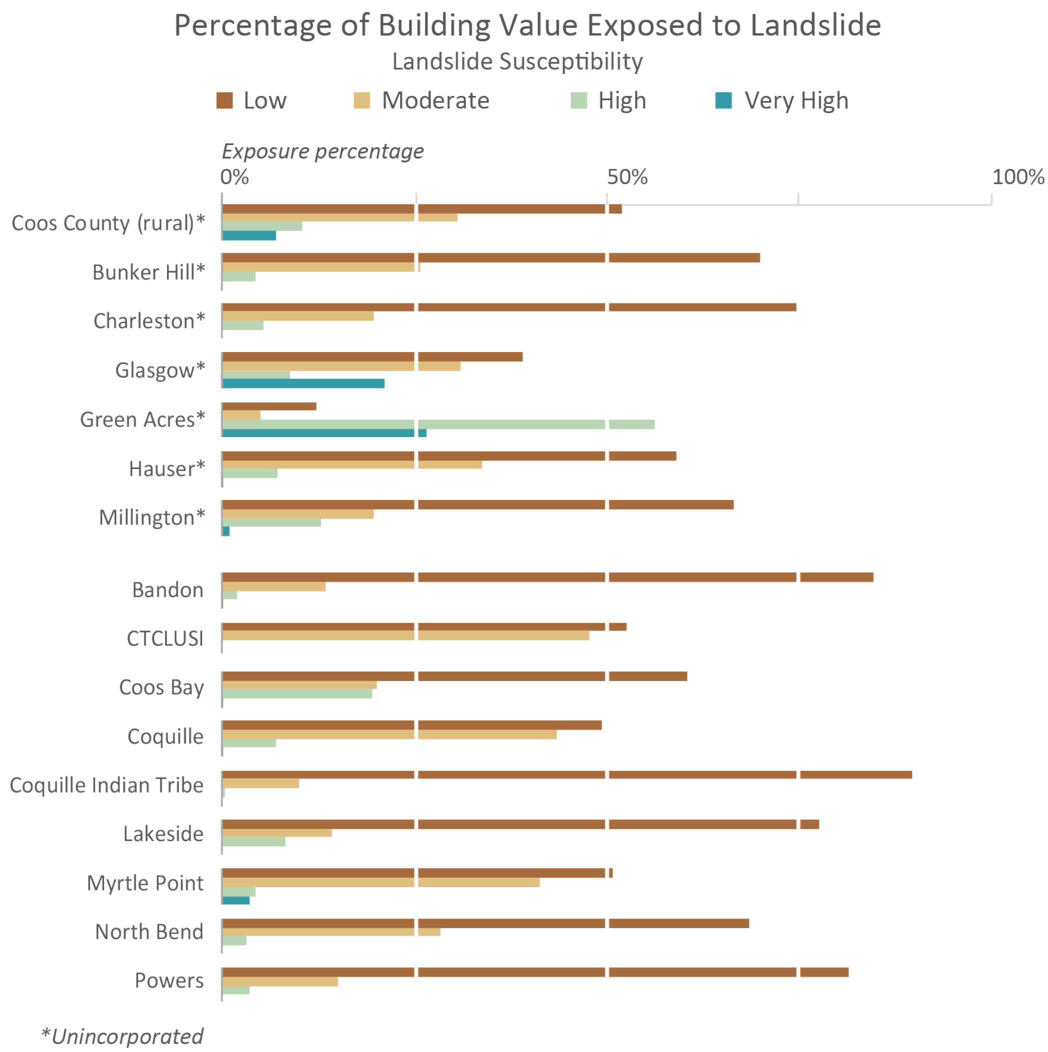
For this risk assessment we compared building locations to geographic extents of the landslide susceptibility zones (**Figure 3-7**). The exposure results shown below are for the high and very high susceptibility zones. See **Appendix B: Detailed Risk Assessment Tables** for multi-scenario analysis results.

Coos countywide landslide exposure (High and Very High susceptibility):

- Number of buildings: 7,123
- Exposure value: $1,583,583,000
- Percentage of exposure value: 14%
- Critical facilities exposed: 16
- Potentially displaced population: 9,550

The majority of buildings in Coos County are located on estuaries and floodplains, which are flatter than the surrounding landscape and are low-susceptibility landslide zones. Still, approximately 14% of the county's buildings have exposure to high or very high susceptibility to landslides. Landslide hazard is ubiquitous in a large percentage of undeveloped land and may present challenges for planning and mitigation efforts. Awareness of nearby areas of landslide hazard is beneficial to reducing risk for every community and rural area of the county.

Figure 3-7. Landslide susceptibility exposure by Coos County community.



3.5.3 Areas of vulnerability or risk

We identified locations within the study area that are comparatively more vulnerable or at greater risk to landslide hazard:

- Several inhabited areas in the community of Glasgow are exposed to very high landslide susceptibility.
- The community of Green Acres has a significant amount of exposure (83%) to high and very high landslide susceptibility.
- Exposure to landslide hazard is present for buildings throughout the unincorporated county. Additionally, a large portion of undeveloped land in the unincorporated county is deemed high or very high landslide susceptibility, which can be a factor when determining future developments.

3.6 Wildfire

Wildfires are a natural part of the ecosystem in Oregon. However, wildfires can present a substantial hazard to life and property, because communities often grow into the transition areas between developed areas and undeveloped areas, commonly called the wildland-urban interface (WUI) (Sanborn Map Company, Inc., 2013). The most common wildfire conditions include: hot, dry, and windy weather; the inability of fire protection forces to contain or suppress the fire; the occurrence of multiple fires that overwhelm committed resources; and a large fuel load (dense vegetation). Once a fire has started, its behavior is influenced by numerous conditions, including fuel, topography, weather, drought, and development (Sanborn Map Company, Inc., 2013). Post-wildfire geologic hazards can also present risk. These usually include flooding, debris flows, and landslides. Post-wildfire geologic hazards were not evaluated in this project.

There is potential for losses due to WUI fires in Coos County. Forests cover most of the undeveloped land in Coos County. According to the Coos County Community Wildfire Protection Plan, forests play an important role in the local economy but also surround homes and businesses (OPDR, 2011). In an effort to limit exposure to wildfire, The Coos County Comprehensive Plan provides guidance on reducing risk to wildfire (CCDP, 1985). Contact the Coos County Department of Planning for specific requirements related to the county's comprehensive plan.

3.6.1 Data sources

The West Wide Wildfire Risk Assessment (WWA; Sanborn Map Company, Inc., 2013) is a comprehensive report that includes a database developed over the course of several years for 17 Western states and some Pacific Islands. The steward of this database in Oregon is the Oregon Department of Forestry (ODF). The database was created to assess the level of risk residents and structures have to wildfire. For this project, the Fire Risk Index (FRI) dataset, a dataset included in the WWA database, was used to measure the level of risk to communities in Coos County.

Using guidance from ODF, we categorized the FRI into low, moderate, and high hazard zones for the wildfire exposure analysis. The FRI hazard zones are based on a combination of the impacts of wildfire (Fire Effects Index) and the probability of wildfire (Fire Threat Index). Both indices are the result of an integration of several input datasets. Broadly, the Fire Effects Index is based on potentially impacted assets and the difficulty of suppression. The components that make up the Fire Threat Index are fire occurrence, fire behavior, and fire suppression effectiveness (Sanborn Map Company, Inc., 2013).

We overlaid the buildings layer and critical facilities on each of the wildfire hazard zones to determine exposure. In certain areas no wildfire data are present which indicates areas that have minimal risk to wildfire hazard (see **Table B-7**). The total dollar value of exposed buildings in the study area is reported below. We also estimated the number of people threatened by wildfire. Land value losses due to wildfire were not examined for this project.

3.6.2 Countywide results

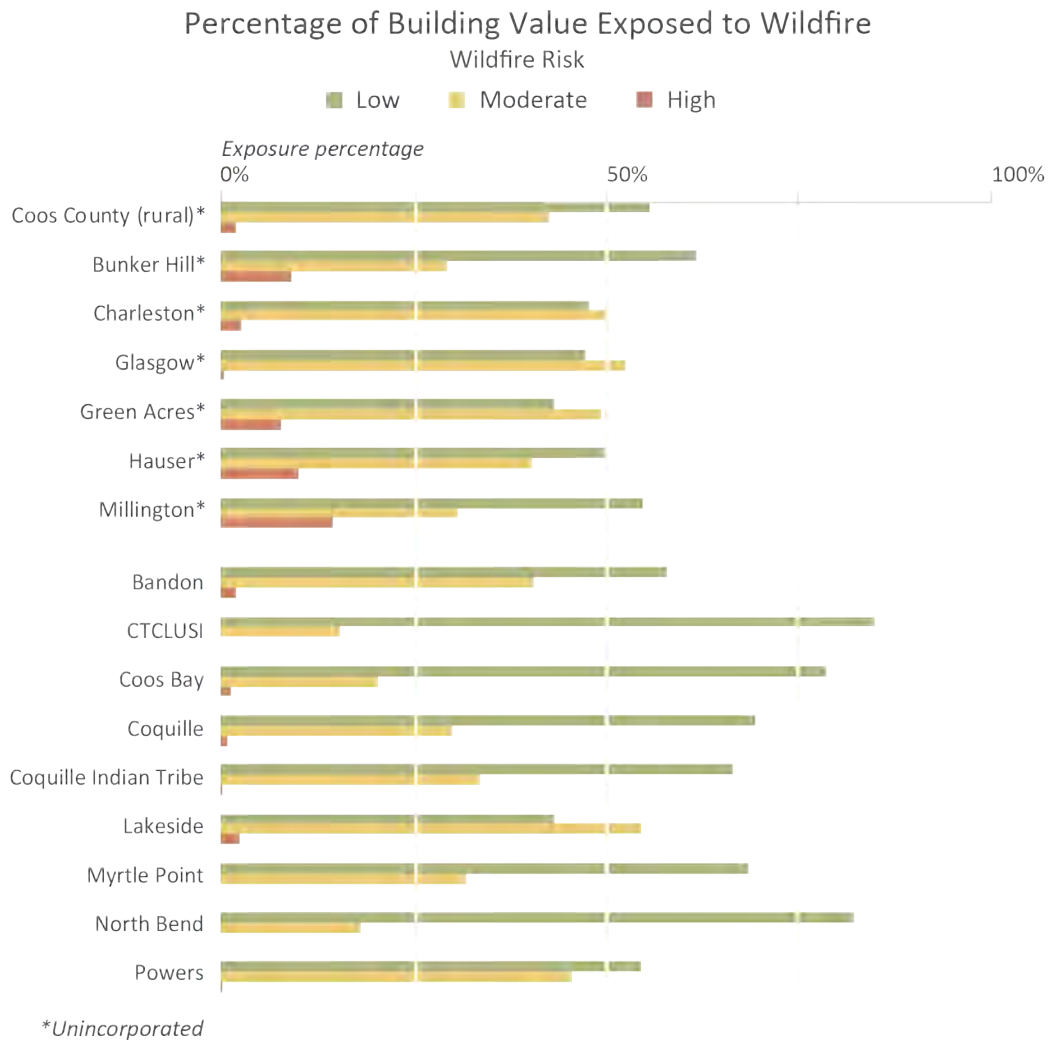
The high hazard category was chosen as the primary scenario for this report because that category represents areas that have the highest potential for losses. However, a large amount of loss would occur if the moderate hazard areas were to burn, as almost every community has ~30–50% of exposure to moderate wildfire hazard. Still, the focus of this section is on high hazard areas within Coos County to emphasize the areas where lives and property are most at risk.

Coos countywide wildfire exposure (high hazard):

- Number of buildings: 1,050
- Exposure value: $216,525,000
- Percentage of exposure value: 1.9%
- Critical facilities exposed: 1
- Potentially displaced population: 1,375

For this risk assessment, building locations were compared to the geographic extent of the wildfire hazard categories. We found that some of the communities in Coos County are exposed to wildfire hazard. The primary areas of exposure to this hazard are in the estuarine areas of the South Slough of the Coos River and some of the dunal areas in the north part of the county (see Appendix E, **Plate 7**). The communities of Bunker Hill, Hauser, Millington, and, to a certain degree, Green Acres are at a higher risk to wildfire than other communities in the county. **Figure 3-8** illustrates the level of risk from wildfire for the different communities of Coos County. See **Appendix B: Detailed Risk Assessment Tables** for multi-scenario analysis results.

Figure 3-8. Wildfire hazard exposure by Coos County community.



3.6.3 Areas of vulnerability or risk

We identified locations within the study area that are comparatively more vulnerable or at greater risk to wildfire hazard:

- Wildfire risk is high for hundreds of homes in the low-laying forested areas of the floodplains south of the City of Coos Bay. This area includes Unincorporated Coos County (rural), Bunker Hill, Green Acres, and Millington.
- Many residential buildings in the dunal areas within the community of Hauser are exposed to high wildfire hazard.

4.0 CONCLUSIONS

The purpose of this study is to provide a better understanding of potential impacts from multiple natural hazards at the community scale. We accomplished this by using the latest natural hazard mapping and loss estimation tools to quantify expected damage to buildings and potential displacement of permanent residents, or determine which buildings and residents are exposed to a hazard. This comprehensive and detailed approach to the analysis provides new context for the county's risk reduction efforts. We note several important findings based on the results of this study:

- **Extensive overall damage and losses are expected from a Cascadia Mw 9.0 earthquake and tsunami -** Due to its proximity to the CSZ, every community in Coos County will experience significant impact and disruption from a CSZ Mw 9.0 earthquake event. We limited our analysis to the impacts of an Mw 9.0 earthquake (including liquefaction and coseismic landslides) and an accompanying tsunami. Results show that a CSZ Mw 9.0 event will cause approximately 35% to 50% in building value losses for most communities. The unincorporated community of Charleston can expect a very high percentage of losses (27%) due to tsunami hazard. Other communities like Lakeside, Myrtle Point, North Bend, Powers, and Hauser have little to no tsunami exposure, but still will have high losses from the earthquake alone. The high loss levels estimated in the study area are due to the highly vulnerable building inventory (primarily because of the age of construction), the proximity to the CSZ event, and the amount of development within tsunami zones.
- **Retrofitting buildings to modern seismic building codes can reduce damages and losses from earthquake -** Seismic building codes have a major influence on earthquake shaking damage estimated in this study. We examined potential loss reduction from seismic retrofits (modifications that improve building's seismic resilience) in simulations by using Hazus-MH building code "design level" attributes of pre, low, moderate, and high codes (FEMA, 2012b) in CSZ earthquake scenarios. The simulations were accomplished by upgrading every pre (non-existent) and low seismic code building to moderate seismic code levels in one scenario, and then further by upgrading all buildings to high (current) code in another scenario. We found that retrofitting to at least moderate code was the most cost-effective mitigation strategy because the additional benefit from retrofitting to high code was minimal. In our simulation of upgrading buildings to at least moderate code, the estimated earthquake building value loss for the entire study area was reduced from 30% to 19%. We found further reduction in estimated loss in our simulation to 16% only by upgrading all buildings to high code. Some communities would see greater loss reduction than the study area as a whole due to older building stock constructed at pre or low code seismic building code standards. Some examples are the cities of Myrtle Point and North Bend, which would see a significant loss reduction (from 40% to 22% and 36% to 21%, respectively) by retrofitting all buildings to at least moderate code. While seismic retrofits are an effective strategy for reducing earthquake shaking damage, it should be noted that earthquake-induced tsunami, landslide, and liquefaction hazards will also be present in some areas, and these hazards require different geotechnical mitigation strategies. Future research focused on tsunami, landslide, and liquefaction hazard specific risk assessments are needed for a clear understanding of the hazard to inform local decisionmakers.
- **Flooding is a threat for some communities in Coos County** – Most of the communities in the study area are estimated to experience less than 1% of total building value loss from the 100-year flood. However, a few communities are estimated to experience higher levels of damage from

flood than other communities in the study area. Unincorporated Coos County (rural), Bunker Hill, Coos Bay, and Lakeside all are estimated to have 2% of building value losses due to 100-year flooding. At first glance, Hazus-MH flood loss estimates may give a false impression of risk because they show fairly low damages for a community relative to other hazards we examined. This is due to the difference between loss estimation and exposure results, as well as the limited area impacted from flooding. An average of 14% loss was calculated for buildings within the 100-year flood zone. Residents and buildings located near the riverine and estuarine portions of the Coos and the Coquille rivers are at a greater risk from flood than other locations within the study area. The highest concentrations of flood damage in the study area are downtown Coos Bay, the commercial area near the marina in the City of Bandon, and in the City of Lakeside near Tenmile Creek and Tenmile Lake.

- **Elevating structures in the flood zone reduces vulnerability -** Flood exposure analysis was used in addition to Hazus-MH loss estimation to identify buildings that were not damaged but that were within the area expected to experience a 100-year flood. By using both analyses in this way, the number of elevated structures within the flood zone could be quantified. This showed possible mitigation needs in flood loss prevention or the effectiveness of past activities. The City of Coos Bay has a high percentage (95%) of flood exposed buildings that are not elevated above the level of flooding, providing an opportunity to greatly reduce the estimated damages from a 100-year flood event. The exposure analysis also estimates the number of people that have limited mobility due to surrounding floodwaters. Many residents in the cities of Coos Bay (773), Lakeside (253), and Myrtle Point (119) may need evacuation assistance during a flood event.
- **New landslide mapping would increase the accuracy of future risk assessments -** Exposure analysis was used to assess the threat from landslides. Landslides are a widespread hazard and are present for some communities within the county. The communities of Glasgow and Green Acres have high levels of exposure to landslides. Landslide hazard is a very significant risk throughout the unincorporated rural parts of Coos County. The landslide hazard data for most of the areas used in this risk assessment were created before modern mapping technology; future risk assessments using lidar-derived landslide hazard data would provide more accurate results.
- **Wildfire risk is high for upstream portions of the Coos River watershed -** Exposure analysis shows that buildings south of Coos Bay are at risk to wildfires, especially around the communities of Bunker Hill and Millington. The western portion of the community of Hauser also has areas of higher risk to wildfires relative to the study area. Moderate wildfire hazard is present throughout the county, especially along transportation corridors. and is a potential threat for most communities. We estimate that most communities in Coos County have approximately 30–50% of exposure to moderate or higher wildfire hazard.
- **Most of the study area's critical facilities are at high risk from a CSZ earthquake and tsunami -** Critical facilities were identified and were specifically examined within this report. We have estimated that 88% (83) of Coos County's 94 critical facilities will be non-functioning after a CSZ event, with 13 of those located with the medium tsunami zone. For comparative purposes, 17% (16) of critical facilities are at risk to landslide, 14% (13) are exposed to flood hazard, and 1% (1) are exposed to wildfire.
- **The biggest causes of displacement to population are earthquake, tsunami, and landslide -** Potential displacement of permanent residents from natural hazards was estimated within this report. We estimated that 20% of the population in the county would be displaced due to a

combined earthquake and tsunami. Landslide hazard is a potential threat to 15% of permanent residents, flood hazard puts 3% at risk to displacement, and 2% are exposed to wildfire hazard.

- **The results allow communities the ability to compare across hazards and prioritize their needs -** Each community within the study area was assessed for natural hazard exposure and loss. This allowed for comparison of risk for a specific hazard between communities. It also allows for a comparison between different hazards, though care must be taken to distinguish loss estimates and exposure results. The loss estimates and exposure analyses can assist in developing plans that address the concerns for those individual communities.

5.0 LIMITATIONS

There are several limitations associated with interpreting the results of this risk assessment.

- **Spatial and temporal variability of natural hazard occurrence** – Flood, landslide, coastal erosion, and wildfire are extremely unlikely to occur across the fully mapped extent of the hazard zones. For example, areas mapped in the 1% annual chance flood zone will be prone to flooding on occasion in certain watersheds during specific events, but not all at once throughout the entire county or even the entire community. While we report the overall impacts of a given hazard, the losses from a single hazard event probably will not be as severe and widespread. Exceptions to this are earthquake ground-shaking and tsunami inundation, which are expected to impact the entire study area, and loss estimates for this hazard are based on a single event.
- **Loss estimation for individual buildings** – Hazus-MH is a model, not reality, which is an important factor when considering the loss ratio of an individual building. On-the-ground mitigation, such as elevation of buildings to avoid flood loss, has been only minimally captured. Also, due to a lack of building material information, assumptions were made about the distribution of wood, steel, and un-reinforced masonry buildings. Loss estimation is most insightful when individual building results are aggregated to the community level because it reduces the impact of data outliers.
- **Loss estimation versus exposure** – We recommend careful interpretation of exposure results. This is due to the spatial and temporal variability of natural hazards (described above) and the inability to perform loss estimations due to the lack of Hazus-MH damage functions. Exposure is reported in terms of total building value, which could imply a total loss of the buildings in a particular hazard zone, but this is not the case. Exposure is simply a calculation of the number of buildings and their value and does not make estimates about the level to which an individual building could be damaged. We note the tsunami hazard as a possible exception, given the extreme and widespread damage to buildings in recent events in Japan, Sumatra, and Chile.
- **Population variability** – Many coastal communities in Coos County are popular vacation destinations, particularly during the summer. Our estimates of potentially displaced people rely on permanent populations published in the 2010 U.S. Census (U.S. Census Bureau, 2010b). As a result, we are underestimating the number of people that may be at risk to hazards, especially during periods of high temporary population.
- **Data accuracy and completeness** – Some datasets in our risk assessment had incomplete coverage or lacked high-resolution data within the study area. We used lower resolution data to fill gaps where there was incomplete coverage or where high resolution was not available. Assumptions to amend areas of incomplete data coverage were made based on reasonable

methods described within this report. However, we are aware that some uncertainty has been introduced from these data amendments at an individual building scale. At community-wide scales the effects of the uncertainties are slight. We made certain assumptions regarding data layers to fill in data gaps for building footprints, population, some attributes derived from the assessor database, and landslide susceptibility. Many of the datasets included known or suspected artifacts, omissions and errors. Identifying or repairing these problems was beyond the scope of the project and require additional research.

6.0 RECOMMENDATIONS

The following areas of implementation are needed to better understand hazards and reduce risk to natural hazards through mitigation planning. These implementation areas, while not comprehensive, touch on all phases of risk management and focus on awareness and preparation, planning, emergency response, mitigation funding opportunities, and hazard-specific risk reduction activities.

6.1 Awareness and Preparation

Awareness is crucial to lowering risk and lessening the impacts of natural hazards. When community members understand their risk and know the role that they play in preparedness, the community in general is a much safer place to live. Awareness and preparation not only reduce the initial impact from natural hazards, but they also reduce the amount of time for a community to recover from a disaster—this ability is commonly referred to as "resilience."

This report is intended to provide local officials a comprehensive and authoritative profile of natural hazard risk to underpin their public outreach efforts.

Messaging can be tailored to stakeholder groups. For example, outreach to homeowners could focus on actions they can take to reduce risk to their property. The DOGAMI Homeowners Guide to Landslides (https://www.oregongeology.org/sub/Landslide/ger_homeowners_guide_landslides.pdf) provides a variety of risk reduction options for homeowners who live in high landslide susceptibility areas. This guide is one of many existing resources. Agencies partnering with local officials in the development of additional effective resources could help reach a broader community and user groups.

6.2 Planning

Information presented here are available for local decisionmakers in developing their local plans and help identify geohazards and associated risks to the community. The primary framework for accomplishing this is through the comprehensive planning process. The comprehensive plan sets the long-term trajectory of capital improvements, zoning, and urban growth boundary expansion, all of which are planning tools that can be used to reduce natural hazard risk.

Another framework is the natural hazard mitigation plan (NHMP) process. NHMP plans focus on characterizing natural hazard risk and identifying actions to reduce risk. Additionally, the information presented here can be a resource when updating the mitigation actions and inform the vulnerability assessment section of the NHMP plan.

While there are many similarities between this report and an NHMP, the hazards or critical facilities in the two reports can vary. Differences between the reports may be due to data availability or limited methodologies for specific hazards. The critical facilities considered in this report may not be identical to those listed in a typical NHMP due to the lack of damage functions in Hazus-MH for non-building structures and to different considerations about emergency response during and after a disaster.

6.3 Emergency Response

Critical facilities will play a major role during and immediately after a natural disaster. This study can help emergency managers identify vulnerable critical facilities and develop contingencies in their response plans. Additionally, detailed mapping of potentially displaced residents can be used to reevaluate evacuation routes and identify vulnerable populations to target for early warning. At the time of writing, DOGAMI is producing a series of tsunami evacuation maps for recommended pedestrian travel speeds to reach tsunami evacuation zones. The product is called "Beat the Wave" and is available at https://www.oregongeology.org/tsuclearinghouse/beatthewave.htm.

The building database that accompanies this report presents many opportunities for future pre-disaster mitigation, emergency response, and community resilience improvements. Vulnerable areas can be identified and targeted for awareness campaigns. These campaigns can be aimed at pre-disaster mitigation through, for example, improvements of the structural connection of the frame to the foundation. Emergency response entities can benefit from the use of the building dataset through identification of potential hazards and populated buildings before and during a disaster. Both reduction of the magnitude of the disaster and a decrease in the response time contribute to a community's overall resilience.

6.4 Mitigation Funding Opportunities

Several funding options are available to communities that are susceptible to natural hazards and have specific mitigation projects they wish to accomplish. State and federal funds are available for projects that demonstrate cost effective natural hazard risk reduction. The Oregon Office of Emergency Management (OEM) State Hazard Mitigation Officer (SHMO) can provide communities assistance in determining eligibility, finding mitigation grants, and navigating the mitigation grant application process.

- At the time of writing this report, FEMA has two programs that assist with mitigation funding for natural hazards: Hazard Mitigation Grant Program (HMGP) and Pre-Disaster Mitigation (PDM) Grant Program. FEMA also has a grant program specifically for flooding called Flood Mitigation Assistance (FMA). The SHMO can help with finding further opportunities for earthquake and tsunami assistance and funding.

6.5 Hazard-Specific Risk Reduction Actions

6.5.1 CSZ Mw 9.0 Earthquake

- Evaluate critical facilities for seismic preparedness by identifying structural deficiencies and vulnerabilities to dependent systems (e.g., water, fuel, power).
- Evaluate vulnerabilities of critical facilities. We estimate that 88% of critical facilities (**Appendix A: Community Risk Profiles**) will be damaged by the CSZ event, which will have many direct and indirect negative effects on first-response and recovery efforts.
- Identify communities and buildings that would benefit from seismic upgrades.
- Improve the mapping of liquefaction and NEHRP datasets within the county.

6.5.2 CSZ Mw 9.0 Tsunami

- Use approved guides on preparing for tsunamis (e.g., Oregon Department of Land Conservation and Development (DLCD) guide on preparing for the CSZ tsunami) https://www.oregon.gov/LCD/OCMP/Pages/Tsunami-Planning.aspx
- Evaluate the community evacuation plan, including consideration for viable vertical evacuation options.

6.5.3 Flood

- Map areas of potential floodwater storage areas.
- Identify structures that have repeatedly flooded in the past and would be eligible for FEMA's "buyout" program.
- Map channel migration zones along rivers identified as having moderate or high susceptibility to channel migration (Roberts and Anthony, 2017).

6.5.4 Landslide

- Create modern landslide inventory and susceptibility maps based on lidar-derived topographic data.
- Monitor ground movement in high susceptibility areas.
- Consider land value losses due to landslide in future risk assessments.

6.5.5 Wildfire

- Evaluate post-wildfire geologic hazards including flood, debris flows, and landslides.

7.0 ACKNOWLEDGMENTS

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9.0 APPENDICES

APPENDIX A. COMMUNITY RISK PROFILES

A risk analysis summary for each community is provided in this section to encourage ideas for natural hazard risk reduction. Increasing disaster preparedness, public hazards communication and education, ensuring functionality of emergency services, and access to evacuation routes are actions that every community can take to reduce their risk. This appendix contains community specific data to provide an overview of the community and the level of risk from each natural hazard analyzed. In addition, for each community a list of critical facilities and assumed impact from individual hazards is provided.

A.1 Unincorporated Coos County (Rural)

Table A-1. Unincorporated Coos County hazard profile.

Community Overview

Community Name	Population	Number of Buildings	Critical Facilities[1]	Total Building Value ($)
Unincorporated Coos County	18,664	18,957	21	4,476,885,000

Hazus-MH Analysis Summary

Hazard	Scenario	Potentially Displaced Residents	% Potentially Displaced Residents	Damaged Buildings	Damaged Critical Facilities	Loss Estimate ($)	Loss Ratio
Flood[2]	1% Annual Chance	763	4.1%	890	0	58,390,000	1.3%
*Earthquake**	*CSZ Mw 9.0 Deterministic*	3,149	17%	5,862	16	1,310,768,000	29%
Earthquake (within Tsunami Zone)		136	0.7%	196	3	44,178,000	1.0%

Exposure Analysis Summary

Hazard	Scenario	Potentially Displaced Residents	% Potentially Displaced Residents	Exposed Buildings	Exposed Critical Facilities	Building Value ($)	Percent of Exposure
Tsunami	*CSZ Mw 9.0 – Medium*	365	2.0%	418	3	94,049,000	2.1%
Tsunami	Senate Bill 379 Regulatory Line	230	1.2%	264	3	62,355,000	1.4%
Landslide	High and Very High Susceptibility	3,411	18%	3,749	3	782,675,000	18%
Wildfire	High Hazard	457	2.4%	402	1	86,157,000	1.9%

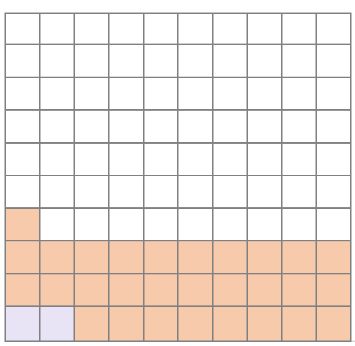
*Earthquake losses were calculated for buildings outside of Medium tsunami zone.

Rows with italicized text and shaded background indicate results should be considered in tandem as they are expected to occur within minutes of one another. Colors correspond to colors in Figure A-1.

[1]Facilities with multiple buildings were consolidated into one building complex.

[2]No damage is estimated for exposed structures with "First floor height" above the level of flooding (base flood elevation).

Figure A-1. Unincorporated Coos County loss ratio from Cascadia subduction zone event.



Each cell represents 1% of building value, so the grid represents 100% of total building value. The magnitude 9.0 CSZ event is predicted to simultaneously produce a damaging earthquake and tsunami. Hazus-MH modeling for loss ratio is available only for earthquake. Buildings with exposure to the tsunami inundation zone are assumed to be completely damaged, which would be 100% loss ratio. To avoid double counting of buildings, the earthquake loss ratio was calculated only for buildings outside of the tsunami zone.

†Each cell represents 1% of building value

= Estimated losses due to tsunami.

= Estimated losses due to earthquake (outside of tsunami zone).

Table A-2. Unincorporated Coos County critical facilities.

Critical Facilities by Community	Flood 1% Annual Chance	Earthquake Moderate to Complete Damage	Tsunami CSZ Mw 9.0 – Medium	Landslide High and Very High Susceptibility	Wildfire High Hazard
	Exposed	>50% Prob.	Exposed	Exposed	Exposed
Bandon RFPD	—	X	—	—	—
Bandon State Airport	—	X	—	—	—
Benham Airstrip	—	—	—	—	—
Bridge Rural Fire Department	—	X	—	—	—
Charleston RFPD	—	X	—	—	—
Charleston RFPD - 2	—	X	—	—	—
Coos RFD Station	—	X	—	—	—
Coquille RFD 1	—	X	—	—	—
Coquille RFD 2	—	X	—	X	—
Coquille RFD 3	—	X	—	X	—
Dora-Sitkum RFPD	—	X	—	—	—
Fairview RFPD	—	X	—	—	—
Millington RFD No. 5	—	X	—	—	—
Myrtle Point Fire 1	—	X	—	—	—
Myrtle Point RFPD Gravelford Station 3	—	X	—	—	—
ODOT - Davis Slough Maintenance	—	X	—	—	—
Port of Coos Bay 1	—	X	X	—	—
Port of Coos Bay 2	—	X	X	—	—
Port of Coos Bay 3	—	X	X	X	X
Powers Airstrip	—	X	—	—	—
Sumner RFPD	—	—	—	—	—

A.2 Unincorporated Community of Bunker Hill

Table A-3. Unincorporated community of Bunker Hill hazard profile.

Community Overview

Community Name	Population	Number of Buildings	Critical Facilities[1]	Total Building Value ($)
Bunker Hill	1,376	740	1	173,872,000

Hazus-MH Analysis Summary

Hazard	Scenario	Potentially Displaced Residents	% Potentially Displaced Residents	Damaged Buildings	Damaged Critical Facilities	Loss Estimate ($)	Loss Ratio
Flood[2]	1% Annual Chance	22	1.6%	50	0	3,061,000	1.8%
*Earthquake**	*CSZ Mw 9.0 Deterministic*	45	3.3%	146	1	37,528,000	22%
Earthquake (within Tsunami Zone)		0	0.0%	5	0	9,733,000	5.6%

Exposure Analysis Summary

Hazard	Scenario	Potentially Displaced Residents	% Potentially Displaced Residents	Exposed Buildings	Exposed Critical Facilities	Building Value ($)	Percent of Exposure
Tsunami	*CSZ Mw 9.0 – Medium*	9	0.7%	6	0	10,370,000	6.0%
Tsunami	Senate Bill 379 Regulatory Line	3	0.2%	2	0	508,000	0.3%
Landslide	High and Very High Susceptibility	84	6.1%	42	0	7,681,000	4.4%
Wildfire	High Hazard	185	14%	92	0	15,762,000	9.1%

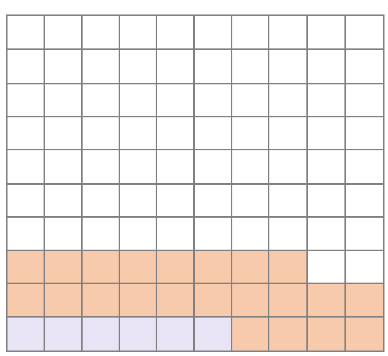
*Earthquake losses were calculated for buildings outside of Medium tsunami zone.

Rows with italicized text and shaded background indicate results should be considered in tandem as they are expected to occur within minutes of one another. Colors correspond to colors in Figure A-2.

[1]Facilities with multiple buildings were consolidated into one building complex.

[2]No damage is estimated for exposed structures with "First floor height" above the level of flooding (base flood elevation).

Figure A-2. Unincorporated community of Bunker Hill loss ratio from Cascadia subduction zone event.



Each cell represents 1% of building value, so the grid represents 100% of total building value. The magnitude 9.0 CSZ event is predicted to simultaneously produce a damaging earthquake and tsunami. Hazus-MH modeling for loss ratio is available only for earthquake. Buildings with exposure to the tsunami inundation zone are assumed to be completely damaged, which would be 100% loss ratio. To avoid double counting of buildings, the earthquake loss ratio was calculated only for buildings outside of the tsunami zone.

†Each cell represents 1% of building value.

= Estimated losses due to tsunami.

= Estimated losses due to earthquake (outside of tsunami zone).

Table A-4. Unincorporated community of Bunker Hill critical facilities.

Critical Facilities by Community	Flood 1% Annual Chance Exposed	Earthquake Moderate to Complete Damage >50% Prob.	Tsunami CSZ Mw 9.0 – Medium Exposed	Landslide High and Very High Susceptibility Exposed	Wildfire High Hazard Exposed
Bunker Hill Elementary	—	X	—	—	—

A.3 Unincorporated Community of Charleston

Table A-5. Unincorporated community of Charleston hazard profile.

Community Overview

Community Name	Population	Number of Buildings	Critical Facilities[1]	Total Building Value ($)
Charleston	2,228	1,549	2	310,927,000

Hazus-MH Analysis Summary

Hazard	Scenario	Potentially Displaced Residents	% Potentially Displaced Residents	Damaged Buildings	Damaged Critical Facilities	Loss Estimate ($)	Loss Ratio
Flood[2]	1% Annual Chance	37	1.7%	18	1	1,381,000	0.4%
*Earthquake**	*CSZ Mw 9.0 Deterministic*	916	41%	686	0	99,432,000	32%
Earthquake (within Tsunami Zone)		91	4.1%	176	1	56,162,000	18%

Exposure Analysis Summary

Hazard	Scenario	Potentially Displaced Residents	% Potentially Displaced Residents	Exposed Buildings	Exposed Critical Facilities	Building Value ($)	Percent of Exposure
Tsunami	*CSZ Mw 9.0 – Medium*	255	11%	267	2	82,989,000	27%
Tsunami	Senate Bill 379 Regulatory Line	217	9.7%	220	2	72,984,000	24%
Landslide	High and Very High Susceptibility	112	5.0%	85	0	16,793,000	5.4%
Wildfire	High Hazard	57	2.6%	39	0	8,259,000	2.7%

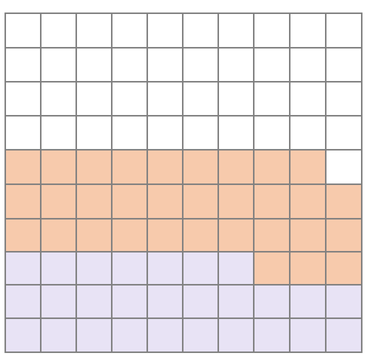
*Earthquake losses were calculated for buildings outside of Medium tsunami zone.

Rows with italicized text and shaded background indicate results should be considered in tandem as they are expected to occur within minutes of one another. Colors correspond to colors in Figure A-3.

[1]Facilities with multiple buildings were consolidated into one building complex.

[2]No damage is estimated for exposed structures with "First floor height" above the level of flooding (base flood elevation).

Figure A-3. Unincorporated community of Charleston loss ratio from Cascadia subduction zone event.



Each cell represents 1% of building value, so the grid represents 100% of total building value. The magnitude 9.0 CSZ event is predicted to simultaneously produce a damaging earthquake and tsunami. Hazus-MH modeling for loss ratio is available only for earthquake. Buildings with exposure to the tsunami inundation zone are assumed to be completely damaged, which would be 100% loss ratio. To avoid double counting of buildings, the earthquake loss ratio was calculated only for buildings outside of the tsunami zone.

†Each cell represents 1% of building value.

= Estimated losses due to tsunami.

= Estimated losses due to earthquake (outside of tsunami zone).

Table A-6. Unincorporated community of Charleston critical facilities.

Critical Facilities by Community	Flood 1% Annual Chance Exposed	Earthquake Moderate to Complete Damage >50% Prob.	Tsunami CSZ Mw 9.0 – Medium Exposed	Landslide High and Very High Susceptibility Exposed	Wildfire High Hazard Exposed
Charleston RFPD - 3	—	—	X	—	—
Coos Bay Coast Guard Station	X	X	X	—	—

A.4 Unincorporated Community of Glasgow

Table A-7. Unincorporated community of Glasgow hazard profile.

Community Overview

Community Name	Population	Number of Buildings	Critical Facilities[1]	Total Building Value ($)
Glasgow	757	578	1	125,629,000

Hazus-MH Analysis Summary

Hazard	Scenario	Potentially Displaced Residents	% Potentially Displaced Residents	Damaged Buildings	Damaged Critical Facilities	Loss Estimate ($)	Loss Ratio
Flood[2]	1% Annual Chance	6	0.7%	9	0	227,000	0.2%
*Earthquake**	*CSZ Mw 9.0 Deterministic*	92	12%	165	0	22,865,000	18%
Earthquake (within Tsunami Zone)		2	0.3%	9	0	1,542,000	1.2%

Exposure Analysis Summary

Hazard	Scenario	Potentially Displaced Residents	% Potentially Displaced Residents	Exposed Buildings	Exposed Critical Facilities	Building Value ($)	Percent of Exposure
Tsunami	*CSZ Mw 9.0 – Medium*	7	1.0%	13	0	2,537,000	2.0%
Tsunami	Senate Bill 379 Regulatory Line	3	0.4%	6	0	2,878,000	2.3%
Landslide	High and Very High Susceptibility	227	30%	194	0	37,475,000	30%
Wildfire	High Hazard	3	0.4%	2	0	550,000	0.4%

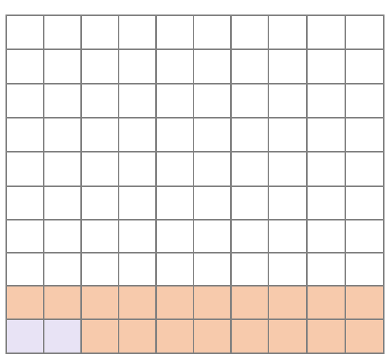
*Earthquake losses were calculated for buildings outside of Medium tsunami zone.

Rows with italicized text and shaded background indicate results should be considered in tandem as they are expected to occur within minutes of one another. Colors correspond to colors in Figure A-4.

[1]Facilities with multiple buildings were consolidated into one building complex.

[2]No damage is estimated for exposed structures with "First floor height" the level of flooding (base flood elevation).

Figure A-4. Unincorporated community of Glasgow loss ratio from Cascadia subduction zone event.



Each cell represents 1% of building value, so the grid represents 100% of total building value. The magnitude 9.0 CSZ event is predicted to simultaneously produce a damaging earthquake and tsunami. Hazus-MH modeling for loss ratio is available only for earthquake. Buildings with exposure to the tsunami inundation zone are assumed to be completely damaged, which would be 100% loss ratio. To avoid double counting of buildings, the earthquake loss ratio was calculated only for buildings outside of the tsunami zone.

†Each cell represents 1% of building value.

= Estimated losses due to tsunami.

= Estimated losses due to earthquake (outside of tsunami zone).

Table A-8. Unincorporated community of Glasgow critical facilities.

Critical Facilities by Community	Flood 1% Annual Chance Exposed	Earthquake Moderate to Complete Damage >50% Prob.	Tsunami CSZ Mw 9.0 – Medium Exposed	Landslide High and Very High Susceptibility Exposed	Wildfire High Hazard Exposed
North Bay RFPD	—	—	—	—	—

A.5 Unincorporated Community of Green Acres

Table A-9. Unincorporated community of Green Acres hazard profile.

Community Overview				
Community Name	Population	Number of Buildings	Critical Facilities[1]	Total Building Value ($)
Green Acres	406	367	1	79,090,000

Hazus-MH Analysis Summary							
Hazard	Scenario	Potentially Displaced Residents	% Potentially Displaced Residents	Damaged Buildings	Damaged Critical Facilities	Loss Estimate ($)	Loss Ratio
Flood[2]	1% Annual Chance	15	3.6%	16	0	681,000	0.9%
*Earthquake**	*CSZ Mw 9.0 Deterministic*	83	21%	112	0	23,040,000	29%
Earthquake (within Tsunami Zone)		0	0%	0	0	0	0%

Exposure Analysis Summary							
Hazard	Scenario	Potentially Displaced Residents	% Potentially Displaced Residents	Exposed Buildings	Exposed Critical Facilities	Building Value ($)	Percent of Exposure
Tsunami	*CSZ Mw 9.0 – Medium*	0	0%	0	0	0	0%
Tsunami	Senate Bill 379 Regulatory Line	0	0%	0	0	0	0%
Landslide	High and Very High Susceptibility	342	84%	306	1	65,380,000	83%
Wildfire	High Hazard	33	8.2%	27	0	6,098,000	7.7%

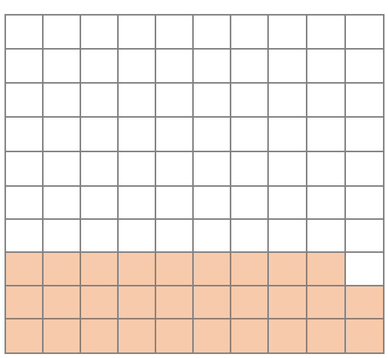
*Earthquake losses were calculated for buildings outside of Medium tsunami zone.

Rows with italicized text and shaded background indicate results should be considered in tandem as they are expected to occur within minutes of one another. Colors correspond to colors in Figure A-4.

[1]Facilities with multiple buildings were consolidated into one building complex.

[2]No damage is estimated for exposed structures with "First floor height" the level of flooding (base flood elevation).

Figure A-5. Unincorporated community of Green Acres loss ratio from Cascadia subduction zone event.



Each cell represents 1% of building value, so the grid represents 100% of total building value. The magnitude 9.0 CSZ event is predicted to simultaneously produce a damaging earthquake and tsunami. Hazus-MH modeling for loss ratio is available only for earthquake. Buildings with exposure to the tsunami inundation zone are assumed to be completely damaged, which would be 100% loss ratio. To avoid double counting of buildings, the earthquake loss ratio was calculated only for buildings outside of the tsunami zone.

†Each cell represents 1% of building value.

= Estimated losses due to tsunami.

= Estimated losses due to earthquake (outside of tsunami zone).

Table A-10. Unincorporated community of Green Acres critical facilities.

Critical Facilities by Community	Flood 1% Annual Chance Exposed	Earthquake Moderate to Complete Damage >50% Prob.	Tsunami CSZ Mw 9.0 – Medium Exposed	Landslide High and Very High Susceptibility Exposed	Wildfire High Hazard Exposed
Greenacres RFPD	—	—	—	X	—

A.6 Unincorporated Community of Hauser

Table A-11. Community of Hauser hazard profile.

Community Overview					
Community Name	Population	Number of Buildings	Critical Facilities[1]	Total Building Value ($)
Hauser	1,145	1,022	2	286,877,000

Hazus-MH Analysis Summary							
Hazard	Scenario	Potentially Displaced Residents	% Potentially Displaced Residents	Damaged Buildings	Damaged Critical Facilities	Loss Estimate ($)	Loss Ratio
Flood[2]	1% Annual Chance	11	1.0%	8	0	1,738,000	0.6%
*Earthquake**	*CSZ Mw 9.0 Deterministic*	422	37%	521	2	149,929,000	52%
Earthquake (within Tsunami Zone)		0	0%	0	0	0	0%

Exposure Analysis Summary							
Hazard	Scenario	Potentially Displaced Residents	% Potentially Displaced Residents	Exposed Buildings	Exposed Critical Facilities	Building Value ($)	Percent of Exposure
Tsunami	*CSZ Mw 9.0 – Medium*	0	0%	0	0	0	0%
Tsunami	Senate Bill 379 Regulatory Line	0	0%	1	0	4,555,000	1.6%
Landslide	High and Very High Susceptibility	114	10%	102	0	20,917,000	7.3%
Wildfire	High Hazard	104	9.1%	123	0	29,007,000	10%

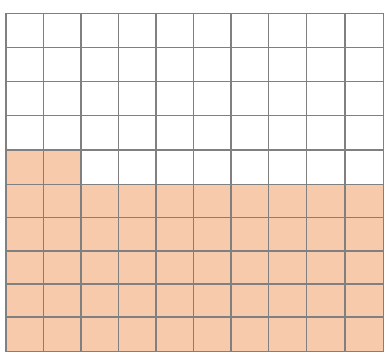
*Earthquake losses were calculated for buildings outside of Medium tsunami zone.

Rows with italicized text and shaded background indicate results should be considered in tandem as they are expected to occur within minutes of one another. Colors correspond to colors in Figure A-6.

[1]Facilities with multiple buildings were consolidated into one building complex.

[2]No damage is estimated for exposed structures with "First floor height" above the level of flooding (base flood elevation).

Figure A-6. Community of Hauser loss ratio from Cascadia subduction zone event.



Each cell represents 1% of building value, so the grid represents 100% of total building value. The magnitude 9.0 CSZ event is predicted to simultaneously produce a damaging earthquake and tsunami. Hazus-MH modeling for loss ratio is available only for earthquake. Buildings with exposure to the tsunami inundation zone are assumed to be completely damaged, which would be 100% loss ratio. To avoid double counting of buildings, the earthquake loss ratio was calculated only for buildings outside of the tsunami zone.

†Each cell represents 1% of building value.

= Estimated losses due to tsunami.

= Estimated losses due to earthquake (outside of tsunami zone).

Table A-12. Community of Hauser critical facilities.

Critical Facilities by Community	Flood 1% Annual Chance Exposed	Earthquake Moderate to Complete Damage >50% Prob.	Tsunami CSZ Mw 9.0 – Medium Exposed	Landslide High and Very High Susceptibility Exposed	Wildfire High Hazard Exposed
Hauser RFPD	—	X	—	—	—
North Bay Light House Elementary School	—	X	—	—	—

A.7 Unincorporated Community of Millington

Table A-13. Community of Millington hazard profile.

Community Overview				
Community Name	Population	Number of Buildings	Critical Facilities[1]	Total Building Value ($)
Millington	666	506	1	100,571,000

Hazus-MH Analysis Summary							
Hazard	Scenario	Potentially Displaced Residents	% Potentially Displaced Residents	Damaged Buildings	Damaged Critical Facilities	Loss Estimate ($)	Loss Ratio
Flood[2]	1% Annual Chance	13	1.9%	13	1	586,000	0.6%
*Earthquake**	*CSZ Mw 9.0 Deterministic*	28	4.2%	108	1	15,917,000	16%
Earthquake (within Tsunami Zone)		0	0%	0	0	0	0%

Exposure Analysis Summary							
Hazard	Scenario	Potentially Displaced Residents	% Potentially Displaced Residents	Exposed Buildings	Exposed Critical Facilities	Building Value ($)	Percent of Exposure
Tsunami	*CSZ Mw 9.0 – Medium*	0	0%	0	0	0	0%
Tsunami	Senate Bill 379 Regulatory Line	0	0%	5	0	779,000	0.8%
Landslide	High and Very High Susceptibility	112	17%	67	0	13,834,000	14%
Wildfire	High Hazard	89	13%	90	0	14,703,000	15%

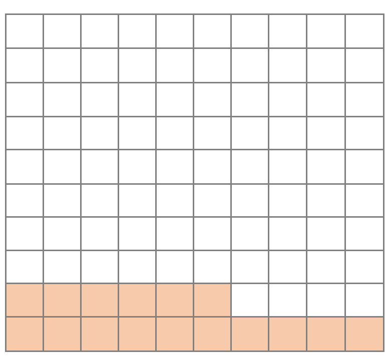
*Earthquake losses were calculated for buildings outside of Medium tsunami zone.

Rows with italicized text and shaded background indicate results should be considered in tandem as they are expected to occur within minutes of one another. Colors correspond to colors in Figure A-7.

[1]Facilities with multiple buildings were consolidated into one building complex.

[2]No damage is estimated for exposed structures with "First floor height" above the level of flooding (base flood elevation).

Figure A-7. Community of Millington loss ratio from Cascadia subduction zone event.



Each cell represents 1% of building value, so the grid represents 100% of total building value. The magnitude 9.0 CSZ event is predicted to simultaneously produce a damaging earthquake and tsunami. Hazus-MH modeling for loss ratio is available only for earthquake. Buildings with exposure to the tsunami inundation zone are assumed to be completely damaged, which would be 100% loss ratio. To avoid double counting of buildings, the earthquake loss ratio was calculated only for buildings outside of the tsunami zone.

†Each cell represents 1% of building value.

= Estimated losses due to tsunami.

= Estimated losses due to earthquake (outside of tsunami zone).

Table A-14. Community of Millington critical facilities.

Critical Facilities by Community	Flood 1% Annual Chance Exposed	Earthquake Moderate to Complete Damage >50% Prob.	Tsunami CSZ Mw 9.0 – Medium Exposed	Landslide High and Very High Susceptibility Exposed	Wildfire High Hazard Exposed
Millington RFPD	X	X	—	—	—

A.8 City of Bandon

Table A-15. City of Bandon hazard profile.

Community Overview

Community Name	Population	Number of Buildings	Critical Facilities[1]	Total Building Value ($)
Bandon	3,066	1,962	8	629,445,000

Hazus-MH Analysis Summary

Hazard	Scenario	Potentially Displaced Residents	% Potentially Displaced Residents	Damaged Buildings	Damaged Critical Facilities	Loss Estimate ($)	Loss Ratio
Flood[2]	1% Annual Chance	60	2.0%	94	1	3,855,000	0.6%
*Earthquake**	CSZ Mw 9.0 Deterministic	837	27%	693	5	213,771,000	34%
Earthquake *(within Tsunami Zone)*		27	0.9%	116	2	43,296,000	6.9%

Exposure Analysis Summary

Hazard	Scenario	Potentially Displaced Residents	% Potentially Displaced Residents	Exposed Buildings	Exposed Critical Facilities	Building Value ($)	Percent of Exposure
Tsunami	*CSZ Mw 9.0 – Medium*	102	3.3%	185	2	64,742,000	10%
Tsunami	Senate Bill 379 Regulatory Line	82	2.7%	158	2	54,088,000	8.6%
Landslide	High and Very High Susceptibility	57	1.9%	51	0	13,379,000	2.1%
Wildfire	High Hazard	51	1.7%	45	0	11,825,000	1.9%

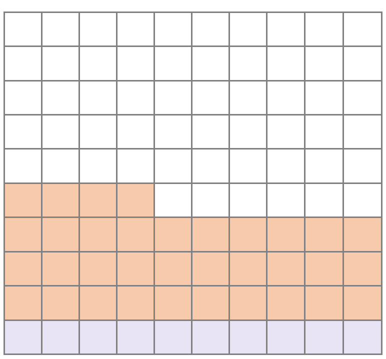
*Earthquake losses were calculated for buildings outside of Medium tsunami zone.

Rows with italicized text and shaded background indicate results should be considered in tandem as they are expected to occur within minutes of one another. Colors correspond to colors in Figure A-8.

[1]Facilities with multiple buildings were consolidated into one building complex.

[2]No damage is estimated for exposed structures with "First floor height" above the level of flooding (base flood elevation).

Figure A-8. City of Bandon loss ratio from Cascadia subduction zone event.



Each cell represents 1% of building value, so the grid represents 100% of total building value. The magnitude 9.0 CSZ event is predicted to simultaneously produce a damaging earthquake and tsunami. Hazus-MH modeling for loss ratio is available only for earthquake. Buildings with exposure to the tsunami inundation zone are assumed to be completely damaged, which would be 100% loss ratio. To avoid double counting of buildings, the earthquake loss ratio was calculated only for buildings outside of the tsunami zone.

†Each cell represents 1% of building value.

= Estimated losses due to tsunami.

= Estimated losses due to earthquake (outside of tsunami zone).

Table A-16. City of Bandon critical facilities.

Critical Facilities by Community	Flood 1% Annual Chance Exposed	Earthquake Moderate to Complete Damage >50% Prob.	Tsunami CSZ Mw 9.0 – Medium Exposed	Landslide High and Very High Susceptibility Exposed	Wildfire High Hazard Exposed
Bandon Fire Department	—	X	—	—	—
Bandon Police Department	—	X	—	—	—
Bandon Senior High School	—	X	—	—	—
Bandon Water Plant	X	X	X	—	—
Harbor Lights Middle School	—	X	—	—	—
Ocean Crest Elementary School	—	X	—	—	—
Port of Bandon - Office	—	X	X	—	—
Southern Coos Hospital	—	—	—	—	—

A.9 Confederated Tribes of Coos, Lower Umpqua, and Siuslaw Indians

Table A-17. Confederated Tribes of Coos, Lower Umpqua, and Siuslaw Indians hazard profile.

Community Overview

Community Name	Population	Number of Buildings	Critical Facilities[1]	Total Building Value ($)
Confederated Tribes of Coos, Lower Umpqua, and Siuslaw Indians	47	33	1	12,470,000

Hazus-MH Analysis Summary

Hazard	Scenario	Potentially Displaced Residents	% Potentially Displaced Residents	Damaged Buildings	Damaged Critical Facilities	Loss Estimate ($)	Loss Ratio
Flood[2]	1% Annual Chance	0	0%	0	0	0	0%
*Earthquake**	*CSZ Mw 9.0 Deterministic*	16	35%	15	1	4,271,000	34%
Earthquake (within Tsunami Zone)		0	0%	0	0	0	0%

Exposure Analysis Summary

Hazard	Scenario	Potentially Displaced Residents	% Potentially Displaced Residents	Exposed Buildings	Exposed Critical Facilities	Building Value ($)	Percent of Exposure
Tsunami	*CSZ Mw 9.0 – Medium*	0	0%	0	0	0	0%
Tsunami	Senate Bill 379 Regulatory Line	0	0%	0	0	0	0%
Landslide	High and Very High Susceptibility	0	0%	0	0	0	0%
Wildfire	High Hazard	0	0%	0	0	0	0%

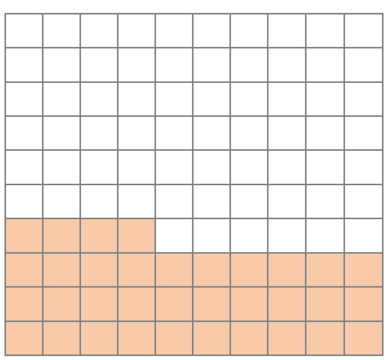
*Earthquake losses were calculated for buildings outside of Medium tsunami zone.

Rows with italicized text and shaded background indicate results should be considered in tandem as they are expected to occur within minutes of one another. Colors correspond to colors in Figure A-9.

[1]Facilities with multiple buildings were consolidated into one building complex.

[2]No damage is estimated for exposed structures with "First floor height" above the level of flooding (base flood elevation).

Figure A-9. Confederated Tribes of Coos, Lower Umpqua, and Siuslaw Indians loss ratio from Cascadia subduction zone event.



Each cell represents 1% of building value, so the grid represents 100% of total building value. The magnitude 9.0 CSZ event is predicted to simultaneously produce a damaging earthquake and tsunami. Hazus-MH modeling for loss ratio is available only for earthquake. Buildings with exposure to the tsunami inundation zone are assumed to be completely damaged, which would be 100% loss ratio. To avoid double counting of buildings, the earthquake loss ratio was calculated only for buildings outside of the tsunami zone.

†Each cell represents 1% of building value.

= Estimated losses due to tsunami.

= Estimated losses due to earthquake (outside of tsunami zone).

Table A-18. Confederated Tribes of Coos, Lower Umpqua, and Siuslaw Indians critical facilities.

	Flood 1% Annual Chance	Earthquake Moderate to Complete Damage	Tsunami CSZ Mw 9.0 – Medium	Landslide High and Very High Susceptibility	Wildfire High Hazard
Critical Facilities by Community	**Exposed**	**>50% Prob.**	**Exposed**	**Exposed**	**Exposed**
CTCLUSI Admin	—	X	—	—	—

A.10 City of Coos Bay

Table A-19. City of Coos Bay hazard profile.

Community Overview

Community Name	Population	Number of Buildings	Critical Facilities[1]	Total Building Value ($)
Coos Bay	15,966	7,220	22	2,420,579,000

Hazus-MH Analysis Summary

Hazard	Scenario	Potentially Displaced Residents	% Potentially Displaced Residents	Damaged Buildings	Damaged Critical Facilities	Loss Estimate ($)	Loss Ratio
Flood[2]	1% Annual Chance	773	4.8%	468	7	42,299,000	1.7%
*Earthquake**	*CSZ Mw 9.0 Deterministic*	2,732	17%	2,027	16	632,247,000	26%
Earthquake (within Tsunami Zone)		181	1.1%	226	3	203,853,000	8.4%

Exposure Analysis Summary

Hazard	Scenario	Potentially Displaced Residents	% Potentially Displaced Residents	Exposed Buildings	Exposed Critical Facilities	Building Value ($)	Percent of Exposure
Tsunami	*CSZ Mw 9.0 – Medium*	421	2.6%	319	3	267,595,000	11%
Tsunami	Senate Bill 379 Regulatory Line	53	0.3%	84	2	41,966,000	1.7%
Landslide	High and Very High Susceptibility	3,978	25%	1,890	6	477,292,000	20%
Wildfire	High Hazard	294	1.8%	163	0	32,642,000	1.3%

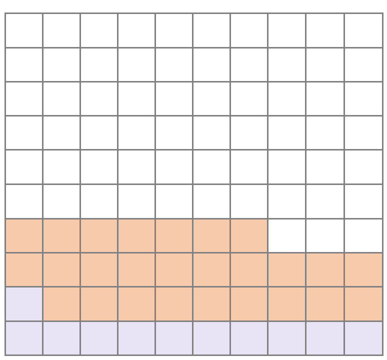
*Earthquake losses were calculated for buildings outside of Medium tsunami zone.

Rows with italicized text and shaded background indicate results should be considered in tandem as they are expected to occur within minutes of one another. Colors correspond to colors in Figure A-10.

[1]Facilities with multiple buildings were consolidated into one building complex.

[2]No damage is estimated for exposed structures with "First floor height" above the level of flooding (base flood elevation).

Figure A-10. City of Coos Bay loss ratio from Cascadia subduction zone event.



Each cell represents 1% of building value, so the grid represents 100% of total building value. The magnitude 9.0 CSZ event is predicted to simultaneously produce a damaging earthquake and tsunami. Hazus-MH modeling for loss ratio is available only for earthquake. Buildings with exposure to the tsunami inundation zone are assumed to be completely damaged, which would be 100% loss ratio. To avoid double counting of buildings, the earthquake loss ratio was calculated only for buildings outside of the tsunami zone.

†Each cell represents 1% of building value.

= Estimated losses due to tsunami (tsunami damage negligible for this community).

= Estimated losses due to earthquake (outside of tsunami zone).

Table A-20. City of Coos Bay critical facilities.

Critical Facilities by Community	Flood 1% Annual Chance Exposed	Earthquake Moderate to Complete Damage >50% Prob.	Tsunami CSZ Mw 9.0 – Medium Exposed	Landslide High and Very High Susceptibility Exposed	Wildfire High Hazard Exposed
Bay Area Hospital	—	—	—	—	—
Blossom Gulch Elementary School	X	X	—	—	—
Coos Bay - North Bend Water Board	—	X	—	—	—
Coos Bay City Shop	X	X	—	—	—
Coos Bay Fire Station - Central	—	—	—	X	—
Coos Bay Fire Station - Eastside	—	X	—	X	—
Coos Bay Fire Station - Empire	—	X	—	—	—
Coos Bay Police Department	X	X	X	—	—
Coos Bay Wastewater Department	X	X	—	—	—
Coos Bay Wastewater Treatment	—	X	X	—	—
Eastside Elementary School	—	X	—	X	—
Harding Learning Center	—	X	—	X	—
Madison Elementary School	—	X	—	—	—
Marshfield Senior High School	—	X	—	X	—
Millicoma Intermediate School	—	X	—	X	—
Oregon Coast Technology School 2	—	X	—	—	—
Oregon International Port of Coos Bay - Port Office	X	X	—	—	—
Oregon State Police	—	—	—	—	—
Pacific Power	X	X	—	—	—
Sunset Middle School	—	X	—	—	—
U.S. Coast Guard Station - Cutter Orcas	X	X	X	—	—
U.S. Oregon Army National Guard	—	X	—	—	—

A.11 City of Coquille

Table A-21. City of Coquille hazard profile.

Community Overview

Community Name	Population	Number of Buildings	Critical Facilities[1]	Total Building Value ($)
Coquille	3,866	1,977	8	606,670,000

Hazus-MH Analysis Summary

Hazard	Scenario	Potentially Displaced Residents	% Potentially Displaced Residents	Damaged Buildings	Damaged Critical Facilities	Loss Estimate ($)	Loss Ratio
Flood[2]	1% Annual Chance	24	0.6%	23	1	1,207,000	0.2%
*Earthquake**	*CSZ Mw 9.0 Deterministic*	259	6.7%	357	6	131,036,000	22%
Earthquake (within Tsunami Zone)		0	0.0%	0	0	0	0.0%

Exposure Analysis Summary

Hazard	Scenario	Potentially Displaced Residents	% Potentially Displaced Residents	Exposed Buildings	Exposed Critical Facilities	Building Value ($)	Percent of Exposure
Tsunami	*CSZ Mw 9.0 – Medium*	0	0%	0	0	0	0%
Tsunami	Senate Bill 379 Regulatory Line	0	0%	0	0	0	0%
Landslide	High and Very High Susceptibility	323	8.4%	202	0	43,926,000	7.2%
Wildfire	High Hazard	51	1.3%	22	0	5,181,000	0.9%

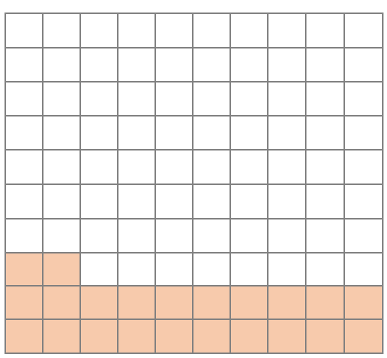
*Earthquake losses were calculated for buildings outside of Medium tsunami zone.

Rows with italicized text and shaded background indicate results should be considered in tandem as they are expected to occur within minutes of one another. Colors correspond to colors in Figure A-10.

[1]Facilities with multiple buildings were consolidated into one building complex.

[2]No damage is estimated for exposed structures with “First floor height” above the level of flooding (base flood elevation).

Figure A-11. City of Coquille loss ratio from Cascadia subduction zone event.



Each cell represents 1% of building value, so the grid represents 100% of total building value. The magnitude 9.0 CSZ event is predicted to simultaneously produce a damaging earthquake and tsunami. Hazus-MH modeling for loss ratio is available only for earthquake. Buildings with exposure to the tsunami inundation zone are assumed to be completely damaged, which would be 100% loss ratio. To avoid double counting of buildings, the earthquake loss ratio was calculated only for buildings outside of the tsunami zone.

†Each cell represents 1% of building value.

= Estimated losses due to tsunami (tsunami damage negligible for this community).

= Estimated losses due to earthquake (outside of tsunami zone).

Table A-22. City of Coquille critical facilities.

Critical Facilities by Community	Flood 1% Annual Chance Exposed	Earthquake Moderate to Complete Damage >50% Prob.	Tsunami CSZ Mw 9.0 – Medium Exposed	Landslide High and Very High Susceptibility Exposed	Wildfire High Hazard Exposed
Coos County Sheriff's Office and EOC	—	X	—	—	—
Coos Couny Road Department	—	X	—	—	—
Coquille City Police Department	—	—	—	—	—
Coquille Fire and Rescue Station No. 1	—	X	—	—	—
Coquille High School	X	X	—	—	—
Coquille Valley Hospital	—	—	—	—	—
Coquille Valley Middle School	—	X	—	—	—
Lincoln Elementary School	—	X	—	—	—

A.12 Coquille Indian Tribe

Table A-23. Coquille Indian Tribe hazard profile.

Community Overview

Community Name	Population	Number of Buildings	Critical Facilities[1]	Total Building Value ($)
Coquille Indian Tribe	313	100	1	80,721,000

Hazus-MH Analysis Summary

Hazard	Scenario	Potentially Displaced Residents	% Potentially Displaced Residents	Damaged Buildings	Damaged Critical Facilities	Loss Estimate ($)	Loss Ratio
Flood[2]	1% Annual Chance	0	0%	1	0	2,000	0%
*Earthquake**	*CSZ Mw 9.0 Deterministic*	44	14%	31	1	32,707,000	41%
Earthquake (within Tsunami Zone)		59	19%	2	0	4,080,000	5.1%

Exposure Analysis Summary

Hazard	Scenario	Potentially Displaced Residents	% Potentially Displaced Residents	Exposed Buildings	Exposed Critical Facilities	Building Value ($)	Percent of Exposure
Tsunami	*CSZ Mw 9.0 – Medium*	59	19%	3	0	4,147,000	5.1%
Tsunami	Senate Bill 379 Regulatory Line	0	0%	5	0	33,438,000	41%
Landslide	High and Very High Susceptibility	3	0.8%	1	0	291,000	0.4%
Wildfire	High Hazard	0	0%	1	0	61,000	0.1%

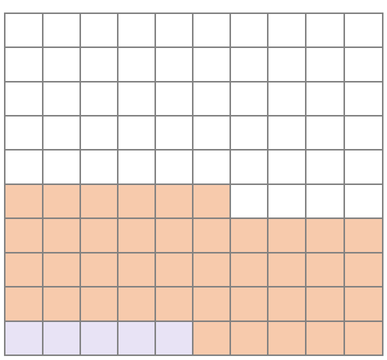
*Earthquake losses were calculated for buildings outside of Medium tsunami zone.

Rows with italicized text and shaded background indicate results should be considered in tandem as they are expected to occur within minutes of one another. Colors correspond to colors in Figure A-12.

[1]Facilities with multiple buildings were consolidated into one building complex.

[2]No damage is estimated for exposed structures with "First floor height" above the level of flooding (base flood elevation).

Figure A-12. Coquille Indian Tribe loss ratio from Cascadia subduction zone event.



Each cell represents 1% of building value, so the grid represents 100% of total building value. The magnitude 9.0 CSZ event is predicted to simultaneously produce a damaging earthquake and tsunami. Hazus-MH modeling for loss ratio is available only for earthquake. Buildings with exposure to the tsunami inundation zone are assumed to be completely damaged, which would be 100% loss ratio. To avoid double counting of buildings, the earthquake loss ratio was calculated only for buildings outside of the tsunami zone.

†Each cell represents 1% of building value.

= Estimated losses due to tsunami.

= Estimated losses due to earthquake (outside of tsunami zone).

Table A-24. Coquille Indian Tribe critical facilities.

Critical Facilities by Community	Flood 1% Annual Chance	Earthquake Moderate to Complete Damage	Tsunami CSZ Mw 9.0 – Medium	Landslide High and Very High Susceptibility	Wildfire High Hazard
	Exposed	**>50% Prob.**	**Exposed**	**Exposed**	**Exposed**
Coquille Indian Tribe Admin Building	—	X	—	—	—

A.13 City of Lakeside

Table A-25. City of Lakeside hazard profile.

Community Overview

Community Name	Population	Number of Buildings	Critical Facilities[1]	Total Building Value ($)
Lakeside	1,699	1,421	3	242,768,000

Hazus-MH Analysis Summary

Hazard	Scenario	Potentially Displaced Residents	% Potentially Displaced Residents	Damaged Buildings	Damaged Critical Facilities	Loss Estimate ($)	Loss Ratio
Flood[2]	1% Annual Chance	253	15%	171	1	5,768,000	2.4%
*Earthquake**	*CSZ Mw 9.0 Deterministic*	572	34%	666	3	96,156,000	40%
Earthquake (within Tsunami Zone)		0	0%	0	0	0	0%

Exposure Analysis Summary

Hazard	Scenario	Potentially Displaced Residents	% Potentially Displaced Residents	Exposed Buildings	Exposed Critical Facilities	Building Value ($)	Percent of Exposure
Tsunami	*CSZ Mw 9.0 – Medium*	0	0%	0	0	0	0%
Tsunami	Senate Bill 379 Regulatory Line	12	0.7%	18	1	4,912,000	2.0%
Landslide	High and Very High Susceptibility	113	6.6%	105	0	20,042,000	8.3%
Wildfire	High Hazard	50	2.9%	43	0	6,144,000	2.5%

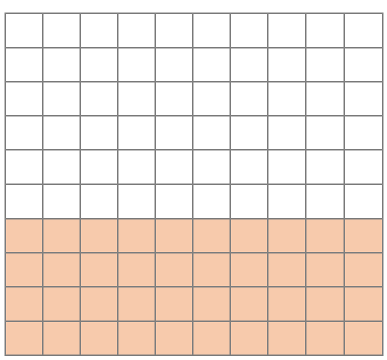
*Earthquake losses were calculated for buildings outside of Medium tsunami zone.

Rows with italicized text and shaded background indicate results should be considered in tandem as they are expected to occur within minutes of one another. Colors correspond to colors in Figure A-10.

[1]Facilities with multiple buildings were consolidated into one building complex.

[2]No damage is estimated for exposed structures with "First floor height" above the level of flooding (base flood elevation).

Figure A-13. City of Lakeside loss ratio from Cascadia subduction zone event.



Each cell represents 1% of building value, so the grid represents 100% of total building value. The magnitude 9.0 CSZ event is predicted to simultaneously produce a damaging earthquake and tsunami. Hazus-MH modeling for loss ratio is available only for earthquake. Buildings with exposure to the tsunami inundation zone are assumed to be completely damaged, which would be 100% loss ratio. To avoid double counting of buildings, the earthquake loss ratio was calculated only for buildings outside of the tsunami zone.

†Each cell represents 1% of building value.

= Estimated losses due to tsunami (tsunami damage negligible for this community).

= Estimated losses due to earthquake (outside of tsunami zone).

Table A-26. City of Lakeside critical facilities.

Critical Facilities by Community	Flood 1% Annual Chance Exposed	Earthquake Moderate to Complete Damage >50% Prob.	Tsunami CSZ Mw 9.0 – Medium Exposed	Landslide High and Very High Susceptibility Exposed	Wildfire High Hazard Exposed
Lakeside Airstrip	—	X	—	—	—
Lakeside RFPD	—	X	—	—	—
Lakeside Water Treatment	X	X	X	—	—

A.14 City of Myrtle Point

Table A-27. City of Myrtle Point hazard profile.

Community Overview

Community Name	Population	Number of Buildings	Critical Facilities[1]	Total Building Value ($)
Myrtle Point	2,514	1,329	6	383,743,000

Hazus-MH Analysis Summary

Hazard	Scenario	Potentially Displaced Residents	% Potentially Displaced Residents	Damaged Buildings	Damaged Critical Facilities	Loss Estimate ($)	Loss Ratio
Flood[2]	1% Annual Chance	119	4.7%	80	1	3,081,000	0.8%
*Earthquake**	*CSZ Mw 9.0 Deterministic*	455	18%	468	6	154,830,000	40%
Earthquake (within Tsunami Zone)		0	0%	0	0	0	0%

Exposure Analysis Summary

Hazard	Scenario	Potentially Displaced Residents	% Potentially Displaced Residents	Exposed Buildings	Exposed Critical Facilities	Building Value ($)	Percent of Exposure
Tsunami	*CSZ Mw 9.0 – Medium*	0	0%	0	0	0	0%
Tsunami	Senate Bill 379 Regulatory Line	0	0%	0	0	0	0%
Landslide	High and Very High Susceptibility	239	9.5%	131	2	30,609,000	8.0%
Wildfire	High Hazard	0	0%	0	0	0	0%

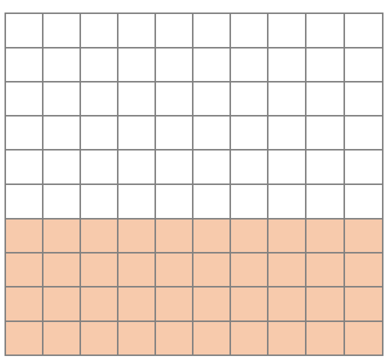
*Earthquake losses were calculated for buildings outside of Medium tsunami zone.

Rows with italicized text and shaded background indicate results should be considered in tandem as they are expected to occur within minutes of one another. Colors correspond to colors in Figure A-10.

[1]Facilities with multiple buildings were consolidated into one building complex.

[2]No damage is estimated for exposed structures with "First floor height" above the level of flooding (base flood elevation).

Figure A-14. City of Myrtle Point loss ratio from Cascadia subduction zone event.



Each cell represents 1% of building value, so the grid represents 100% of total building value. The magnitude 9.0 CSZ event is predicted to simultaneously produce a damaging earthquake and tsunami. Hazus-MH modeling for loss ratio is available only for earthquake. Buildings with exposure to the tsunami inundation zone are assumed to be completely damaged, which would be 100% loss ratio. To avoid double counting of buildings, the earthquake loss ratio was calculated only for buildings outside of the tsunami zone.

†Each cell represents 1% of building value.

= Estimated losses due to tsunami (tsunami damage negligible for this community).

= Estimated losses due to earthquake (outside of tsunami zone).

Table A-28. City of Myrtle Point critical facilities.

Critical Facilities by Community	Flood 1% Annual Chance Exposed	Earthquake Moderate to Complete Damage >50% Prob.	Tsunami CSZ Mw 9.0 – Medium Exposed	Landslide High and Very High Susceptibility Exposed	Wildfire High Hazard Exposed
Myrtle Crest School	—	X	—	X	—
Myrtle Point City Hall	—	X	—	—	—
Myrtle Point Fire Department	—	X	—	—	—
Myrtle Point High School	—	X	—	X	—
Myrtle Point Water Plant	X	X	—	—	—
Myrtle Point Water Plant 2	—	X	—	—	—

A.15 City of North Bend

Table A-29. City of North Bend hazard profile.

Community Overview

Community Name	Population	Number of Buildings	Critical Facilities[1]	Total Building Value ($)
North Bend	9,651	4,233	12	1,494,790,000

Hazus-MH Analysis Summary

Hazard	Scenario	Potentially Displaced Residents	% Potentially Displaced Residents	Damaged Buildings	Damaged Critical Facilities	Loss Estimate ($)	Loss Ratio
Flood[2]	1% Annual Chance	18	0.2%	27	0	3,063,000	0.2%
*Earthquake**	*CSZ Mw 9.0 Deterministic*	1,576	16%	1,225	9	542,929,000	36%
Earthquake (within Tsunami Zone)		25	0.3%	55	2	71,271,000	4.8%

Exposure Analysis Summary

Hazard	Scenario	Potentially Displaced Residents	% Potentially Displaced Residents	Exposed Buildings	Exposed Critical Facilities	Building Value ($)	Percent of Exposure
Tsunami	*CSZ Mw 9.0 – Medium*	55	0.6%	75	2	85,107,000	5.7%
Tsunami	Senate Bill 379 Regulatory Line	29	0.3%	51	2	72,394,000	4.8%
Landslide	High and Very High Susceptibility	408	4.2%	179	3	49,187,000	3.3%
Wildfire	High Hazard	0	0%	0	0	0	0%

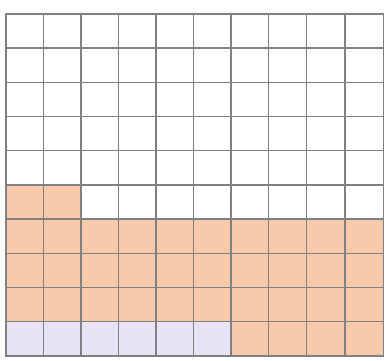
*Earthquake losses were calculated for buildings outside of Medium tsunami zone.

Rows with italicized text and shaded background indicate results should be considered in tandem as they are expected to occur within minutes of one another. Colors correspond to colors in Figure A-15.

[1]Facilities with multiple buildings were consolidated into one building complex.

[2]No damage is estimated for exposed structures with "First floor height" above the level of flooding (base flood elevation).

Figure A-15. City of North Bend loss ratio from Cascadia subduction zone event.



Each cell represents 1% of building value, so the grid represents 100% of total building value. The magnitude 9.0 CSZ event is predicted to simultaneously produce a damaging earthquake and tsunami. Hazus-MH modeling for loss ratio is available only for earthquake. Buildings with exposure to the tsunami inundation zone are assumed to be completely damaged, which would be 100% loss ratio. To avoid double counting of buildings, the earthquake loss ratio was calculated only for buildings outside of the tsunami zone.

†Each cell represents 1% of building value.

= Estimated losses due to tsunami.

= Estimated losses due to earthquake (outside of tsunami zone).

Table A-30. City of North Bend critical facilities.

Critical Facilities by Community	Flood 1% Annual Chance Exposed	Earthquake Moderate to Complete Damage >50% Prob.	Tsunami CSZ Mw 9.0 – Medium Exposed	Landslide High and Very High Susceptibility Exposed	Wildfire High Hazard Exposed
Airport Water Treatment Facility	—	X	X	X	—
Hillcrest Elementary School	—	X	—	—	—
North Bend Fire - Airport	—	X	—	—	—
North Bend Fire and Rescue	—	X	—	—	—
North Bend Fire Station 3	—	—	—	X	—
North Bend Middle School	—	X	—	—	—
North Bend Police Department	—	X	—	—	—
North Bend Senior High School	—	X	X	X	—
Oregon Coast Technology School	—	X	—	—	—
Oregon State Trooper Office	—	X	—	—	—
Southwest Oregon Regional Airport	—	X	—	—	—
U.S. Coast Guard Sector North Bend	—	X	—	—	—

A.16 City of Powers

Table A-31. City of Powers hazard profile.

Community Overview

Community Name	Population	Number of Buildings	Critical Facilities[1]	Total Building Value ($)
Powers	687	556	4	111,516,000

Hazus-MH Analysis Summary

Hazard	Scenario	Potentially Displaced Residents	% Potentially Displaced Residents	Damaged Buildings	Damaged Critical Facilities	Loss Estimate ($)	Loss Ratio
Flood[2]	1% Annual Chance	4	0.6%	2	0	11,000	0%
*Earthquake**	*CSZ Mw 9.0 Deterministic*	252	37%	267	4	49,542,000	44%
Earthquake (within Tsunami Zone)		0	0%	0	0	0	0%

Exposure Analysis Summary

Hazard	Scenario	Potentially Displaced Residents	% Potentially Displaced Residents	Exposed Buildings	Exposed Critical Facilities	Building Value ($)	Percent of Exposure
Tsunami	*CSZ Mw 9.0 – Medium*	0	0%	0	0	0	0%
Tsunami	Senate Bill 379 Regulatory Line	0	0%	0	0	0	0%
Landslide	High and Very High Susceptibility	26	3.7%	19	1	4,102,000	3.7%
Wildfire	High Hazard	0	0%	1	0	135,000	0.1%

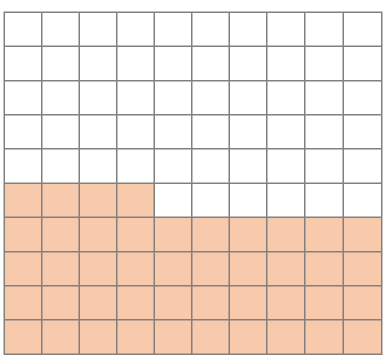
*Earthquake losses were calculated for buildings outside of Medium tsunami zone.

Rows with italicized text and shaded background indicate results should be considered in tandem as they are expected to occur within minutes of one another. Colors correspond to colors in Figure A-15.

[1]Facilities with multiple buildings were consolidated into one building complex.

[2]No damage is estimated for exposed structures with "First floor height" above the level of flooding (base flood elevation).

Figure A-16. City of Powers loss ratio from Cascadia subduction zone event.



Each cell represents 1% of building value, so the grid represents 100% of total building value. The magnitude 9.0 CSZ event is predicted to simultaneously produce a damaging earthquake and tsunami. Hazus-MH modeling for loss ratio is available only for earthquake. Buildings with exposure to the tsunami inundation zone are assumed to be completely damaged, which would be 100% loss ratio. To avoid double counting of buildings, the earthquake loss ratio was calculated only for buildings outside of the tsunami zone.

†Each cell represents 1% of building value.

= Estimated losses due to tsunami.

= Estimated losses due to earthquake (outside of tsunami zone).

Table A-32. City of Powers critical facilities.

Critical Facilities by Community	Flood 1% Annual Chance Exposed	Earthquake Moderate to Complete Damage >50% Prob.	Tsunami CSZ Mw 9.0 – Medium Exposed	Landslide High and Very High Susceptibility Exposed	Wildfire High Hazard Exposed
Powers Elementary School	—	X	—	—	—
Powers High School	—	X	—	X	—
Powers Police Department	—	X	—	—	—
Powers Volunteer Fire Department	—	X	—	—	—

APPENDIX B. DETAILED RISK ASSESSMENT TABLES

Table B-1. Coos County building inventory.

(all dollar amounts in thousands)

	Residential			Commercial and Industrial			Agricultural			Public and Nonprofit			All Buildings			
Community	Number of Buildings	Building Value ($)	Building Value per Community Total	Number of Buildings	Building Value ($)	Building Value per Community Total	Number of Buildings	Building Value ($)	Building Value per Community Total	Number of Buildings	Building Value ($)	Building Value per Community Total	Number of Buildings	Number of Buildings per County Total	Building Value ($)	Building Value per County Total
Unincorp. County (rural)	11,513	2,443,296	55%	706	378,565	8.5%	6,655	1,594,035	36%	83	60,989	1.4%	18,957	45%	4,476,885	39%
Bunker Hill	501	91,415	53%	87	52,807	30%	146	19,028	11%	6	10,622	6.1%	740	1.7%	173,872	1.5%
Charleston	889	183,211	59%	107	45,254	15%	545	77,684	25%	8	4,777	1.5%	1,549	3.6%	310,927	2.7%
Glasgow	366	94,263	75%	10	3,624	2.9%	201	25,987	21%	1	1,754	1.4%	578	1.4%	125,629	1.1%
Green Acres	265	58,361	74%	2	2,386	3.0%	98	16,574	21%	2	1,769	2.2%	367	0.9%	79,090	0.7%
Hauser	507	116,877	41%	102	82,673	29%	409	62,173	22%	4	25,154	8.8%	1,022	2.4%	286,877	2.4%
Millington	292	59,020	59%	42	17,903	18%	170	22,548	22%	2	1,099	1.1%	506	1.2%	100,571	0.9%
Total Unincorp. County	14,333	3,046,443	55%	1,056	583,212	11%	8,224	1,818,029	33%	106	106,164	1.9%	23,719	56%	5,553,851	48%
Bandon	1,480	417,147	66%	188	109,241	17%	256	36,430	5.8%	38	66,627	11%	1,962	4.6%	629,445	5.5%
CTCLUSI	19	5,333	43%	6	2,171	17%	5	1,802	14%	3	3,164	25%	33	0.1%	12,470	0.1%
Coos Bay	5,817	1,440,007	59%	557	619,017	26%	728	100,335	4.1%	118	261,220	11%	7,220	17%	2,420,579	21%
Coquille	1,485	345,664	57%	151	129,958	21%	303	38,388	6.3%	38	92,661	15%	1,977	4.6%	606,670	5.3%
Coquille Indian Tribe	88	30,570	38%	5	38,992	48%	1	61	0.1%	6	11,098	14%	100	0.2%	80,721	0.7%
Lakeside	942	164,648	68%	68	20,309	8.4%	391	46,906	19%	20	10,905	4.5%	1,421	3.3%	242,768	2.1%
Myrtle Point	941	223,699	58%	102	67,707	18%	258	44,084	11%	28	48,254	13%	1,329	3.1%	383,743	3.3%
North Bend	3,398	950,809	64%	285	291,672	20%	451	58,263	3.9%	99	194,046	13%	4,233	10%	1,494,790	13%
Powers	352	66,890	60%	13	6,149	5.5%	176	24,443	22%	15	14,033	13%	556	1.3%	111,516	1%
Total Coos County	28,855	6,691,210	58%	2,431	1,868,428	16%	10,793	2,168,741	19%	471	808,172	7.0%	42,550	100%	11,536,553	100%

Table B-2. Cascadia subduction zone earthquake loss estimates.

(all dollar amounts in thousands)

Community	Total Number of Buildings	Total Estimated Building Value ($)	Total Earthquake Damage*: Buildings Damaged: Sum of Economic Loss	Total Earthquake Damage*: Buildings Damaged: Loss Ratio	Earthquake Damage outside of Medium Tsunami Zone: Buildings Damaged: Yellow-Tagged Buildings	Earthquake Damage outside of Medium Tsunami Zone: Buildings Damaged: Red-Tagged Buildings	Earthquake Damage outside of Medium Tsunami Zone: Buildings Damaged: Sum of Economic Loss	Earthquake Damage outside of Medium Tsunami Zone: Buildings Damaged: Loss Ratio	Building Design Level Upgraded to at Least Moderate Code: Yellow-Tagged Buildings	Building Design Level Upgraded to at Least Moderate Code: Red-Tagged Buildings	Building Design Level Upgraded to at Least Moderate Code: Sum of Economic Loss	Building Design Level Upgraded to at Least Moderate Code: Loss Ratio
Unincorp. County (rural)	18,957	4,476,885	1,354,946	30%	1,606	4,256	1,310,768	29%	1,273	2,752	873,272	20%
Bunker Hill	740	173,872	47,261	27%	86	61	37,528	22%	29	35	23,631	14%
Charleston	1,549	310,927	155,594	50%	124	561	99,432	32%	140	417	76,008	24%
Glasgow	578	125,629	24,408	19%	71	94	22,865	18%	21	71	16,247	13%
Green Acres	367	79,090	23,040	29%	25	87	23,040	29%	11	76	18,263	23%
Hauser	1,022	286,877	149,929	52%	91	429	149,929	52%	177	217	85,514	30%
Millington	506	100,571	15,917	16%	73	34	15,917	16%	18	19	8,930	9%
Total Unincorp. County	23,719	5,553,851	1,771,095	32%	2,076	5,522	1,659,479	30%	1,669	3,587	1,101,865	20%
Bandon	1,962	629,445	257,067	41%	142	551	213,771	34%	171	347	131,333	21%
CTCLUSI	33	12,470	4,271	34%	5	10	4,271	34%	3	5	2,026	16%
Coos Bay	7,220	2,420,579	836,100	35%	604	1,423	632,247	26%	464	886	375,844	16%
Coquille	1,977	606,670	131,036	22%	162	195	131,036	22%	62	113	59,419	10%
Coquille Indian Tribe	100	80,721	36,787	46%	10	21	32,707	41%	4	16	26,245	33%
Lakeside	1,421	242,768	96,156	40%	155	511	96,156	40%	186	327	68,136	28%
Myrtle Point	1,329	383,743	154,830	40%	129	339	154,830	40%	105	209	83,263	22%
North Bend	4,233	1,494,790	614,201	41%	328	898	542,929	36%	193	609	319,391	21%
Powers	556	111,516	49,542	44%	48	219	49,542	44%	68	140	32,084	29%
Total Coos County	42,550	11,536,552	3,951,085	34%	3,659	9,689	3,516,968	30%	2,925	6,239	2,199,606	19%

*All losses calculated from earthquake inside or outside of Medium tsunami zone.

Table B-3. Tsunami exposure.

(all dollar amounts in thousands)

			Small (Low Severity)			Medium (Moderate Severity)			Large (High Severity)			X Large (Very High Severity)			XX Large (Extreme Severity)		
Community	Total Number of Buildings	Total Estimated Building Value ($)	Number of Buildings	Building Value ($)	Percent of Building Value Exposed	Number of Buildings	Building Value ($)	Percent of Building Value Exposed	Number of Buildings	Building Value ($)	Percent of Building Value Exposed	Number of Buildings	Building Value ($)	Percent of Building Value Exposed	Number of Buildings	Building Value ($)	Percent of Building Value Exposed
Unincorp. County (rural)	18,957	4,476,885	234	46,762	1.0%	418	94,049	2.1%	918	200,079	4.5%	2,015	464,241	10%	2,337	544,997	12%
Bunker Hill	740	173,872	1	418	0.2%	6	10,370	6.0%	71	40,907	24%	96	45,748	26%	107	48,463	28%
Charleston	1,549	310,927	247	78,239	25%	267	82,989	27%	465	123,141	40%	1,122	235,075	76%	1,238	254,901	82%
Glasgow	578	125,629	5	407	0.3%	13	2,537	2.0%	24	4,838	3.9%	37	8,339	7%	42	9,270	7.4%
Green Acres	367	79,090	0	0	0%	0	0	0%	0	0	0%	32	5,177	6.5%	45	8,693	11%
Hauser	1,022	286,877	0	0	0%	0	0	0%	1	11	0%	19	16,933	5.9%	52	38,178	13%
Millington	506	100,571	0	0	0%	0	0	0%	3	506	0.5%	44	13,191	13%	54	14,961	15%
Total Unincorp. County	23,719	5,553,851	487	125,826	2.3%	704	189,945	3.4%	1,482	369,482	6.7%	3,365	788,704	14%	3,875	919,463	17%
Bandon	1,962	629,445	145	49,200	7.8%	185	64,742	10%	276	91,553	15%	925	285,412	45%	1,374	431,860	69%
CTCLUSI	33	12,470	0	0	0%	0	0	0%	0	0	0%	0	0	0%	0	0	0%
Coos Bay	7,220	2,420,579	79	43,133	1.8%	319	267,595	11%	624	455,071	19%	1,018	578,485	24%	1,238	634,178	26%
Coquille	1,977	606,670	0	0	0%	0	0	0%	0	0	0%	0	0	0%	1	447	0.1%
Coquille Indian Tribe	100	80,721	0	0	0%	3	4,147	5.1%	6	44,153	55%	37	56,737	70%	44	58,670	73%
Lakeside	1,421	242,768	0	0	0%	0	0	0%	7	4,044	1.7%	43	10,543	4.3%	76	16,944	7.0%
Myrtle Point	1,329	383,743	0	0	0%	0	0	0%	0	0	0%	0	0	0%	0	0	0%
North Bend	4,233	1,494,790	23	6,110	0.4%	75	85,107	5.7%	263	168,526	11%	558	304,613	20%	608	316,952	21%
Powers	556	111,516	0	0	0%	0	0	0%	0	0	0%	0	0	0%	0	0	0%
Total Coos County	42,550	11,536,553	734	224,269	1.9%	1,286	611,536	5.3%	2,658	1,132,829	9.8%	5,946	2,024,494	18%	7,216	2,378,514	21%

Table B-4. Flood loss estimates.

			(all dollar amounts in thousands)											
			10% (10-yr)			**2% (50-yr)**			**1% (100-yr)***			**0.2% (500-yr)**		
Community	**Total Number of Buildings**	**Total Estimated Building Value ($)**	**Number of Buildings**	**Loss Estimate**	**Loss Ratio**	**Number of Buildings**	**Loss Estimate**	**Loss Ratio**	**Number of Buildings**	**Loss Estimate**	**Loss Ratio**	**Number of Buildings**	**Loss Estimate**	**Loss Ratio**
Unincorp. County (rural)	18,957	4,476,885	602	27,673	0.6%	825	45,993	1.0%	890	58,390	1.3%	948	79,270	1.8%
Bunker Hill	740	173,872	33	1,463	0.8%	41	2,465	1.4%	50	3,061	1.8%	52	4,379	2.5%
Charleston	1,549	310,927	14	1,050	0.3%	17	1,324	0.4%	18	1,381	0.4%	20	1,517	0.5%
Glasgow	578	125,629	7	120	0.1%	9	183	0.1%	9	227	0.2%	10	292	0.2%
Green Acres	367	79,090	12	485	0.6%	15	613	0.8%	16	681	0.9%	22	877	1.1%
Hauser	1,022	286,877	6	931	0.3%	7	1,475	0.5%	8	1,738	0.6%	8	2,148	0.7%
Millington	506	100,571	6	191	0.2%	11	449	0.4%	13	586	0.6%	18	853	0.8%
Total Unincorp. County	23,719	5,553,851	680	31,913	0.6%	925	52,502	0.9%	1,004	66,064	1.2%	1,078	89,336	1.6%
Bandon	1,962	629,445	21	544	0.1%	74	2,774	0.4%	94	3,855	0.6%	110	6,028	1.0%
CTCLUSI	33	12,470	0	0	0%	0	0	0%	0	0	0%	0	0	0%
Coos Bay	7,220	2,420,579	344	25,021	1.0%	436	36,201	1.5%	468	42,299	1.7%	490	54,591	2.3%
Coquille	1,977	606,670	8	415	0.1%	19	799	0.1%	23	1,207	0.2%	23	1,619	0.3%
Coquille Indian Tribe	100	80,721	0	0	0%	0	0	0%	1	2	0%	1	9	0%
Lakeside	1,421	242,768	49	2,033	0.8%	119	4,044	1.7%	171	5,768	2.4%	248	9,661	4.0%
Myrtle Point	1,329	383,743	17	197	0.1%	60	1,474	0.4%	80	3,081	0.8%	88	5,224	1.4%
North Bend	4,233	1,494,790	12	385	0%	24	1,852	0.1%	27	3,063	0.2%	32	5,360	0.4%
Powers	556	111,516	0	0	0%	0	0	0%	2	11	0%	4	157	0.1%
Total Coos County	42,550	11,536,553	1,131	60,508	0.5%	1,657	99,646	0.9%	1,870	125,350	1.1%	2,074	171,985	1.5%

*1% results include coastal flooding source.

Table B-5. Flood exposure.

Community	Total Number of Buildings	Total Population	1% (100-yr)* Potentially Displaced Residents from Flood Exposure	% Potentially Displaced Residents from Flood Exposure	Number of Flood Exposed Buildings	% of Flood Exposed Buildings	Number of Flood Exposed Buildings Without Damage
Unincorp. County (rural)	18,957	18,664	763	4.1%	938	4.9%	48
Bunker Hill	740	1,376	22	1.6%	53	7.2%	3
Charleston	1,549	2,228	37	1.7%	20	1.3%	2
Glasgow	578	757	6	0.7%	10	1.7%	1
Green Acres	367	406	15	3.6%	21	5.7%	5
Hauser	1,022	1,145	11	1.0%	8	0.8%	0
Millington	506	666	13	1.9%	14	2.8%	1
Total Unincorp. County	23,719	25,242	867	3.4%	1,064	4.5%	60
Bandon	1,962	3,066	60	2.0%	123	6.3%	29
CTCLUSI	33	47	0	0%	0	0%	0
Coos Bay	7,220	15,966	773	4.8%	493	6.8%	25
Coquille	1,977	3,866	24	0.6%	23	1.2%	0
Coquille Indian Tribe	100	313	0	0.0%	1	1.0%	0
Lakeside	1,421	1,699	253	15%	233	16%	62
Myrtle Point	1,329	2,514	119	4.7%	85	6.4%	5
North Bend	4,233	9,651	18	0.2%	29	0.7%	2
Powers	556	687	4	0.6%	4	0.7%	2
Total Coos County	42,550	63,051	2,118	3.4%	2,055	4.8%	185

*1% results include coastal flooding source.

Table B-6. Landslide exposure.

Community	Total Number of Buildings	Total Estimated Building Value ($)	Very High Susceptibility: Number of Buildings	Very High Susceptibility: Building Value ($)	Very High Susceptibility: Percent of Building Value Exposed	High Susceptibility: Number of Buildings	High Susceptibility: Building Value ($)	High Susceptibility: Percent of Building Value Exposed	Moderate Susceptibility: Number of Buildings	Moderate Susceptibility: Building Value ($)	Moderate Susceptibility: Percent of Building Value Exposed
			(all dollar amounts in thousands)								
Unincorp. County (rural)	18,957	4,476,885	1,406	314,141	7.0%	2,343	468,534	11%	6,435	1,372,990	31%
Bunker Hill	740	173,872	0	0	0%	42	7,681	4.4%	255	44,854	26%
Charleston	1,549	310,927	0	0	0%	85	16,793	5.4%	304	61,103	20%
Glasgow	578	125,629	131	26,504	21%	63	10,971	8.7%	198	39,009	31%
Green Acres	367	79,090	100	21,050	27%	206	44,330	56%	24	4,008	5.1%
Hauser	1,022	286,877	3	415	0%	99	20,502	7.1%	452	96,894	34%
Millington	506	100,571	4	942	0.9%	63	12,892	13%	110	19,876	20%
Total Unincorp. County	23,719	5,553,851	1,644	363,052	6.5%	2,901	581,703	11%	7,778	1,638,734	30%
Bandon	1,962	629,445	4	672	0.1%	47	12,707	2.0%	285	84,494	13%
CTCLUSI	33	12,470	0	0	0%	0	0	0%	20	5,935	48%
Coos Bay	7,220	2,420,579	15	4,255	0.2%	1,875	473,037	20%	1,701	484,382	20%
Coquille	1,977	606,670	4	1,179	0.2%	198	42,747	7.0%	982	263,510	43%
Coquille Indian Tribe	100	80,721	0	0	0%	1	291	0.4%	32	8,147	10%
Lakeside	1,421	242,768	0	0	0%	105	20,042	8.3%	192	34,725	14%
Myrtle Point	1,329	383,743	64	14,091	3.7%	67	16,518	4.3%	622	158,591	41%
North Bend	4,233	1,494,790	0	0	0%	179	49,187	3.3%	1,401	422,578	28%
Powers	556	111,516	0	0	0%	19	4,102	3.7%	85	16,701	15%
Total Coos County	42,550	11,536,553	1,731	383,249	3.3%	5,392	1,200,334	10%	13,098	3,117,797	27%

Table B-7. Wildfire exposure.

Community	Total Number of Buildings	Total Estimated Building Value ($)	High Hazard: Number of Buildings	High Hazard: Building Value ($)	High Hazard: Percent of Building Value Exposed	Moderate Hazard: Number of Buildings	Moderate Hazard: Building Value ($)	Moderate Hazard: Percent of Building Value Exposed
			(all dollar amounts in thousands)					
Unincorp. County (rural)	18,957	4,476,885	402	86,157	1.9%	8,603	1,904,749	43%
Bunker Hill	740	173,872	92	15,762	9.1%	257	50,895	29%
Charleston	1,549	310,927	39	8,259	2.7%	858	154,453	50%
Glasgow	578	125,629	2	550	0.4%	286	65,751	52%
Green Acres	367	79,090	27	6,098	7.7%	189	38,881	49%
Hauser	1,022	286,877	123	29,007	10%	591	115,620	40%
Millington	506	100,571	90	14,703	15%	177	30,871	31%
Total Unincorp. County	23,719	5,553,851	775	160,536	2.9%	10,961	2,361,220	43%
Bandon	1,962	629,445	45	11,825	1.9%	892	254,314	40%
CTCLUSI	33	12,470	0	0	0%	7	1,921	15%
Coos Bay	7,220	2,420,579	163	32,642	1.3%	1,649	493,509	20%
Coquille	1,977	606,670	22	5,181	0.9%	681	181,451	30%
Coquille Indian Tribe	100	80,721	1	61	0.1%	78	27,107	34%
Lakeside	1,421	242,768	43	6,144	2.5%	792	131,891	54%
Myrtle Point	1,329	383,743	0	0	0%	532	121,994	32%
North Bend	4,233	1,494,790	0	0	0%	805	269,076	18%
Powers	556	111,516	1	135	0.1%	293	50,668	45%
Total Coos County	42,550	11,536,553	1,050	216,524	1.9%	16,690	3,893,151	34%

APPENDIX C. HAZUS-MH METHODOLOGY

C.1 Software

We performed all loss estimations using Hazus®-MH 3.0 and ArcGIS® Desktop® 10.2.2.

C.2 User-Defined Facilities (UDF) Database

We compiled a UDF database for all buildings in Coos County for use in both flood and earthquake modules of Hazus-MH. We used the Coos County assessor database (acquired in 2015) to determine which tax lots had improvements (i.e., buildings) and how many building points should be included in the UDF database.

C.2.1 Locating buildings points

We used the existing DOGAMI dataset of building footprints (unpublished) to help precisely locate the centroid of each building. Where the building footprint dataset lacked coverage in the eastern portion of the county, we used the centroid of the tax lot; for tax lots larger than 10 acres the building centroid was corrected by using orthoimagery. Extra effort was spent to locate building points along the 1% and 0.2% annual chance inundation fringe. For buildings partially within the inundation zone, we moved the building point to the centroid of the portion of the building within the inundation zone. We used an iterative approach to further refine locations of building points for the flood module by generating results, reviewing the highest value buildings, and moving the building point over a representative elevation on the lidar digital elevation model to ensure an accurate first-floor height.

C.2.2 Attributing building points

We populated the required attributes for Hazus-MH through a variety of approaches. We used the Coos County assessor database wherever possible, but in many cases that database did not provide the necessary information. The following is list of attributes and their sources:

- **Longitude** and **Latitude** – Location information that provides Hazus-MH the x and y positions of the UDF point. This allows for an overlay to occur between the UDF point and the flood or earthquake input data layers. The hazard model uses this spatial overlay to determine the correct hazard risk level that will be applied to the UDF point. The format of the attribute must be in decimal degrees. A simple geometric calculation using GIS software is done on the point to derive this value.
- **Occupancy class** – An alphanumeric attribute that indicates the use of the UDF (e.g., "RES1" is a single family dwelling). The alphanumeric code is composed of seven broad occupancy types (RES = residential, COM = commercial, IND = industrial, AGR = agricultural, GOV = public, REL = nonprofit/religious, EDU = education) and various suffixes that indicate more specific types. This code determines the damage function to be used for flood analysis. It is also used to attribute the Building type field, discussed below, for the earthquake analysis. The code was interpreted from "Stat Class" or "Description" data found in the Coos County assessor database. Where data were not available, the default value of RES1 was applied throughout.
- **Cost** – The cost of an individual UDF. Loss ratio is derived from this value. The value was obtained from the Coos County assessor database. Where not available, cost was based on the square footage of the building footprint or from the square footage found in the Coos County assessor

database. When multiple UDFs occupied a single tax lot, the overall cost of the tax lot was distributed to the UDFs based on square footage.

- **Year built** – The year of construction that is used to attribute the **Building design level** field for the earthquake analysis (see "Building design" below). The year a UDF was built is obtained from Coos County assessor database. Where not available the year of "1900" was applied (12% of the UDFs).
- **Square feet** – The size of the UDF is used to pro-rate the total improvement value for tax lots with multiple UDFs. The value distribution method will ensure that UDFs with the highest square footage will be the most expensive on a given tax lot. This value is also used to pro-rate the **Number of people** field for Residential UDFs within a census block. The value was obtained from DOGAMI's building footprints; where (RES) footprints were not available, we used the Coos County assessor database.
- **Number of stories** – The number of stories for an individual UDF, along with **Occupancy class**, determines the applied damage function for flood analysis. The value was obtained from the Coos County assessor database where available. For UDFs without assessor information for number of stories that are within the flood zone, closer inspection using the Google Street View™ mapping service or available oblique imagery was used for attribution.
- **Foundation type** – The UDF foundation type correlates with **First floor height** values in feet (see Table 3.11 in the Hazus-MH Technical Manual for the Flood Model [FEMA Hazus-MH, 2012c]). It also functions within the flood model by indicating if a basement exists or not. UDFs with a basement have a different damage function from UDFs that do not have one. The value was obtained from the Coos County assessor database where available. For UDFs without assessor information for basements that are within the flood zone, closer inspection using Google Street View™ mapping service or available oblique imagery was used to ascertain basement presence.
- **First floor height** – The height in feet above grade for the lowest habitable floor. The height is factored during the depth of flooding analysis. The value is used directly by Hazus-MH: Hazus-MH overlays a UDF location on a depth grid and by using the **First floor height** determines the level of flooding occurring to a building. The **First floor height** is derived from the **Foundation type** attribute (Coos County assessor data) or observation via oblique imagery or the Google Street View™ mapping service.
- **Building type** – This attribute determines the construction material and structural integrity of an individual UDF. It is used by Hazus-MH to estimate earthquake losses by determining which damage function will be applied. This information was not in the Coos County assessor data, so instead Building type was derived from a statistical distribution based on **Occupancy class**.
- **Building design level** – This attribute determines the seismic building code for an individual UDF. It is used by Hazus-MH for estimating earthquake losses by determining which damage function will be applied. (see "Seismic building codes" section below for more informatio*n*). This information is derived from the **Year built** attribute (Coos Assessor) and state seismic Building Code benchmark years.
- **Number of people** – The estimated number of permanent residents living within an individual residential structure. It is used in the post-analysis phase to determine the number of people affected by a given hazard. This attribute is derived from the default Hazus-MH database (United States Census Bureau, 2010a) of population per census block and distributed across residential UDFs.

- **Community** – The community that a UDF is within. These areas are used in the post-analysis for reporting results. The communities were based on incorporated area boundaries; unincorporated community areas were based on building density.

C.2.3 Seismic building codes

Oregon initially adopted seismic building codes in the mid-1970s (Judson, 2012). The established benchmark years of code enforcement are used in determining a “design level” for individual buildings. The design level attributes (pre-code, low-code, moderate-code, and high-code) are used in the Hazus-MH earthquake model to determine what damage functions are applied to a given building (FEMA, 2012b). The year built or the year of the most recent seismic retrofit are the main considerations for an individual design level attribute. Seismic retrofitting information for structures would be ideal for this analysis but was not available for Coos County. **Table C-1** outlines the benchmark years that apply to buildings within Coos County.

Table C-1. Coos County seismic design level benchmark years.

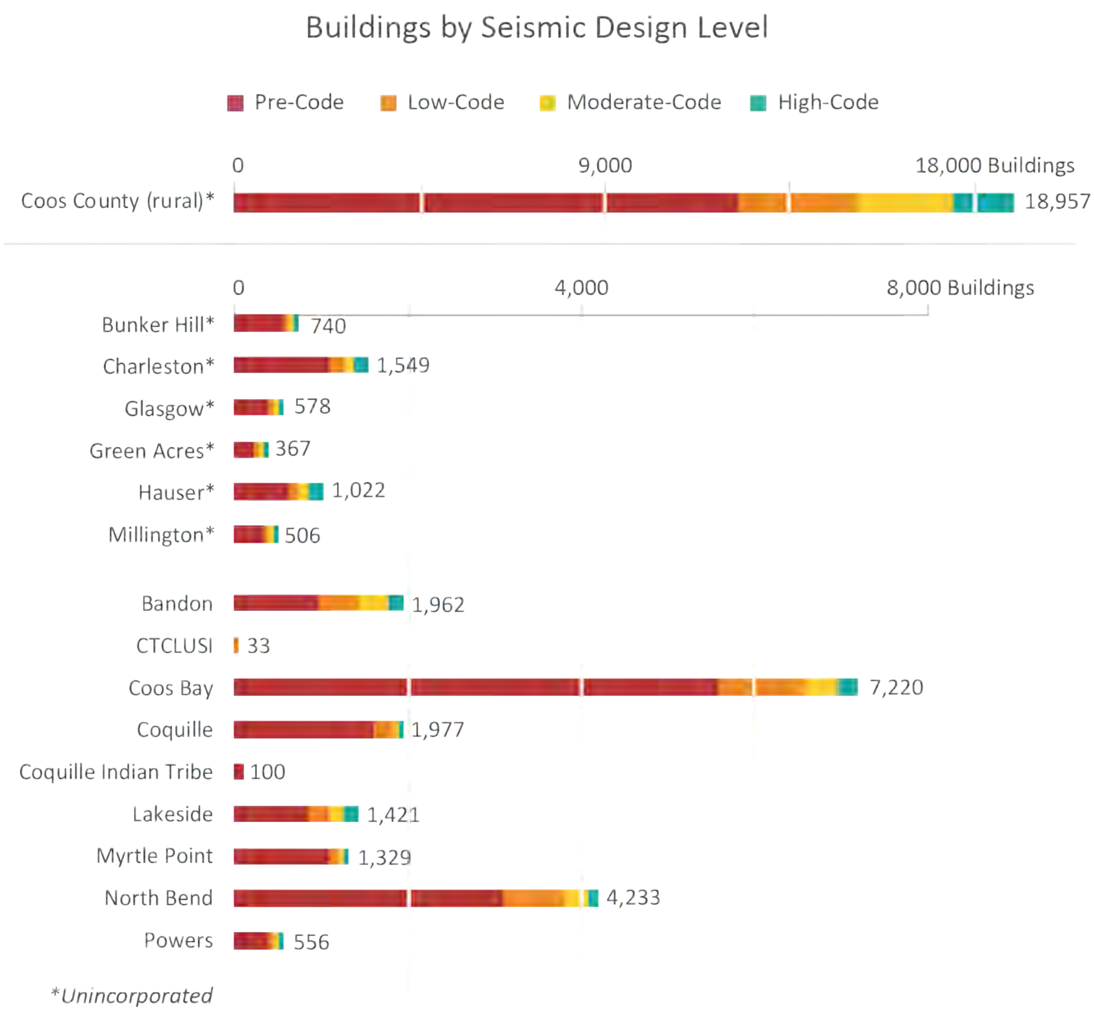
Building Type	Year Built	Design Level	Basis
Single Family Dwelling (includes Duplexes)	prior to 1976 1976–1991 1992–2003 2004–2016	Pre-Code Low-Code Moderate-Code High-Code	Interpretation of Judson (Judson, 2012)
Manufactured Housing	prior to 2003 2003–2010	Pre-Code Low-Code	Interpretation of OR BCD 2002 Manufactured Dwelling Special Codes (Oregon Building Codes Division, 2002)
	2011–2016	Moderate-Code	Interpretation of OR BCD 2010 Manufactured Dwelling Special Codes Update (Oregon Building Codes Division, 2010)
All other buildings	prior to 1976 1976–1990 1991–2018	Pre-Code Low-Code Moderate-Code	Business Oregon 2014-0311 Oregon Benefit-Cost Analysis Tool, p. 24 (Business Oregon, 2015)

Table C-2 and corresponding **Figure C-1** illustrate the current state of seismic building codes for the county.

Table C-2. Seismic design level in Coos County.

Community	Total Number of Buildings	Pre-Code Number of Buildings	Pre-Code Percentage of Buildings	Low-Code Number of Buildings	Low-Code Percentage of Buildings	Moderate-Code Number of Buildings	Moderate-Code Percentage of Buildings	High-Code Number of Buildings	High-Code Percentage of Buildings
Unincorp. County (rural)	18,957	12,240	65%	2,906	15%	2,284	12%	1,527	8.1%
Bunker Hill	740	593	80%	77	10%	35	4.7%	35	4.7%
Charleston	1,549	1,094	71%	164	11%	152	10%	139	9.0%
Glasgow	578	422	73%	55	10%	63	11%	38	6.6%
Green Acres	367	268	73%	39	11%	38	10%	22	6.0%
Hauser	1,022	657	64%	127	12%	98	10%	140	14%
Millington	506	386	76%	31	6.1%	44	8.7%	45	8.9%
Total Unincorp. County	23,719	15,660	66%	3,399	14%	2,714	11%	1,946	8.2%
Bandon	1,962	991	51%	478	24%	297	15%	196	10%
CTCLUSI	33	22	67%	11	33%	0	0%	0	0%
Coos Bay	7,220	5,611	78%	952	13%	396	5.5%	261	3.6%
Coquille	1,977	1,624	82%	212	11%	86	4.4%	55	2.8%
Coquille Indian Tribe	100	100	100%	0	0%	0	0%	0	0%
Lakeside	1,421	870	61%	215	15%	183	13%	153	11%
Myrtle Point	1,329	1,081	81%	154	12%	55	4.1%	39	2.9%
North Bend	4,233	3,124	74%	664	16%	296	7.0%	149	3.5%
Powers	556	433	78%	63	11%	38	6.8%	22	4.0%
Total Coos County	42,550	29,516	69%	6,148	14%	4,065	10%	2,821	6.6%

Figure C-1. Seismic design level by Coos County community.



C.3 Flood Hazard Data

DOGAMI developed flood hazard data in 2012 for a revision of the Coos County FEMA FIS (FEMA, 2014). The hazard data were based on a combination of previous flood studies and new riverine and coastal hydrologic and hydraulic analyses. For riverine areas, flood elevations for the 10-, 50-, 100-, and 500-year events for each stream cross-section were used to develop depth of flooding raster datasets or "depth grids." For coastal zones and other stillwater flood areas, a 100-year stillwater elevation was used to create the depth grid.

A countywide, 2-meter (~6.5 foot), lidar-based depth grid was developed for each of the 10-, 50-, 100-, and 500-year annual chance flood events. The depth grids were imported into Hazus-MH for determining the depth of flooding for areas within the FEMA flood zones.

Once the UDF database was developed into a Hazus-compliant format, the Hazus-MH methodology was applied using a Python (programming language) script developed by DOGAMI. The analysis was then run for a given flood event, and the script cross-referenced a UDF location with the depth grid to find the depth of flooding. The script then applied a specific damage function, based on a UDF's Occupancy Class [OccCls], which was used to determine the loss ratio for a given amount of flood depth, relative to the UDF's first-floor height.

C.4 Earthquake Hazard Data

Several data layers were used for the deterministic analysis conducted for this report. Data layers created for the ORP (Madin and Burns, 2013) provided most of the earthquake inputs for the CSZ magnitude 9.0 event modeled in Hazus-MH. Liquefaction susceptibility data came directly from the ORP, but site ground motion data (PGA: peak ground acceleration; PGV: peak ground velocity; SA10 and SA03: spectral acceleration at 1.0 second period and 0.3 second period) were derived from NEHRP site class soil data. The GIS procedure used to amplify the site ground motion data from NEHRP soil data are described in Appendix B of Bauer and others (2018): Site Ground Motion and Ground Deformation Map Development. The landslide susceptibility data from the ORP were replaced with newer and more accurate data (Burns and others, 2016).

The hazard layers were formatted for use in a Python script developed by DOGAMI to apply the Hazus-MH methodology. The earthquake hazard datasets used in the analysis were: ground motion data (PGA, PGV, SA03, and SA10), a landslide susceptibility map, and liquefaction susceptibility map. Permanent ground deformation (PGD) for landslide and liquefaction were both calculated using Hazus-MH methodology for each of the susceptibility maps. In addition to the earthquake data layers, Hazus-MH requires a water table parameter for PGD due to liquefaction. As water table data were unavailable, we set the water table value to a depth of 5 feet (1.5 meters).

A deterministic method for a CSZ Mw 9.0 event was deemed the most likely and impactful earthquake scenario for Coos County. Past work has shown that probabilistic models of a 500-year event for this area are roughly the same as the CSZ Mw 9.0 event.

During the Hazus-MH earthquake analysis, each UDF was analyzed given its site-specific parameters (ground motion and ground deformation) and evaluated for loss, expressed as a probability of a damage state. Specific damage functions based on Building type and Building design level were used to calculate the damage states given the site-specific parameters for each UDF. The output provided probabilities of the five damage states (None, Slight, Moderate, Extensive, Complete) from which losses in dollar amounts were derived.

C.5 Post-Analysis Quality Control

Ensuring the quality of the results from Hazus-MH flood and earthquake modules is an essential part of the process. A primary characteristic of the process is that it is iterative. A UDF database without errors is highly unlikely, so this part of the process is intended to limit the influence these errors have on the final outcome. Before applying the Hazus-MH methodology, closely examining the top 10 largest area UDFs and the top 10 most expensive UDFs is advisable. Special consideration can also be given to critical facilities due to their importance to communities.

Identifying, verifying, and correcting (if needed) the outliers in the results is the most efficient way to improve the UDF database. This can be done by sorting the results based on the loss estimates and closely scrutinizing the top 10 to 15 records. If corrections are made, then subsequent iterations are necessary. We continued checking the "loss leaders" until no more corrections were needed.

Finding anomalies and investigating possible sources of error are crucial in making corrections to the data. A wide range of corrections might be required to produce a better outcome. For example, floating homes may need to have a first-floor height adjustment or a UDF point position might need to be moved due to issues with the depth grid. Incorrect basement or occupancy type attribution could be the cause of a problem. Commonly, inconsistencies between assessor data and tax lot geometry can be the source of an error. These are just a few of the many types of problems addressed in the quality control process.

APPENDIX D. ACRONYMS AND DEFINITIONS

D.1 Acronyms

CPAC	Community Planning Advisory Committee
CRS	Community Rating System
CSZ	Cascadia subduction zone
DLCD	Oregon Department of Land Conservation and Development
DOGAMI	Department of Geology and Mineral Industries (State of Oregon)
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
FRI	Fire Risk Index
GIS	Geographic Information System
NFIP	National Flood Insurance Program
NHMP	Natural hazard mitigation plan
NOAA	National Oceanic and Atmospheric Administration
ODF	Oregon Department of Forestry
OEM	Oregon Emergency Management
OFR	Open-File Report
OPDR	Oregon Partnership for Disaster Resilience
PGA	Peak ground acceleration
PGD	Permanent ground deformation
PGV	Peak ground velocity
RFPD	Rural Fire Protection District
Risk MAP	Risk Mapping, Assessment, and Planning
SHMO	State Hazard Mitigation Officer
SLIDO	State Landslide Information Layer for Oregon
SLR	Sea level rise
UDF	User-defined facilities
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey
WUI	Wildland-urban interface
WWA	West Wide Wildfire Risk Assessment

D.2 Definitions

1% annual chance flood – The flood elevation that has a 1% chance of being equaled or exceeded each year. Sometimes referred to as the 100-year flood.

0.2% annual chance flood – The flood elevation that has a 0.2% chance of being equaled or exceeded each year. Sometimes referred to as the 500-year flood.

Base flood elevation (BFE) – Elevation of the 1%-annual-chance flood. This elevation is the basis of the insurance and floodplain management requirements of the NFIP.

Critical facilities – Facilities that, if damaged, would present an immediate threat to life, public health, and safety. As categorized in HAZUS-MH, critical facilities include hospitals, emergency operations centers, police stations, fire stations and schools.

Exposure – Determination of whether a building is within or outside of a hazard zone. No loss estimation is modeled.

Flood Insurance Rate Map (FIRM) – An official map of a community, on which FEMA has delineated both the Special Flood Hazard Areas (SFHAs) and the risk premium zones applicable to the community.

Flood Insurance Study (FIS) – Contains an examination, evaluation, and determination of the flood hazards of a community and, if appropriate, the corresponding water-surface elevations.

Hazus-MH – A GIS-based risk assessment methodology and software application created by FEMA and the National Institute of Building Sciences for analyzing potential losses from floods, hurricane winds, and earthquakes.

Lidar – A remote sensing technology that measures distance by illuminating a target with a laser and analyzing the reflected light. Lidar is popularly used as a technology to make high-resolution maps.

Liquefaction – Describes a phenomenon whereby a saturated soil substantially loses strength and stiffness in response to an applied stress, usually an earthquake, causing it to behave like liquid.

Loss Ratio – The expression of loss as a fraction of the value of the local inventory (total value/loss).

Magnitude – A scale used by seismologists to measure the size of earthquakes in terms of energy released.

Risk – Probability multiplied by consequence; the degree of probability that a loss or injury may occur as a result of a natural hazard. Sometimes referred to as vulnerability.

Risk MAP – The vision of this FEMA strategy is to work collaboratively with State, local, and tribal entities to deliver quality flood data that increases public awareness and leads to action that reduces risk to life and property.

Riverine – Of or produced by a river. Riverine floodplains have readily identifiable channels.

Susceptibility – Degree of proneness to natural hazards that is determined based on physical characteristics that are present.

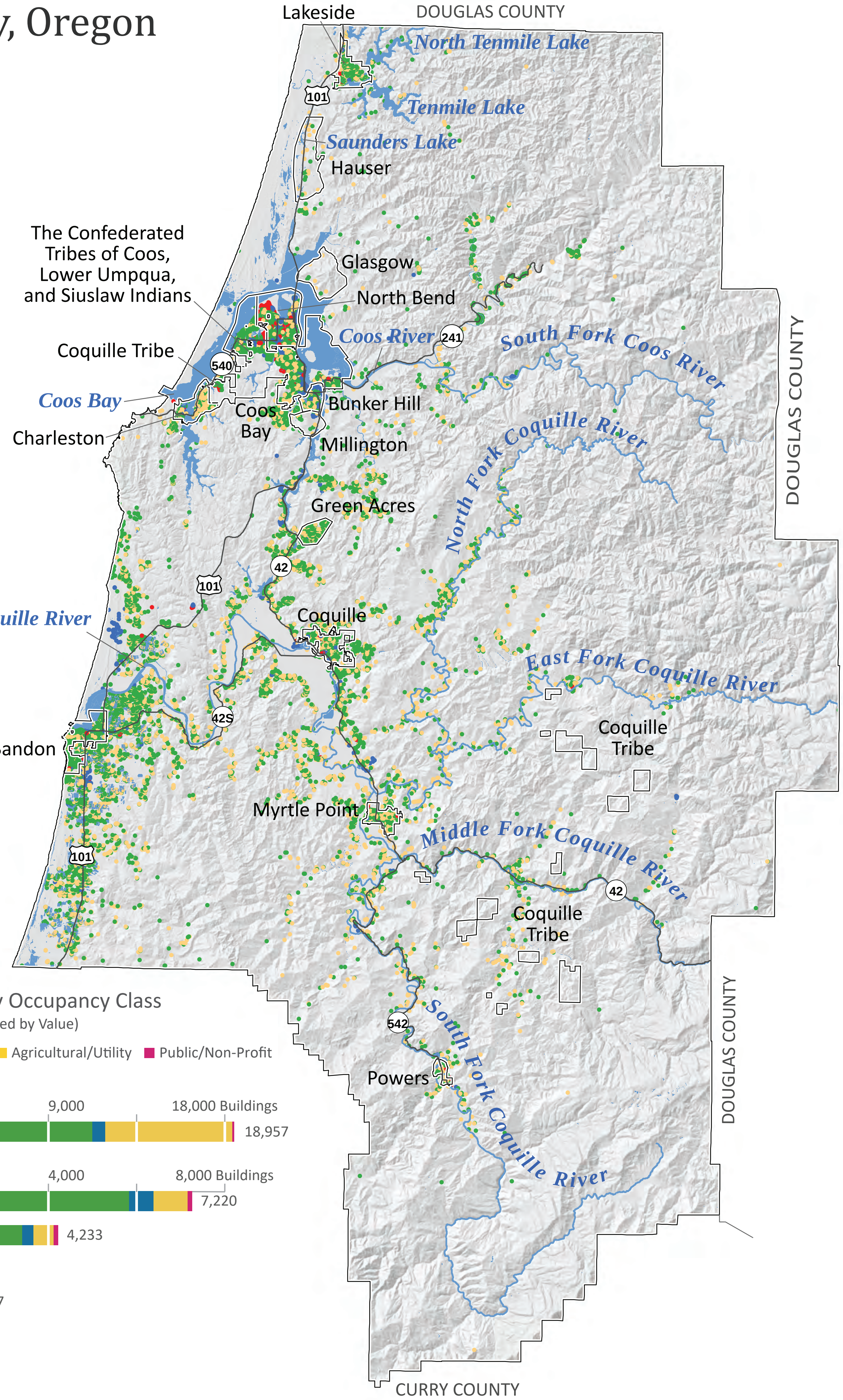
Vulnerability – Characteristics that make people or assets more susceptible to a natural hazard.

APPENDIX E. MAP PLATES

See appendix folder for individual map PDFs.

PLATE 1

Building Distribution Map of Coos County, Oregon



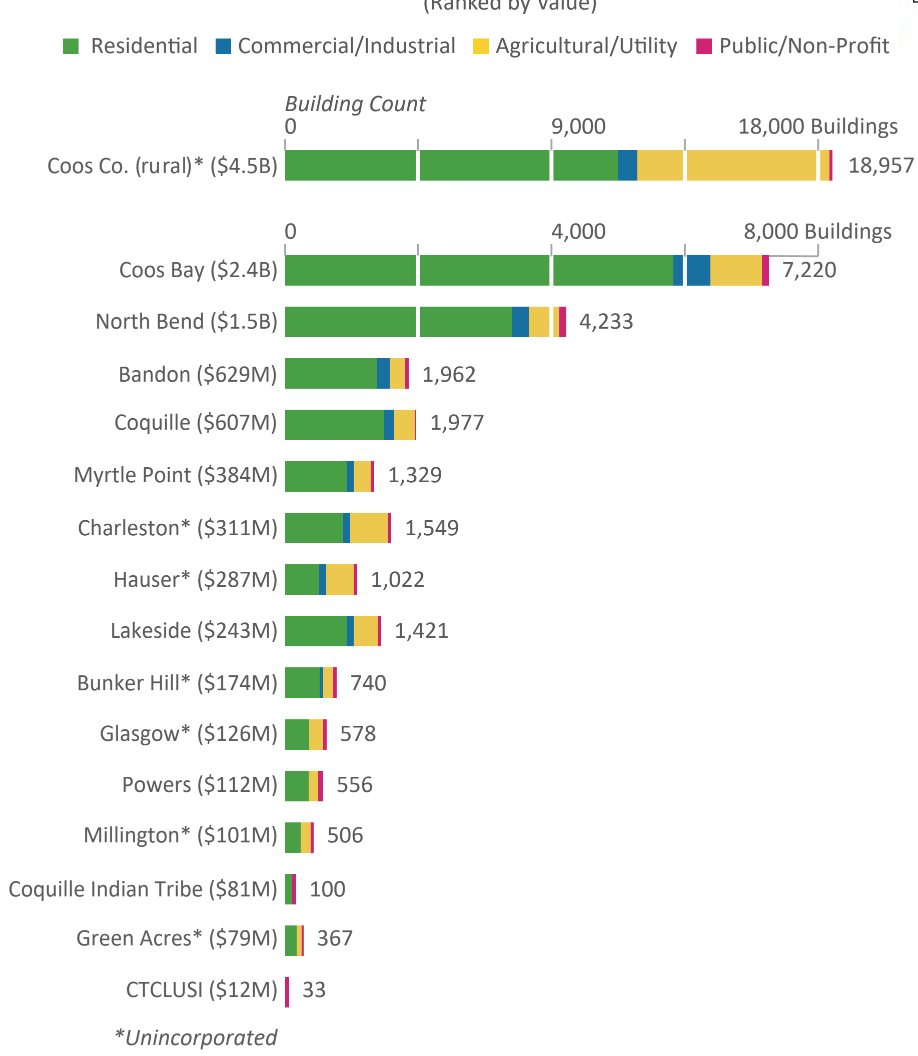
Building Occupancy

- Agricultural / Utility
- Commercial & Industrial
- Public & Non Profit
- Residential

This map is an overview map and not intended to provide details at the community scale. The GIS data that is published with the Coos County Natural Hazard Risk Assessment can be used to inform regarding queries at the community scale.

Buildings by Occupancy Class

(Ranked by Value)



*Unincorporated

Study Location Map

N

0 2.5 5 Miles

0 4 8 Kilometers

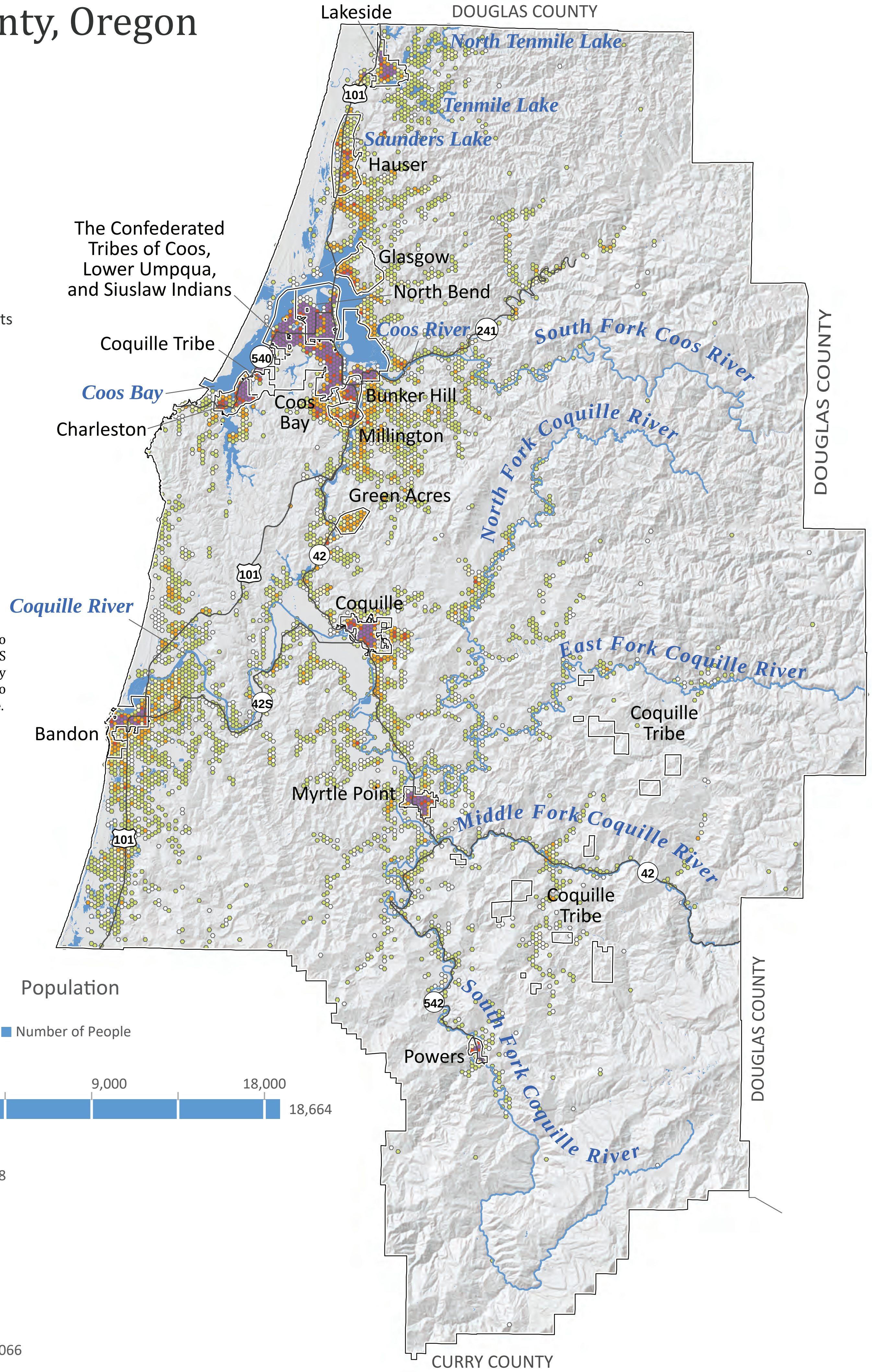
Data Sources:
Building footprints: Oregon Department of Geology (2010)
Roads: Oregon Department of Transportation (2014)
Place names: U.S. Geological Survey Geograpic Names Information System (2015)
City limits: Oregon Department of Transportation (2014)
Basemap: U.S. Geological Survey and Oregon Lidar Consortium (2012)
Hydrography: U.S. Geological Survey National Hydrography Dataset (2017)

Projection: NAD 1983 UTM Zone 10N
Software: Esri® ArcMap 10, Adobe® Illustrator CS6

Cartography by: Lowell H. Anthony, 2018

Disclaimer: 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. See the accompanying text report for more details on the limitations of the methods and data used to prepare this publication.

Population Density Map of Coos County, Oregon



People per 20 acres

- Building(s) present no permanent residents
- 0 - 10
- 11 - 20
- 21 - 40
- 41 - 80
- 81 +

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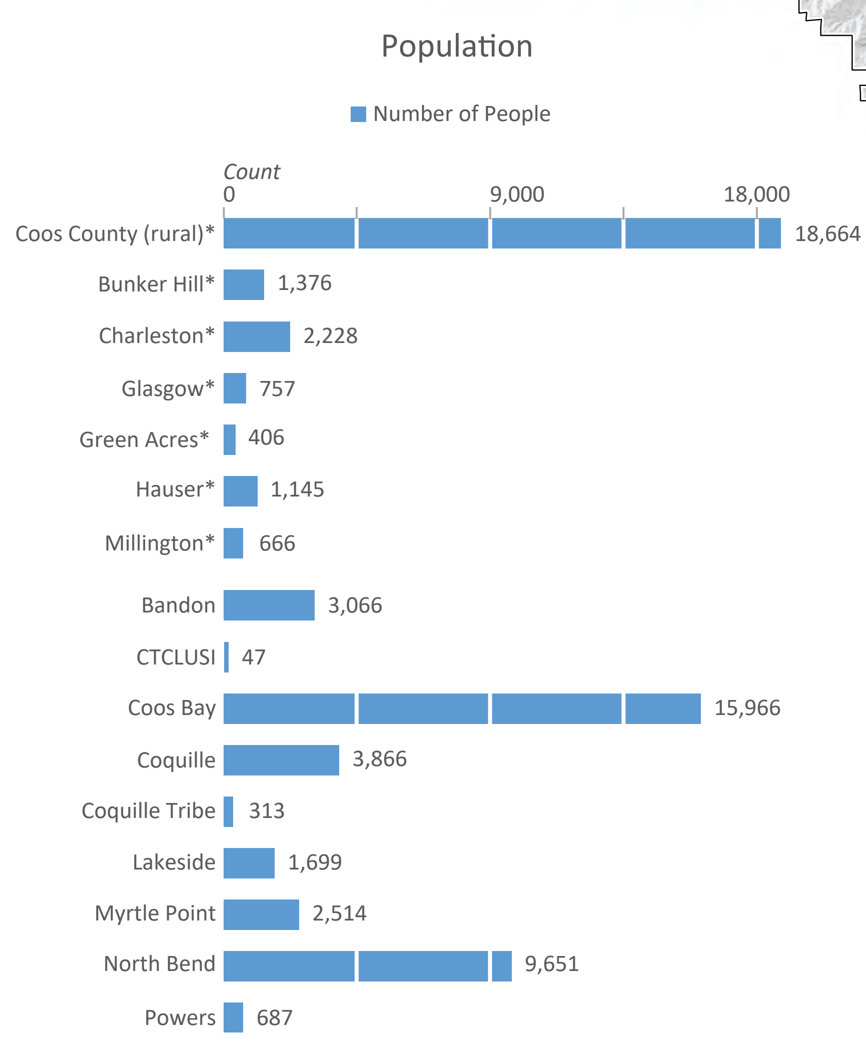

Study Location Map

Data Sources:
Population data: U.S. Census (2010)
Roads: Oregon Department of Transportation (2014)
Place names: U.S. Geological Survey Geograpic Names Information System (2015)
City limits: Oregon Department of Transportation (2014)
Basemap: U.S. Geological Survey and Oregon Lidar Consortium (2012)
Hydrography: U.S. Geological Survey National Hydrography Dataset (2017)

Projection: NAD 1983 UTM Zone 10N
Software: Esri® ArcMap 10, Adobe® Illustrator CS6

Cartography by: Lowell H. Anthony, 2018

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N
0 2.5 5 Miles
0 4 8 Kilometers

Mw 9.0 CSZ Earthquake Shaking Map of Coos County, Oregon

Peak Ground Acceleration (PGA) is the maximum acceleration in a given location or rather how hard the ground is shaking during an earthquake. It is one measurement of ground motion, which is closely associated with the level of damage that occurs from an earthquake.

Earthquake Peak Ground Acceleration

(Correlated Modified Mercalli Scale)

Very Strong — Severe

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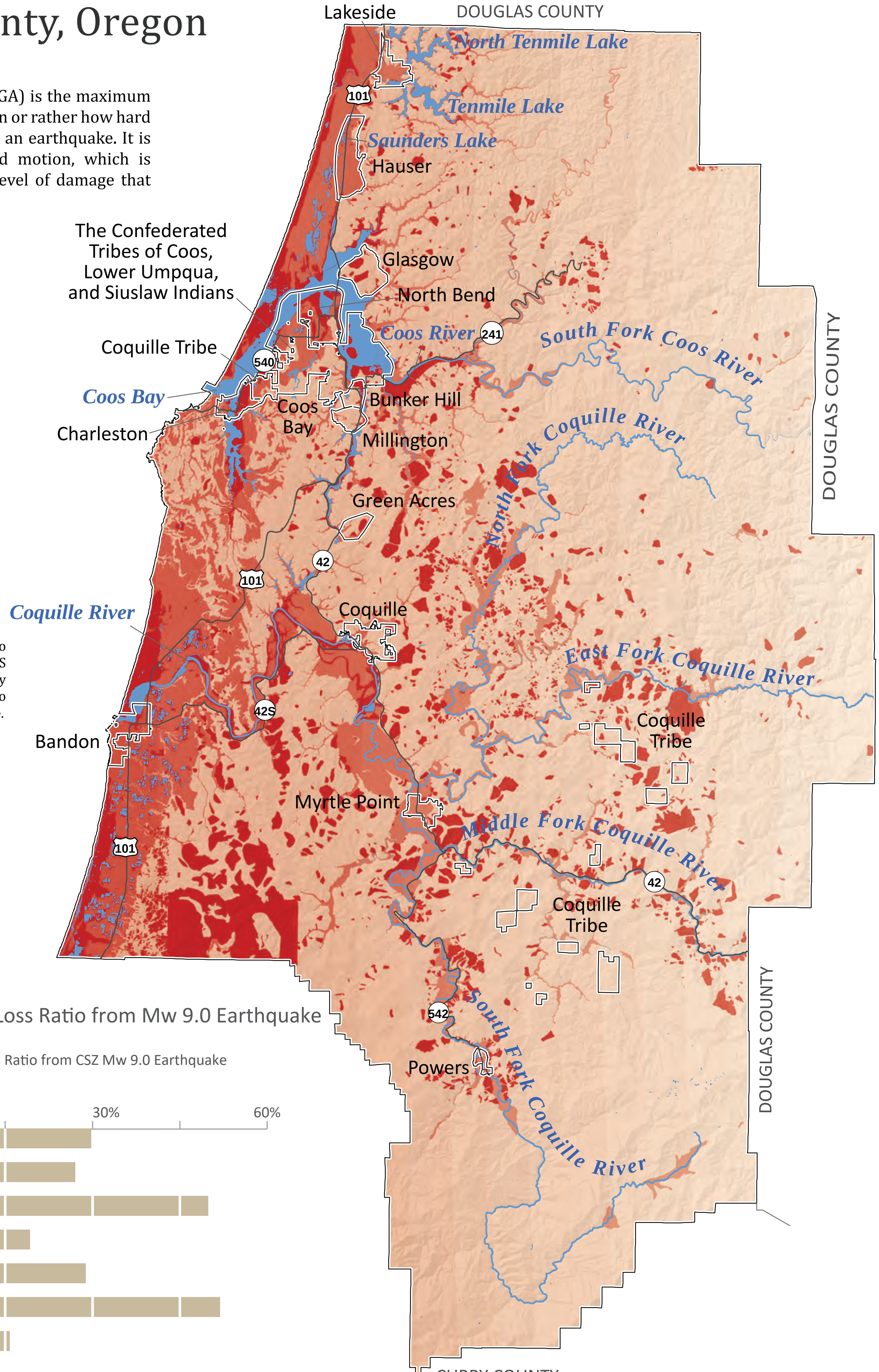
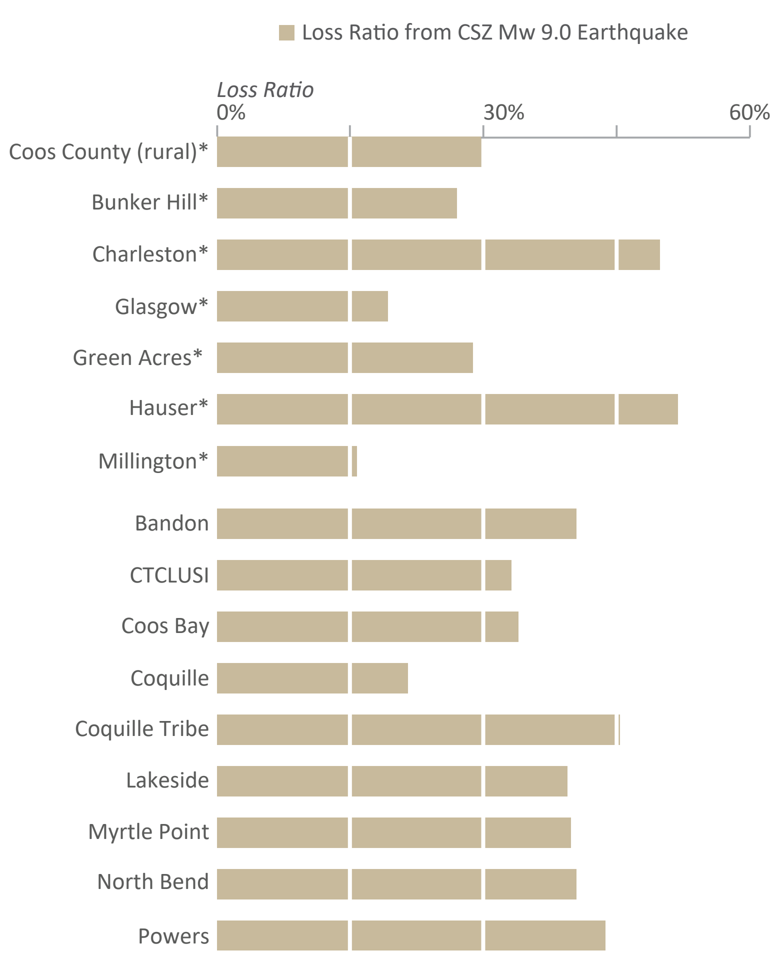


Total Building Value Loss Ratio from Mw 9.0 Earthquake



*Unincorporated

Study Location Map

Data Sources:
Earthquake peak ground acceleration: Oregon Department of Geology, Appleby and Bauer, unpub. data (2018)
Roads: Oregon Department of Transportation (2014)
Place names: U.S. Geological Survey Geograpic Names Information System (2015)
City limits: Oregon Department of Transportation (2014)
Basemap: U.S. Geological Survey and Oregon Lidar Consortium (2012)
Hydrography: U.S. Geological Survey National Hydrography Dataset (2017)

Projection: NAD 1983 UTM Zone 10N
Software: Esri® ArcMap 10, Adobe® Illustrator CS6
Cartography by: Lowell H. Anthony, 2018

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N
0 2.5 5 Miles
0 4 8 Kilometers

Tsunami Inundation Map of Coos County, Oregon

The tsunami hazard data show areas of expected innundation from several local tsunami scenarios produced from a magnitude 9.0 CSZ earthqauke. The scenarios were categorized based on "t-shirt" sizes, ranging from Small to XX-Large

Tsunami Hazard Zone

- Small
- Medium
- Large
- X-Large
- XX-Large

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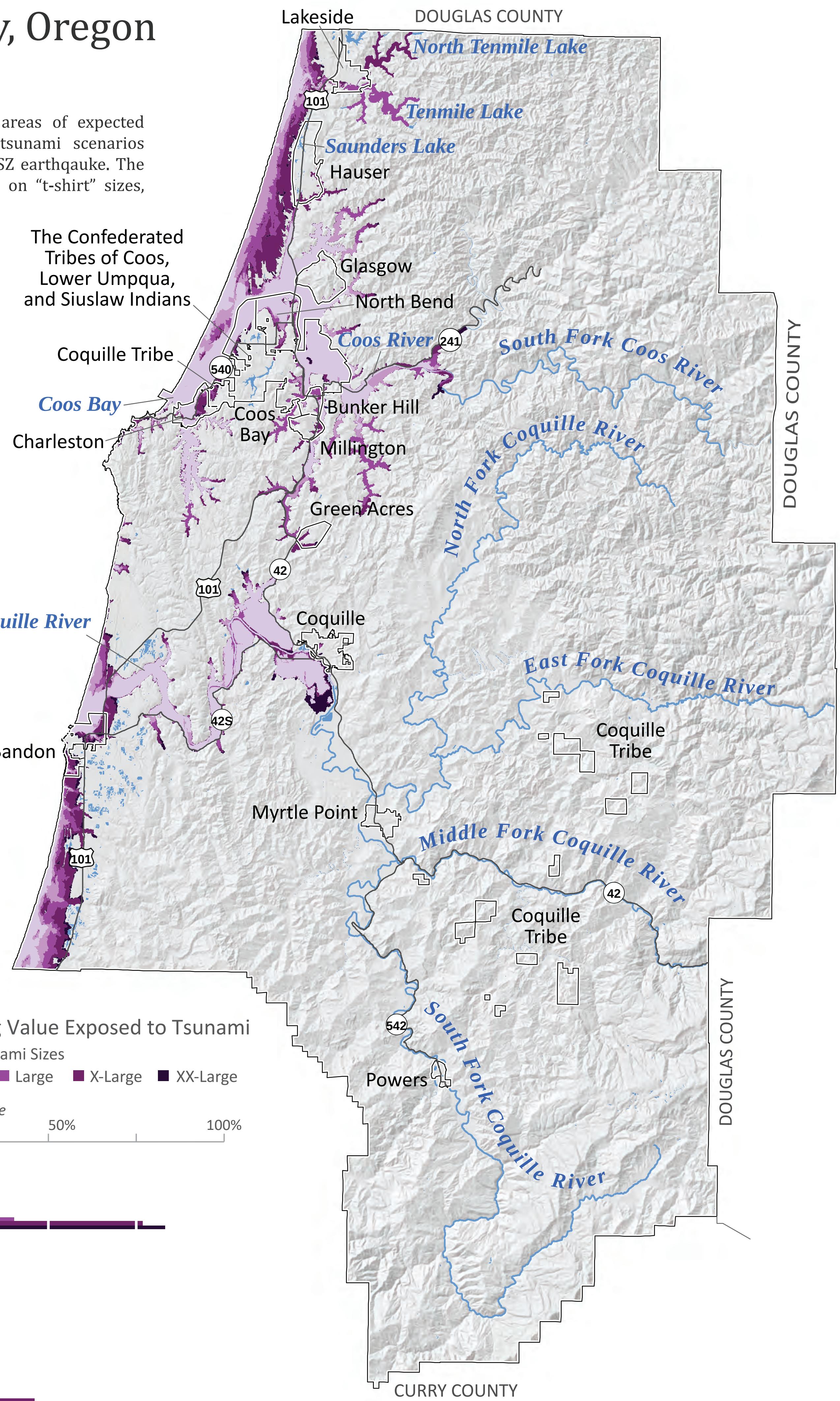

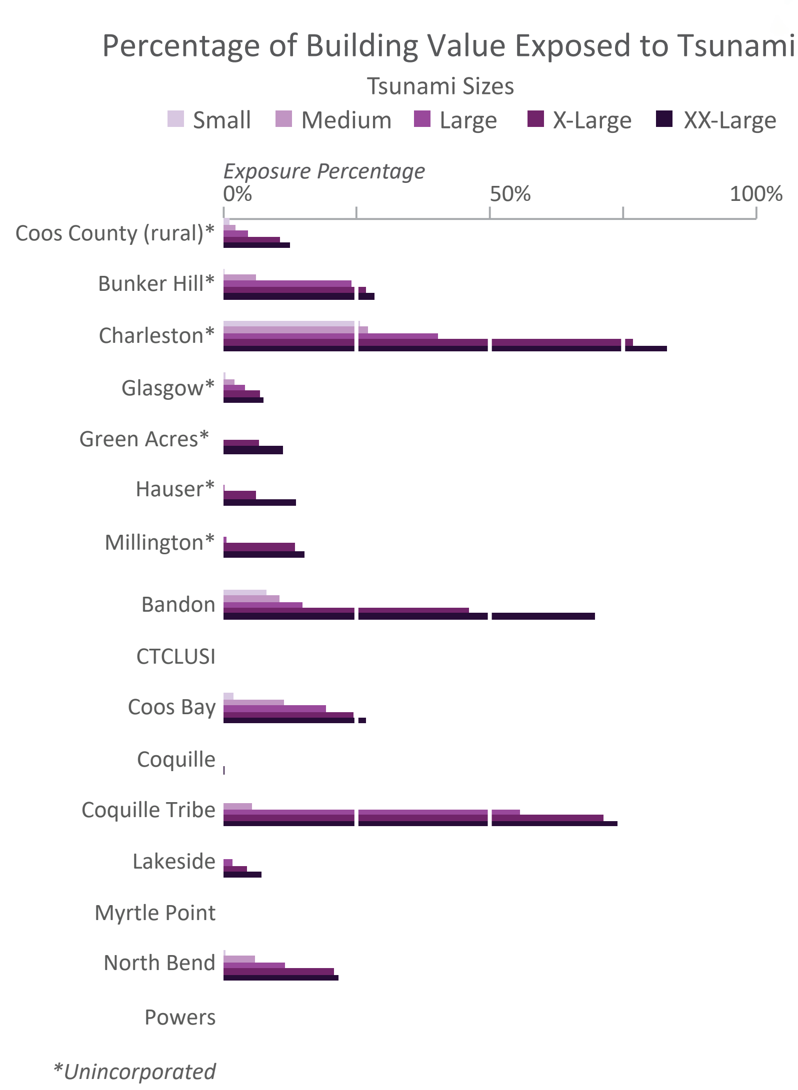

Data Sources:
Tsunami hazard zones: Oregon Department of Geology, Priest and others (2013)
Roads: Oregon Department of Transportation (2014)
Place names: U.S. Geological Survey Geograpic Names Information System (2015)
City limits: Oregon Department of Transportation (2014)
Basemap: U.S. Geological Survey and Oregon Lidar Consortium (2012)
Hydrography: U.S. Geological Survey National Hydrography Dataset (2017)

Projection: NAD 1983 UTM Zone 10N
Software: Esri® ArcMap 10, Adobe® Illustrator CS6

Cartography by: Lowell H. Anthony, 2018

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N
0 2.5 5 Miles
0 4 8 Kilometers

Flood Hazard Map of Coos County, Oregon

The flood hazard data show areas expected to be inundated during a 100-year flood event. Flooding sources include riverine. Areas are consistent with the regulatory flood zones depicted in Coos County's Digital Flood Insurance Rate Maps.

Flood Hazard Zone

100-Year Flood (1% annual chance)

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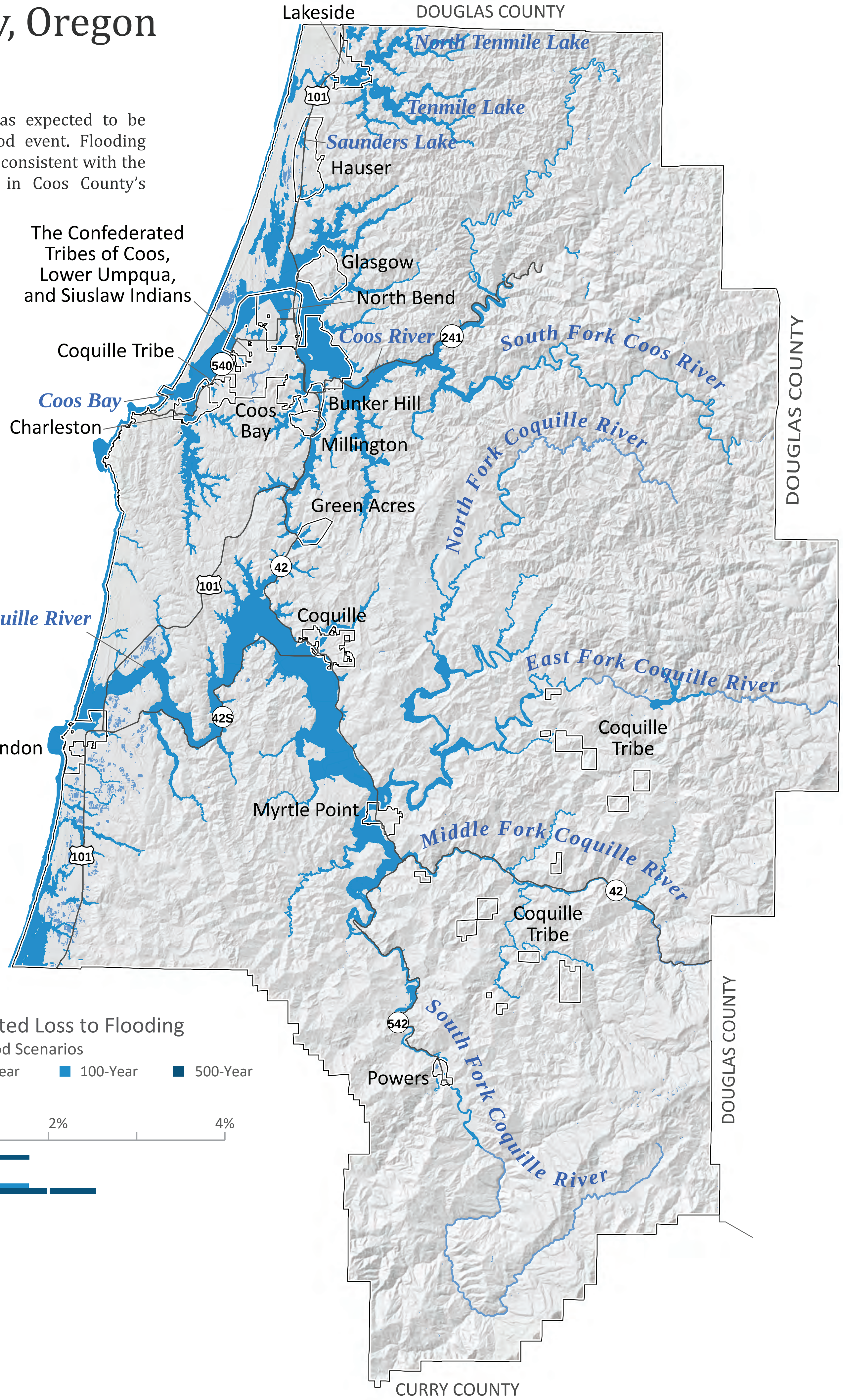

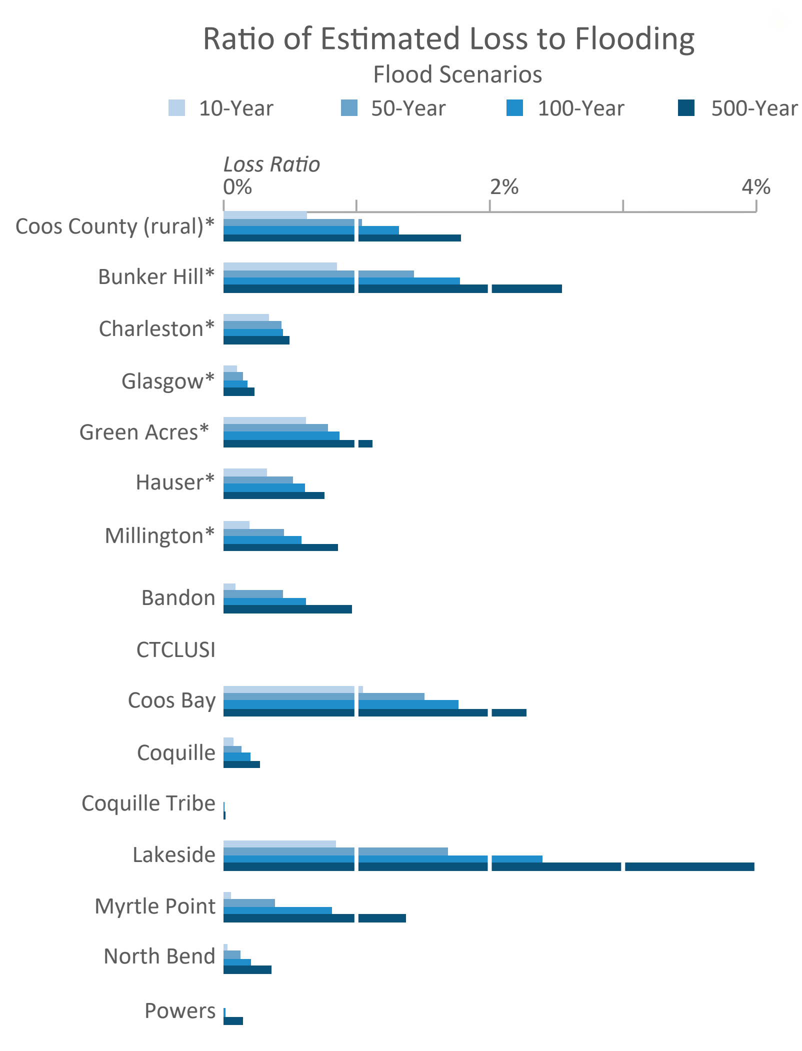

Data Sources:
Flood hazard zone (100-year): Coos County Flood Insurance Rate Map (2018)
Roads: Oregon Department of Transportation (2014)
Place names: U.S. Geological Survey Geograpic Names Information System (2015)
City limits: Oregon Department of Transportation (2014)
Basemap: U.S. Geological Survey and Oregon Lidar Consortium (2012)
Hydrography: U.S. Geological Survey National Hydrography Dataset (2017)

Projection: NAD 1983 UTM Zone 10N
Software: Esri® ArcMap 10, Adobe® Illustrator CS6
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N
0 2.5 5 Miles
0 4 8 Kilometers

Landslide Susceptibility Map of Coos County, Oregon

Landslide susceptibility is categorized as Low, Moderate, High, and Very High which describes the general level of susceptibility to landslide hazard. The dataset is an aggregation of three primary sources: landslide inventory (SLIDO), generalized geology, and slope.

Landslide Susceptibility

- Low
- Moderate
- High
- Very High

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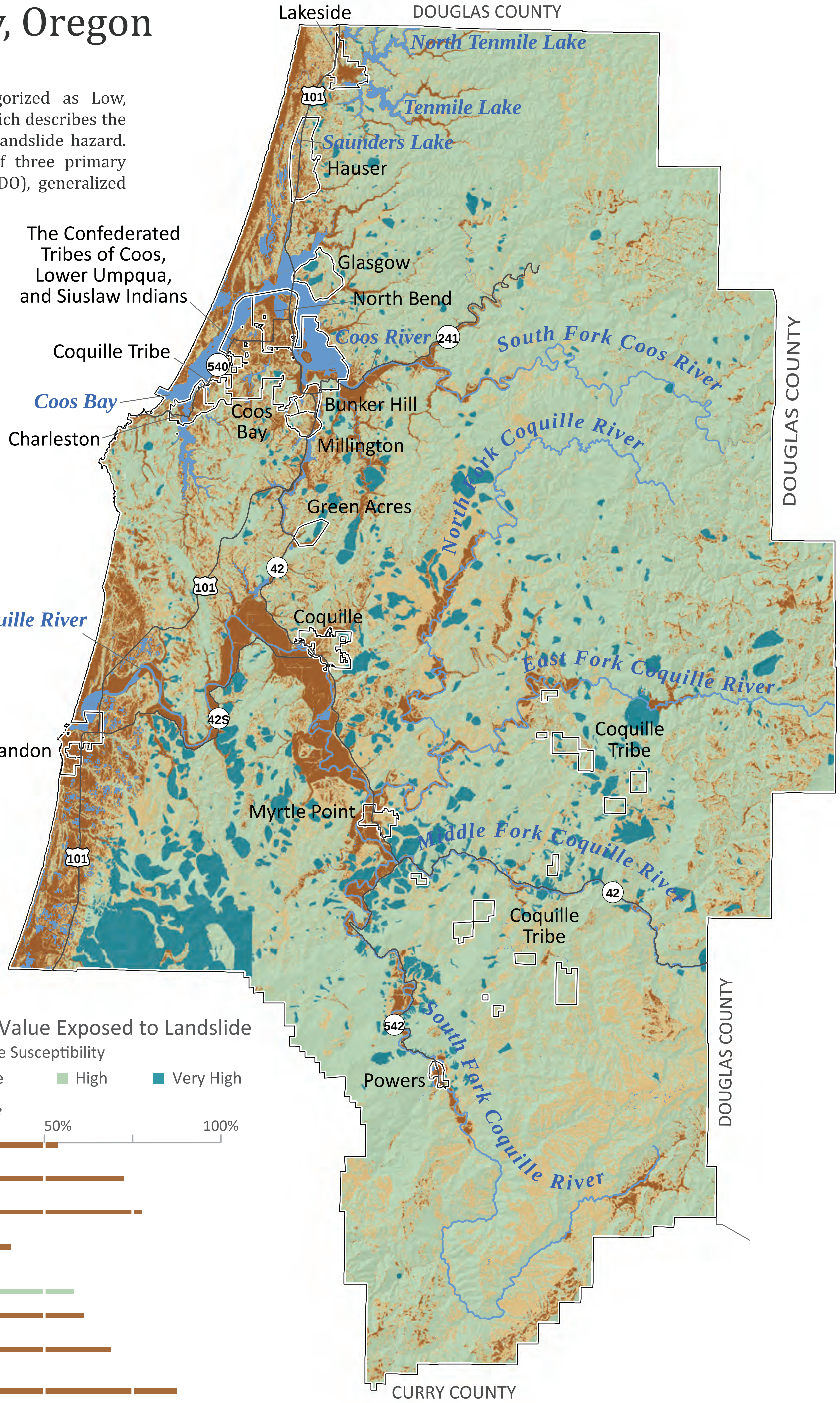
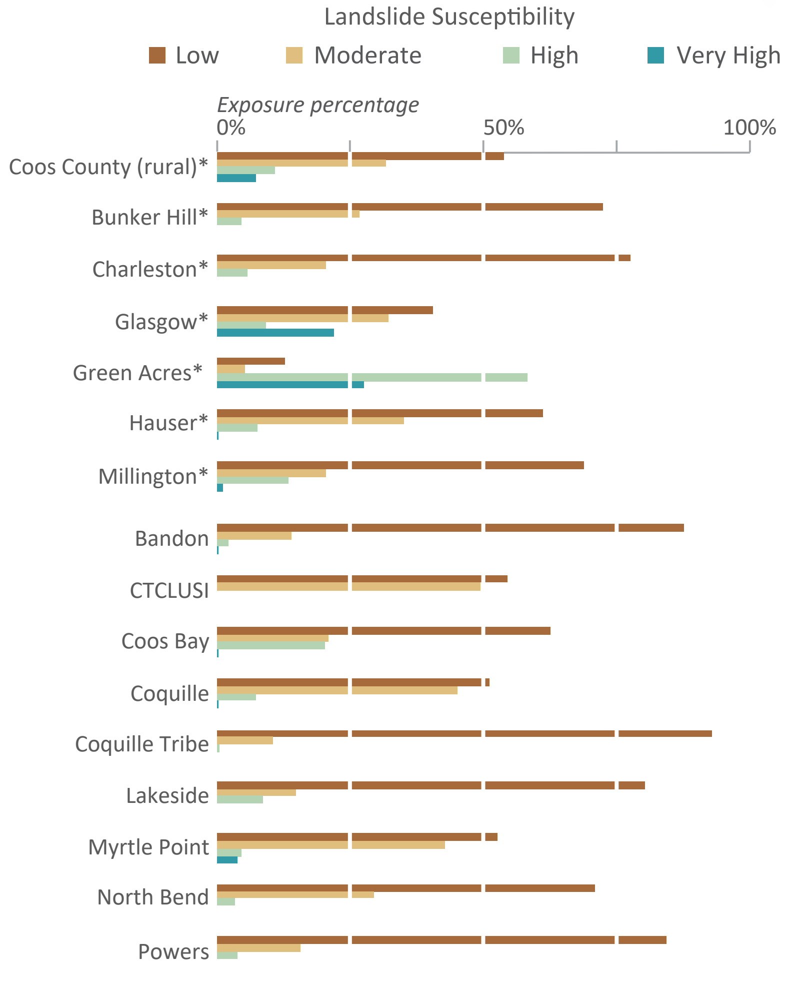


Percentage of Building Value Exposed to Landslide



*Unincorporated

Study Location Map

Data Sources:
Landslide susceptibility: Oregon Department of Geology, Burns and others (2016)
Roads: Oregon Department of Transportation (2014)
Place names: U.S. Geological Survey Geograpic Names Information System (2015)
City limits: Oregon Department of Transportation (2014)
Basemap: U.S. Geological Survey and Oregon Lidar Consortium (2012)
Hydrography: U.S. Geological Survey National Hydrography Dataset (2017)

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N 0 2.5 5 Miles
0 4 8 Kilometers

Wildfire Risk Map of Coos County, Oregon

Wildfire Risk is categorized as Low, Moderate, and High and indicates the level of risk a location has to wildfire hazard. The Wildfire Risk data layer (Fire Risk Index) is derived from a combination of the Fire Threat Index (fire history and behavior) and the Fire Effects Index (infrastructure and assets).

Wildfire Risk

- Low
- Moderate
- High

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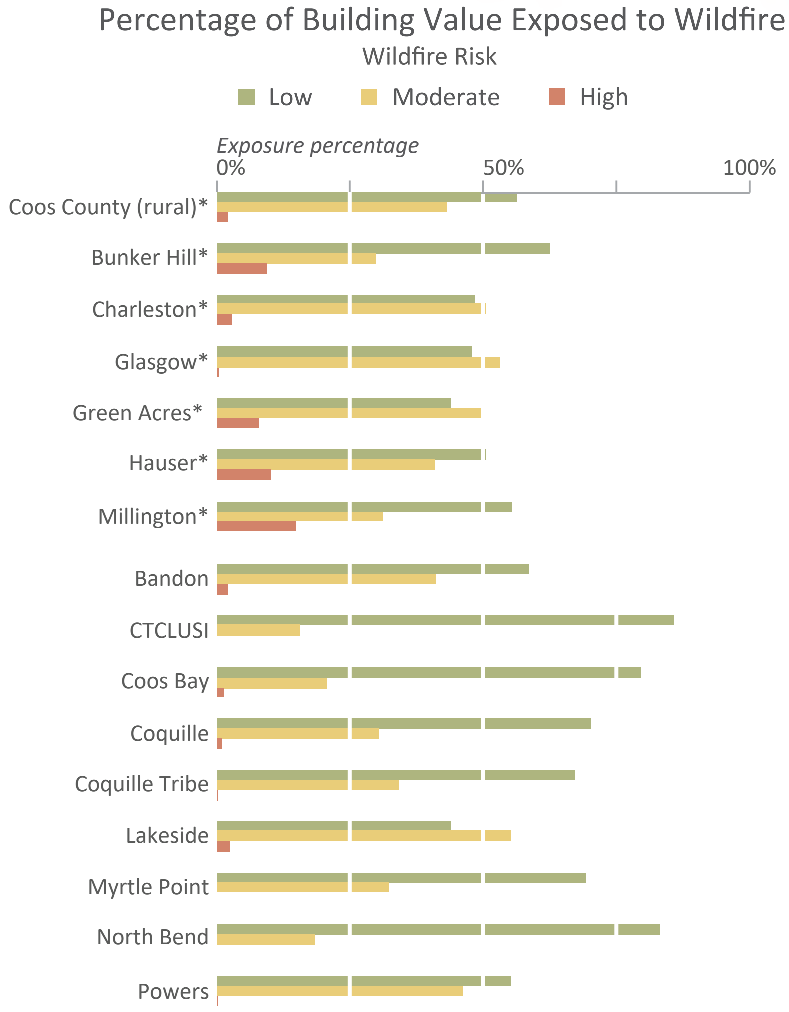
Percentage of Building Value Exposed to Wildfire



*Unincorporated

Study Location Map

Data Sources:
Wildfire risk data: Oregon Department of Forestry, Sanborn Map Company, Inc. (2013)
Roads: Oregon Department of Transportation (2014)
Place names: U.S. Geological Survey Geograpic Names Information System (2015)
City limits: Oregon Department of Transportation (2014)
Basemap: U.S. Geological Survey and Oregon Lidar Consortium (2012)
Hydrography: U.S. Geological Survey National Hydrography Dataset (2017)

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