STATE OF OREGON

COMPREHENSIVE EMERGENCY MANAGEMENT PLAN

VOLUME I:

Natural Hazards Mitigation Plan

EFFECTIVE September 15, 2025

THROUGH September 14, 2030

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OREGON
NATURAL HAZARDS
MITIGATION PLAN

EFFECTIVE September 15, 2025

THROUGH September 14, 2030

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State of Oregon Promulgation

TINA KOTEK
GOVERNOR

August 6, 2025

Vincent J. Maykovich, Acting Regional Administrator
Federal Emergency Management Agency
U.S. Department of Homeland Security
Federal Regional Center
130 228th Street, SW
Bothell, WA 98021-8627

Dear Mr. Maykovich:

The State of Oregon is pleased to submit the updated *Oregon Natural Hazards Mitigation Plan*.

This Plan contains the most complete and up-to-date description of Oregon's natural hazards and their probabilities, vulnerabilities, mitigation strategies, and the state's implementation capability. The State Hazard Mitigation Officer and the State Interagency Hazard Mitigation Team were deeply involved in the update. The State Interagency Hazard Mitigation Team is a collaborative body providing expertise and support for natural hazard mitigation planning and implementation statewide.

The *Oregon Natural Hazards Mitigation Plan* meets the requirements of Robert T. Stafford Disaster Relief and Emergency Assistance Act, as amended, as well as those of 44 CFR 201.1-201.4, maintaining the State of Oregon's eligibility for Stafford Act assistance and Hazard Mitigation Assistance (HMA) grants. The Plan includes a Repetitive Loss Strategy meeting the requirements of 44 CFR §201.4(c)(3)(v) which qualifies the state to request increased funding for mitigating repetitive loss properties under the Flood Mitigation Assistance Program. The Plan also complies with 44 CFR §201.4(c)(2) and (3) and 44 CFR §204.51(d)(2) which qualify the state to request Fire Management Assistance Grants. Further, the Plan complies with FEMA Policy 104-008-7, Rehabilitation of High Hazard Potential Dams Grant Program Guidance, Sections 2.2.1 and 5.2, qualifying the state to request High Hazard Potential Dam Rehabilitation Grants.

I hereby adopt the *Oregon Natural Hazards Mitigation Plan* and assure that the State of Oregon will continue to comply with all acceptable federal statutes and regulations in effect with respect to the periods for which Oregon receives grant funding including 2 CFR Parts 200 and 3002, and will amend this plan as necessary to reflect changes in state or federal statutes and regulations as required in 44 CFR 201.4(c)(7).

Sincerely,

Governor Tina Kotek

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Federal Emergency Management Agency Approval

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September 15, 2025

Tina Kotek,
Governor
State of Oregon
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Reference: Approval of the Oregon Natural Hazards Mitigation Plan

Dear Governor Kotek,

The U.S. Department of Homeland Security's Federal Emergency Management Agency (FEMA) Region 10 Mitigation Division, Risk Analysis Branch has approved the updated Oregon Natural Hazards Mitigation Plan effective Sep. 15, 2025, through Sep. 14, 2030. This plan is approved in accordance with applicable mitigation planning regulations and policy requirements[1]. FEMA's review and approval of this plan is limited to current FEMA mitigation planning requirements. Any additional content included beyond applicable FEMA mitigation planning requirements was not reviewed or considered in FEMA's approval.

In addition, this plan met the requirements to address wildfire risks and mitigation measures and all dam risks. An approved mitigation plan is a condition of receiving certain FEMA non-emergency assistance and mitigation grants; approval of a mitigation plan does not guarantee funding under any FEMA program. Please refer to the individual FEMA non-emergency assistance and mitigation grant program policy and/or annual Notice of Funding Opportunity for specific application and eligibility requirements for the FEMA programs listed above.

State mitigation plans must be updated and resubmitted to the FEMA Region 10 Mitigation Division, Risk Analysis Branch for approval. If the plan is not updated by the date indicated on this FEMA approval letter, the plan is considered lapsed, and FEMA will not obligate funds until the mitigation plan is approved.

If at any time over the plan approval period, FEMA determines that the State is not complying with all applicable federal statutes and regulations in effect during the periods for which it receives funding or is unable to fulfill mitigation commitments, FEMA may take action to correct the noncompliance (44 CFR §§ 201.3[b][5] and 201.4[c][7]).

[1] Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act), as amended; the National Flood Insurance Act of 1968, as amended; and National Dam Safety Program Act, as amended; Title 44 Code of Federal Regulations (CFR) Part 201, Mitigation Planning; and State Mitigation Planning Policy Guide (FP-302-094-2).

www.fema.gov

The state is responsible for communicating with local and tribal officials, as applicable, who are interested in applying for FEMA assistance through the State. FEMA encourages States to communicate with the appropriate officials regarding mitigation plan status and eligibility requirements. At a minimum of every six months, FEMA will provide to the State written information on mitigation plans, including, but not limited to:

- Local and tribal, as applicable, mitigation plan expiration dates.
- Consequences of not having an approved local or tribal, as applicable, mitigation plan with respect to eligibility for FEMA mitigation grant programs.
- Availability of mitigation planning training and technical assistance.
- Upcoming funding opportunities.

The state is responsible for reviewing and submitting approvable state and local mitigation plans to FEMA. If the State is not submitting approvable mitigation plans, FEMA will provide feedback as well as technical assistance or training to the state and local governments, as needed.

FEMA will provide a reminder at least 12 months before the plan's expiration date and outline the consequences of not having an approved mitigation plan, which is required in order to apply for and receive funding for FEMA non-emergency assistance and mitigation grant programs. In order to continue to apply for and receive funding from the programs listed on page 1, the State must submit a draft of the updated mitigation plan before the end of the approval period and allow FEMA sufficient time to complete the review and approval process for the updated mitigation plan. The approval process may include FEMA making a request to the state to make required revisions to the mitigation plan. Upon the state making the required revisions to the mitigation plan, FEMA will make a determination that the plan has achieved a status of "Approvable Pending Adoption." Once FEMA has made this determination, the state will formally "Adopt" the updated mitigation plan.

We look forward to working with you to discuss the status of the State mitigation program each year over the approval period. If we can be of assistance, please contact FEMA Region 10 Mitigation Division, Risk Analysis Branch, Community Planning Team at fema-r10-mit-planning@fema.dhs.gov.

Sincerely,

Vincent J. Maykovich
Regional Administrator, Acting

Enclosure

JF: MB

Chapter 1 Introduction

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1.1 Background and Purpose

The dramatic increase in the costs associated with natural disasters over recent decades fostered interest in identifying and implementing effective means of reducing vulnerability. On February 26, 2002, the Federal Emergency Management Agency (FEMA) published Interim Final Rule 44 CFR Part 201, which required all states and local governments to develop natural hazards mitigation plans to be eligible for certain hazard mitigation grant programs, and in the case of the states, to be eligible for certain categories of disaster assistance.

Disasters occur as a predictable interaction among three broad systems: natural systems (e.g., watersheds and tectonic plates), the built environment (e.g., cities and roads), and social systems (community organization infrastructure that includes demographics, business climate, service provision, etc.). What is not predictable is exactly when natural hazards will occur or the extent to which they will affect communities within the state. However, with careful planning and collaboration it is possible to minimize the losses that can result from natural hazards.

Hazard mitigation is defined in the Code of Federal Regulations (CFR) at 44 CFR 201.2 as "any sustained action taken to reduce or eliminate the long-term risk to human life and property from hazards." Hazard mitigation is the responsibility of individuals, private businesses and industries, state and local governments, and the federal government. Engaging in mitigation actions provides the state, counties, cities, businesses, and citizens with several benefits: fewer injuries and deaths; less damage to buildings, critical facilities, and infrastructure; diminished interruption in essential services; reduced economic hardship; minimized environmental harm; and quicker, lower-cost recovery.

The Oregon Natural Hazards Mitigation Plan (NHMP, Plan) provides information to guide mitigation actions throughout the state. It contains the most complete and up-to-date description of Oregon's natural hazards and their probability, the state's vulnerabilities, its mitigation strategies and

implementation resources. Oregon's counties and cities can rely upon this information when preparing local natural hazards mitigation plans. Similarly, local NHMPs provide the state with a deeper understanding of local and regional mitigation goals and issues, advancing alignment of mitigation goals and strategies statewide. Oregon's Natural Hazards Mitigation Plan meets FEMA eligibility requirements for hazard mitigation and disaster assistance funding, benefitting the state and local communities alike.

The Oregon NHMP has a five-year life cycle. It must be reviewed, updated, and re-approved by FEMA every five years to maintain state and local eligibility for certain federal natural hazards mitigation funding sources.

The Oregon NHMP comprises Volume I of the *State Comprehensive Emergency Management Plan,* administered by the Oregon Department of Emergency Management (OEM). Figure 1.1-1 illustrates this organizational relationship.

Figure 1.1-1 The Oregon NHMP in the State Comprehensive Emergency Management Plan.

Source: Modified from the Oregon Department of Emergency Management.

1.1.1 Oregon's Natural Hazards

The State of Oregon is subject to 12 natural hazards. Table 1.1.1-1 lists each hazard and describes in general terms where the hazard is located.

Table 1.1.1-1 Oregon Hazards Overview

	Hazards	Generalized Locations
1	Coastal Hazards	Coast
2	High Hazard Potential Dam Failure	Localized risks statewide
3	Droughts	Generally east of the Cascades, with localized risks statewide

	Hazards	Generalized Locations
4	Earthquakes	Cascadia Subduction Zone earthquakes primarily in western Oregon. Other active earthquake faults localized statewide.
5	Extreme Heat	Statewide
6	Floods	Localized risks statewide
7	Landslides	Localized risks statewide
8	Tsunamis	Coast
9	Volcanic Hazards	Central Oregon, Cascade Range and southeast Oregon, High Lava Plains
10	Wildfires	Primarily southwest, central and northeast Oregon, with localized risks statewide
11	Windstorms	Statewide
12	Winter Storms	Statewide

Source: Oregon NHMP lead state agencies for each hazard

Table 1.1.1-2 shows the state agencies in Oregon responsible for the 12 natural hazards addressed in this plan.

Table 1.1.1-2 Oregon NHMP Hazard Agencies

Hazard	Agencies
Coastal Hazards	Department of Geology and Mineral Industries Department of Land Conservation and Development Department of State Lands
Dam Failure	Oregon Water Resources Department Dam Safety Program Department of Land Conservation and Development
Droughts	Oregon Water Resources Department Oregon Health Authority Oregon Climate Change Research Institute
Earthquakes	Department of Geology and Mineral Industries Oregon Department of Emergency Management
Extreme Heat	Oregon Health Authority, Public Health Division Oregon Health Authority – Health, Security, Preparedness, and Response Division Oregon Climate Change Research Institute
Floods	Department of Geology and Mineral Industries Department of Land Conservation and Development Department of State Lands
Landslides	Department of Geology and Mineral Industries
Tsunamis	Department of Geology and Mineral Industries Department of Land Conservation and Development
Volcanic Hazards	Department of Geology and Mineral Industries Oregon Department of Emergency Management
Wildfires	Oregon Department of Forestry Oregon Office of the State Fire Marshal Department of Land Conservation and Development

Hazard	Agencies
Windstorms	Oregon Department of Energy Oregon Climate Change Resource Institute
Winter Storms	Oregon Public Utilities Commission Oregon Climate Change Research Institute

Source: DLCD

The United States began formally tracking natural disasters in 1955. Since that time, Oregon has received 40 Presidential major disaster declarations, 4 emergency declarations, and 73 fire management assistance declarations. Section 1.1.2 lists each of the major disaster declarations, the hazard to which it is attributed, and the impacted counties. Since 1955, approximately one-third of Oregon's counties have been impacted by 10 or more federally declared disasters. Of the 40 major disasters to impact Oregon, the majority have resulted from storm events. Notably, flooding impacts from those events are reported in over two-thirds of the major disaster declarations. The federal disaster declarations document that storm events, floods, and wildfires have been the primary chronic hazards with major disaster impacts in Oregon over the last 70 years.

1.1.2 Presidential Major Disaster Declarations Since 1955

DR-4768

Incident Period: Jan. 10, 2024 - Jan. 22, 2024

Disaster Type: Oregon Severe Winter Storms, Straight-line Winds, Landslides, and Mudslides

Affected Counties and Indian Reservations: Benton, Clackamas, Coos, Hood River, Lane, Lincoln, Multnomah, Sherman, Siletz Indian Reservation, Tillamook, Wasco

DR-4733

Incident Period: Jun. 11-12, 2023

Disaster Type: Burns Paiute Tribe Severe Storm, Flooding, Landslides, and Mudslides

Affected Counties and Indian Reservations: Burns Paiute Indian Reservation

DR-4599

Incident Period: Feb. 11-15, 2021

Disaster Type: Oregon Severe Winter Storm

Affected Counties and Indian Reservations: Benton, Clackamas, Grand Ronde Indian Reservation, Linn, Marion, Polk, Yamhill

DR-4562

Incident Period: Sep. 7, 2020 - Nov. 3, 2020

Disaster Type: Oregon Wildfires and Straight-line Winds

Affected Counties and Indian Reservations: Benton, Clackamas, Columbia, Coos, Deschutes, Douglas, Jackson, Jefferson, Josephine, Klamath, Lake, Lane, Lincoln, Linn, Marion, Multnomah, Tillamook, Wasco, Washington, Yamhill

DR-4499

Incident Period: Jan. 20, 2020 - May 11, 2023

Disaster Type: Oregon Covid-19 Pandemic

Affected Counties and Indian Reservations: Benton, Burns Paiute Indian Reservation, Clackamas, Clatsop, Columbia, Coos, Crook, Curry, Deschutes, Douglas, Gilliam, Grant, Harney, Hood River, Jackson, Jefferson, Josephine, Klamath, Lake, Lane, Lincoln, Linn, Malheur, Marion, Morrow, Multnomah, Polk, Sherman, Tillamook, Umatilla, Union, Wallowa, Wasco, Washington, Wheeler, Yamhill

DR-4519

Incident Period: Feb. 5-9, 2020

Disaster Type: severe storms, flooding, landslides, and mudslides

Affected Counties and Indian Reservations: Umatilla, Union, Wallowa

DR-4452

Incident Period: Apr. 6-21, 2019

Disaster Type: severe storms, flooding, landslides, and mudslides

Affected Counties and Indian Reservations: Curry, Douglas, Grant, Linn, Umatilla, Wheeler

DR-4432

Incident Period: Feb. 23-26, 2019

Disaster Type: severe winter storms, flooding, landslides, and mudslides

Affected Counties and Indian Reservations: Coos, Curry, Douglas, Jefferson, Lane

DR-4328

Incident Period: Jan. 7-10, 2017

Disaster Type: severe winter storms, flooding, landslides, and mudslides

Affected Counties and Indian Reservations: Columbia, Deschutes, Hood River, Josephine

DR-4296

Incident Period: Dec. 14-17, 2016

Disaster Type: severe winter storm and flooding

Affected Counties and Indian Reservations: Josephine, Lane

DR-4258

Incident Period: Dec. 6-23, 2015

Disaster Type: severe winter storms, straight-line winds, flooding, landslides, and mudslides

Affected Counties and Indian Reservations: Clackamas, Clatsop, Columbia, Coos, Curry, Douglas, Lane, Lincoln, Linn, Multnomah, Polk, Tillamook, Washington, Yamhill

DR-4169

Incident Period: Feb. 6–14, 2014

Disaster Type: severe winter storm

Affected Counties and Indian Reservations: Benton, Lane, Lincoln, Linn

DR-4055

Incident Period: Jan. 17–21, 2013

Disaster Type: severe winter storm / flooding / landslides / mudslides

Affected Counties and Indian Reservations: Benton, Columbia, Coos, Curry, Douglas, Hood River, Lane, Lincoln, Linn, Marion, Polk, Tillamook

DR-1964

Incident Period: Mar. 11, 2011

Disaster Type: tsunami

Affected Counties and Indian Reservations: Coos, Curry, Lincoln

DR-1956

Incident Period: Jan. 13–21, 2011

Disaster Type: winter storms / flooding / mudslides/ landslides / debris flows

Affected Counties and Indian Reservations: Clackamas, Clatsop, Crook, Douglas, Lincoln, Tillamook

DR-1824

Incident Period: Dec. 13, 2007–Jan. 26, 2008

Disaster Type: winter storms / flooding

Affected Counties and Indian Reservations: Clackamas, Clatsop, Columbia, Morrow, Polk, Sherman, Tillamook, Washington, Yamhill

DR-1733

Incident Period: Dec. 1–17, 2007

Disaster Type: storms / flooding / landslides / mudslides

Affected Counties and Indian Reservations: Sherman, Tillamook, Washington, Yamhill

DR-1683

Incident Period: Dec. 14–15, 2006

Disaster Type: winter storms / flooding

Affected Counties and Indian Reservations: Benton, Clatsop, Columbia, Lincoln, Sherman, Siletz Indian Reservation, Tillamook, Wasco, Wheeler, Yamhill

DR-1672

Incident Period: Nov. 5–8, 2006

Disaster Type: storms / flooding / landslides / mudslides

Affected Counties and Indian Reservations: Clatsop, Hood River, Lincoln, Tillamook

DR-1632

Incident Period: Dec. 18, 2005 – Jan. 21, 2006

Disaster Type: storms / flooding / landslides / mudslides

Affected Counties and Indian Reservations: Benton, Clackamas, Clatsop, Columbia, Coos, Crook, Curry, Douglas, Gilliam, Jackson, Jefferson, Josephine, Lincoln, Linn, Sherman, Siletz Indian Reservation, Tillamook, Warm Springs Indian Reservation, Wheeler, Yamhill

DR-1510

Incident Period: Dec. 26, 2003 – Jan. 14, 2004

Disaster Type: winter storms

Affected Counties and Indian Reservations: Baker, Benton, Clackamas, Clatsop, Columbia, Crook, Deschutes, Douglas, Gilliam, Grant, Harney, Hood River, Jefferson, Lake, Lane, Lincoln, Linn, Malheur, Marion, Morrow, Multnomah, Polk, Sherman, Tillamook, Umatilla, Union, Wallowa, Wasco, Wheeler, Yamhill

DR-1405

Incident Period: Feb. 7-8, 2002

Disaster Type: winter storm

Affected Counties and Indian Reservations: Coos, Curry, Douglas, Lane, Linn

DR-1221

Incident Period: May 28–June 3, 1998

Disaster Type: flooding

Affected Counties and Indian Reservations: Crook

DR-1160

Incident Period: Dec. 25, 1996 –Jan. 6, 1997

Disaster Type: winter storm / flooding

Affected Counties and Indian Reservations: Coos, Douglas, Jackson, Josephine, Klamath, Lake, Lane, Wallowa

DR-1107

Incident Period: Dec. 10–12, 1995

Disaster Type: storms / high winds

Affected Counties and Indian Reservations: Benton, Clatsop, Columbia, Douglas, Lane, Lincoln, Linn, Tillamook, Washington, Yamhill

DR-1099

Incident Period: Feb. 4–21, 1996

Disaster Type: storms / flooding

Affected Counties and Indian Reservations: Benton, Clackamas, Clatsop, Columbia, Coos, Deschutes, Douglas, Gilliam, Hood River, Jefferson, Josephine, Lane, Lincoln, Linn, Marion, Morrow, Multnomah, Polk, Sherman, Tillamook, Umatilla, Union, Wallowa, Wasco, Washington, Yamhill

DR-1061

Incident Period: July 8–9, 1995

Disaster Type: flash flooding

Affected Counties and Indian Reservations: Wasco

DR-1036

Incident Period: May 1–Oct. 31, 1994

Disaster Type: El Niño effects

Affected Counties and Indian Reservations: Clatsop, Columbia, Coos, Curry, Douglas, Lane, Lincoln, Tillamook

DR-1004

Incident Period: Sep. 20, 1993

Disaster Type: earthquakes

Affected Counties and Indian Reservations: Klamath

DR-985

Incident Period: Mar. 25, 1993

Disaster Type: earthquake

Affected Counties and Indian Reservations: Clackamas, Marion, Washington, Yamhill

DR-853

Incident Period: Jan. 6-9, 1990

Disaster Type: storms / flooding

Affected Counties and Indian Reservations: Clatsop, Tillamook

DR-413

Incident Period: Jan. 25, 1974

Disaster Type: storms / flooding / snow melt

Affected Counties and Indian Reservations: Benton, Clackamas, Columbia, Coos, Curry, Douglas, Gilliam, Hood River, Jackson, Josephine, Lane, Lincoln, Marion, Polk, Tillamook, Wallowa, Wasco, Washington, Yamhill

DR-319

Incident Period: Jan. 21, 1972

Disaster Type: storms / flooding

Affected Counties and Indian Reservations: Clackamas, Clatsop, Coos, Douglas, Lane, Lincoln, Linn, Multnomah, Tillamook, Washington

DR-301

Incident Period: Feb. 13, 1971

Disaster Type: storms / flooding

Affected Counties and Indian Reservations: Clatsop, Tillamook

DR-184

Incident Period: Dec. 24, 1964

Disaster Type: heavy rains / flooding

Affected Counties and Indian Reservations: Baker, Benton, Clackamas, Clatsop, Columbia, Coos, Crook, Curry, Deschutes, Douglas, Gilliam, Grant, Harney, Hood River, Jackson, Jefferson, Josephine, Klamath, Lake, Lane, Lincoln, Linn, Malheur, Marion, Morrow, Multnomah, Polk, Sherman, Tillamook, Umatilla, Union, Wallowa, Wasco, Washington, Wheeler, Yamhill

DR-144

Incident Period: Feb. 25, 1963

Disaster Type: flooding

Affected Counties and Indian Reservations: No individual county impact data available

DR-136

Incident Period: Oct. 16, 1962

Disaster Type: storms

Affected Counties and Indian Reservations: No individual county impact data available

DR-69

Incident Period: Mar. 1, 1957

Disaster Type: flooding

Affected Counties and Indian Reservations: No individual county impact data available

DR-60

Incident Period: July 20, 1956

Disaster Type: storm / flooding

Affected Counties and Indian Reservations: No individual county impact data available

DR-49

Incident Period: Dec. 29, 1955

Disaster Type: flooding

Affected Counties and Indian Reservations: No individual county impact data available

1.1.3 Disasters in Each County or Indian Reservation

Baker: 2
Benton: 13
Burns Paiute Indian Reservation: 2
Clackamas: 14
Clatsop: 15
Columbia: 14
Coos: 15
Crook: 6
Curry: 11
Deschutes: 6

Douglas: 17
Gilliam: 6
Grant: 4
Grand Ronde Indian Reservation: 1
Harney: 3
Hood River: 9
Jackson: 6
Jefferson: 7
Josephine: 9
Klamath: 5
Lake: 5
Lane: 17
Lincoln: 18
Linn: 14
Malheur: 3
Marion: 9
Morrow: 5
Multnomah: 8
Polk: 9
Sherman: 9
Siletz Indian Reservation: 3
Tillamook: 20
Umatilla: 6
Union: 5
Wallowa: 7
Warm Springs Indian Reservation: 1
Wasco: 9
Washington: 11
Wheeler: 6
Yamhill: 14

1.1.4 Local Risk Assessment and State Risk Assessment Comparison

KEY **-** Hazard not present
L Low risk
M Medium risk
H High risk
Y High hazard potential dam present

Yellow Shading: Different risk rating, used higher rating

Green shading: No specific designation, included in broader rating

Orange Shading: EQ was for CSZ and Crustal, used the higher rating of the two

County	Coastal Hazards		Tsunami		Dam Failure		Drought		Earthquake		Extreme Heat		Flood		Landslide		Volcano		Wildfire		Windstorm		Winter Storm	
	Local	State	Local	State	Local	State	Local	State	Local	State	Local	State	Local	State	Local	State	Local	State	Local	State	Local	State	Local	State
Baker	-	-	-	-	-	Y	H	H	H	M	-	H	M	M	L	M	L	-	H	M	M	H	M	H
Benton	-	-	-	-	L	Y	M	L	L	M	M	L	H	L	M	L	L	-	H	L	H	M	H	M
Clackamas	-	-	-	-	-	Y	L	L	H	L	M	L	M	L	L	L	L	L	M	L	L	L	M	M
Clatsop	M	L	H	M	-	Y	H	L	H	H	-	L	H	M	L	H	L	-	L	L	H	H	H	H
Columbia	-	-	-	-	-	-	L	L	H	M	-	L	H	M	-	M	M	-	M	L	-	H	-	H
Coos	L	M	H	M	-	Y	M	M	H	H	-	M	H	M	H	M	-	-	M	L	H	H	H	H
Crook	-	-	-	-	-	Y	-	H	H	H	-	M	H	M	L	M	H	-	M	M	-	M	-	M
Curry	M	H	H	M	-	Y	M	M	H	H	M	M	M	H	H	H	L	-	H	M	H	H	H	—
Deschutes	-	-	-	-	-	Y	L	M	H	L	-	M	L	L	L	L	H	H	H	M	H	L	H	H
Douglas	L	M	M	H	-	Y	M	M	H	M	M	M	M	M	M	M	-	M	H	M	M	M	H	M
Gilliam	-	-	-	-	-	-	H	H	M	M	*	H	M	H	H	H	L	-	H	H	M	L	H	H
Grant	-	-	-	-	-	Y	H	H	M	H	-	H	H	H	L	H	H	-	H	H	L	H	H	H
Harney	-	-	-	-	-	-	H	H	L	H		H	-	H		M		-		H	-	L	-	M

County	Coastal Hazards		Tsunami		Dam Failure		Drought		Earthquake		Extreme Heat		Flood		Landslide		Volcano		Wildfire		Windstorm		Winter Storm	
	Local	State	Local	State	Local	State	Local	State	Local	State	Local	State	Local	State	Local	State	Local	State	Local	State	Local	State	Local	State
Hood River	-	-	-	-	-	Y	M	M	M	M	-	L	L	L	M	M	L	H	H	M	L	H	H	H
Jackson	-	-	-	-	-	Y	M	M	H	M	M	H	M	M	L	M	L	M	H	M	M	H	M	H
Jefferson	-	-	-	-	-	Y	H	H	L	M	-	M	M	H	L	M	L	H	H	H	M	—	H	H
Josephine	-	-	-	-	-	Y	H	M	H	M	M	H	M	M	L	M	L	-	H	M	M	H	H	H
Klamath	-	-	-	-	M	Y	H	H	H	M	H	M	M	M	M	M	H	H	H	H	M	-	M	M
Lake	-	-	-	-	-	Y	H	H	H	H	-	M	H	H	L	H	H	-	H	H	H	M	H	H
Lane	-	M	M	L	-	Y	L	M	H	M	*	L	H	M	H	L	L	M	H	L	H	M	H	H
Lincoln	L	H	H	M	-	Y	M	M	H	H	-	L	M	H	H	H	L	-	M	L	H	H	M	—
Linn	-	-	-	-	L	Y	M	M	M	M	H	L	M	M	L	L	M	M	M	L	M	M	H	H
Malheur	-	-	-	-		Y	H	H	L	H	*	H	M	H	L	M	L	-	M	M	-	M	H	M
Marion	-	-	-	-	H	Y	H	L	H	M	M	L	H	L	H	L	M	M	H	L	-	H	-	H
Morrow - North	-	-	-	-	-	Y	M	M	H	M	M	M	L	M	L	L	H	-	L	M	M	M	H	H
Morrow - South	-	-	-		-		M		H		M		M		M		L		H		M		M	
Multnomah	-	-	-	-	-	Y	H	L	H	L	H	L	M	L	M	L	L	L	H	L	H	H	H	H
Polk	-	-	-	-	-	Y	M	L	H	M	M	L	M	M	L	L	L	-	M	L	H	H	H	-
Sherman	-	-	-	-	-	Y	H	H	L	M	H	H	L	H	M	H	M	-	H	H	H	M	H	-
Tillamook	M	M	H	L	-	-	H	L	H	H	H	L	H	M	H	H	-	-	H	L	H	H	H	H
Umatilla	-	-	-	-	-	Y	H	H	H	M	-	H	H	M	M	L	H	-	H	M	-	H	-	H
Union	-	-	-	-	L	Y	M	H	M	M	M	M	M	M	L	M	-	-	M	M	M	H	H	H
Wallowa	-	-	-	-	M	Y	H	H	H	M	M	H	M	H	M	H	-	-	H	H	M	M	M	M
Wasco	-	-	-	-	-	Y	H	H	M	H	H	H	M	M	L	H	H	H	H	H	-	H	-	H
Washington	-	-	-	-	M	Y	H	L	H	M	M	L	M	L	L	L	M	-	M	L	M	H	H	H
Wheeler	-	-	-	-	-	Y	H	H	H	M	-	M	H	M	H	H	H	-	H	H	M	M	H	H
Yamhill	-	-	-	-	-	Y	M	L	H	H	-	M	H	M	L	M	L	-	L	L	M	M	H	H

Notes:

- Marion County used a different risk assessment method that still resulted in High, Medium, or Low rankings.
- The Morrow County Natural Hazard Mitigation Plan assessed risk separately for the North County and South County. The Oregon Natural Hazards Risk Assessment assessed the county as a whole.

This comparison shows similarities and differences between local and state vulnerability rankings. For some counties, local and state assessments agree on the level of vulnerability to a hazard. In other

instances, local and state rankings are not the same. For example, in several instances a county did not score itself for a hazard (indicating it is not at risk to that hazard) or scored itself "L" (as having low vulnerability) to a hazard, while the state ranked that county as having "H" (high) vulnerability to that hazard. DLCD used GIS software to break the risk assessment preference scores (that include socio-economic factors) into three categories using Jenks classification to create a 3-tiered state ranking (Low, Medium, High) in order to have consistency with local assessments. However, it is important to note this manipulation is exclusive to this analysis.

It would be instructive to compare the results of the 2025 risk assessment with local risk assessments and the National Risk Index. The results of such a comparison could lead to more accurate assessments by local planners and illuminate areas that could most benefit from mitigation investment. Traditional ecological knowledge from indigenous populations is also useful to assess risk. All four perspectives – local practitioners, state hazard experts, indigenous ecological knowledge, and objective data – are necessary for reaching the best assessment of vulnerability. They complement one another and lead to more robust mitigation.

Some hazards and counties have nuanced reporting. For example, dam failure is reported as simply the presence of a high hazard potential dam within the county, and similarly symbolized with an "Y" to indicate the presence of a federally or state regulated high hazard potential dam, and dash to indicate no presence of a state or federally regulated high hazard potential dam. Additionally, Morrow County splits its county into two geographic regions, north and south, and assesses hazards based on those regions. We report those evaluations and a single county evaluation for the statewide assessment.

While this perspective may be skewed by the last hazard event suffered, it also contextualizes the assessment with a depth of knowledge and experience with the community that is valuable to the assessment. Local practitioners with such understanding can identify errors in data, assumptions, or interpretation that may be made by outside experts. They know the places that the population cares about protecting, for example iconic establishments or heritage sites. The local perspective is also helpful on the human side of vulnerability assessment. People know their neighbors and the organizations in the community that serve those in need. They are invaluable in identifying the potential and actual human costs of hazard events. While the state may provide data and analysis, the local risk assessors can use that data and analysis to derive a deeper understanding of the vulnerabilities of their community, use that knowledge to improve the local risk assessment, and then to more effectively mitigate. Local risk assessments therefore can add depth and granularity to the state risk assessment.

As the state strives to incorporate local risk assessments into the state risk assessment (Chapter 3), this deeper local understanding of local vulnerability and risk, based in part on state data and analysis and in part on local knowledge and experience, will help the state focus its limited resources in communities that need them most and in the ways those communities need them most. This linkage between state and local mitigation planning promises to be beneficial to tribal governments, local governments, state government and all Oregonians.

1.2 Approach

The 2025 Oregon Natural Hazards Mitigation Plan meets the requirements of 44 CFR 201.4, Standard State Mitigation Plans.

Oregon set several goals for the 2025 Oregon NHMP Update:

- To employ a sophisticated, scientifically-sound risk assessment method.
- The results of the risk assessment should provide the information necessary to drive strategic investments in natural hazards mitigation.
- Priority mitigation actions should be those that:
    - Respond to the risk assessment results through the mitigation goals.
    - Meet FEMA requirements.
    - The state has or can quickly obtain the capability to accomplish.
    - The state can accomplish within the five-year life of the Plan.
    - Are as specific as possible.
    - Are measurable, if possible.
    - Will not result in inequities, to the extent foreseeable.
- Reduce the NHMP's size to enhance user experience.

The 2025 Oregon Natural Hazards Risk Assessment (ONHRA) produced results at the census tract level for the entire state for nine of the 12 hazards addressed in this plan:

- Coastal Hazards
- Droughts
- Earthquakes
- Extreme Heat
- Floods
- Landslides
- Tsunamis
- Volcanic Hazards
- Wildfires

Data for Windstorms and Winter Storms is available in a form that is incompatible with this method. The standard dam risk assessment method also does not lend itself to this method. While dam failure is generally not considered a natural hazard, FEMA requires that state NHMPs include a section on "high hazard potential dams (HHPDs)," to maintain eligibility for certain FEMA dam mitigation grants. Thus, the Oregon Natural Hazards Mitigation Plan includes a section on dam failure, and the ONHRA focuses on the nine hazards listed above.

Recognizing that this Plan has a five-year life, the state is focusing on the areas the risk assessment methods identified as most vulnerable or most at risk. This method takes social as well as physical vulnerability into account. State mitigation goals and actions will focus on reducing the risk in the areas identified.

1.2.1 Natural Hazards Mitigation Planning Regions

Because Oregon is a large state with diverse geophysical regions that experience natural hazards differently, the state uses eight natural hazards mitigation planning regions to address their characteristics, hazards, and mitigation, referring to them by number.

Figure 1.2-1 Oregon NHMP Natural Hazards Mitigation Planning Regions

1.3 Plan Structure

The 2025 Oregon NHMP contains nine chapters.

Chapter 2 – Oregon Profile: General overview of the state's physical and human geography, built environment, and economy.

Chapter 3 – Hazard Identification and Risk Assessment: Introduces and characterizes Oregon's natural hazards and discusses how vulnerability and risk were assessed. It presents the results of the assessments, highlighting areas most at risk from natural hazards.

Chapter 4 – Statewide Mitigation Capability Assessment: Summarizes and evaluates Oregon's ability to implement natural hazards mitigation through its legal and regulatory framework, policies, programs, and funding sources. Building codes, FEMA's National Flood Insurance and Risk Mapping, Analysis, and Planning Programs receive special attention.

Chapter 5 – Mitigation Strategy: Establishes Oregon's natural hazards mitigation goals based on the risk assessment. It describes mitigation actions to advance achievement of those goals over time through the capabilities identified in Chapter 4.

Chapter 6 – Local Capabilities and Planning Coordination: Contains a general description and evaluation of local government capabilities to accomplish natural hazards mitigation. It describes how the state supports local governments in developing, updating, and submitting their natural hazards mitigation plans to FEMA for approval, and sharing mitigation data and priorities. It contains criteria for prioritizing jurisdictions to receive mitigation grants.

Chapter 7 – Planning Process: Describes the 2025 update process, highlighting coordination with other state agencies and integration with other state planning efforts. It describes the process of evaluating the 2020 Oregon NHMP, and processes for tracking implementation progress, monitoring, evaluating, and updating the 2025 Plan.

Chapter 8 – Abbreviations and Glossary: Defines acronyms, abbreviations, and terms used in the plan.

Chapter 9 – Appendices: Additional background data to support other chapters.

Chapter 2 Oregon Profile

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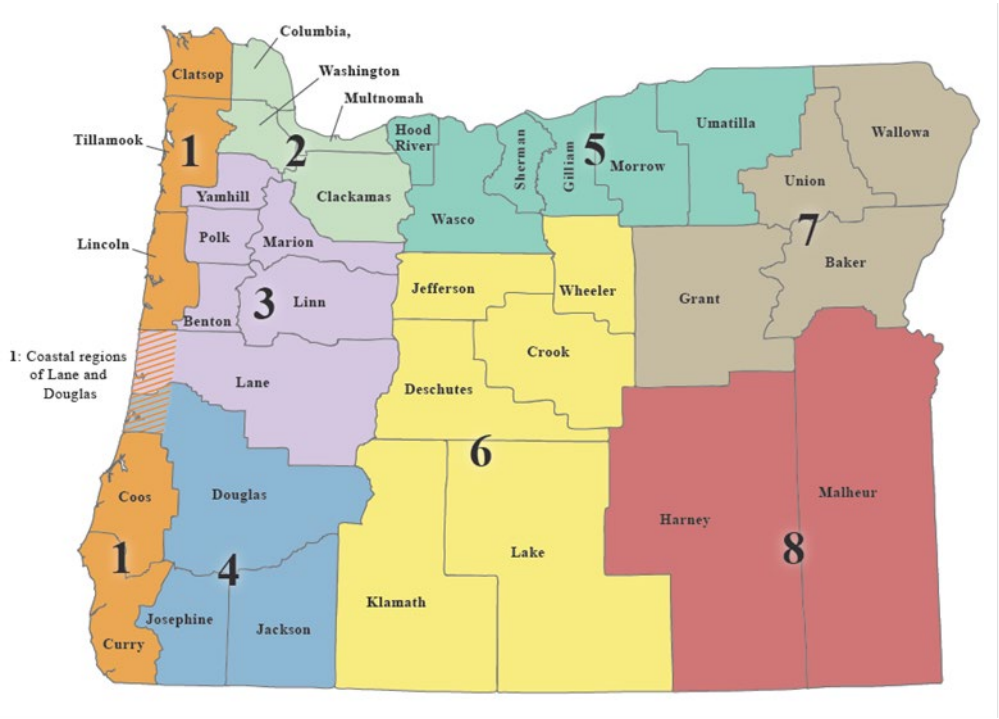
Natural disasters occur when hazards caused by the earth's natural systems intersect with human societies. Therefore, to understand Oregon's risk, it is essential to understand Oregon's physical geography, human geography, built environment, and economy. This helps understand how hazards interact with people, property, infrastructure, economy, environment, and cultural resources, how those interactions with some hazards will change over time, and how vulnerable populations will be affected more acutely. This knowledge will inform mitigation actions that will reduce risks.

The sections below describe portions of these domains at a statewide and regional scale. *Chapter 3: Hazard Identification and Risk Assessment* delves deeper to examine the vulnerability of these domains at a census tract and county scale in greater detail.

2.1 Physical Geography

Oregon has an area of 95,996 square miles. Oregon's physical geography is remarkably diverse due to its large area and volcanic geology. The following sections briefly describe the physical geography of the eight natural hazards mitigation planning regions.

Figure 2.2.1-1 - Oregon NHMP Natural Hazards Regions



Region 1: Oregon Coast

Region 1 is approximately 8,300 square miles in area with the Coast Range mountains, the pacific coast, and numerous rivers and estuaries shaping its topography. Region 1 is bordered to the west by the Pacific Ocean and the Coast Range to the east. The Coast Range's elevations reach over 4,000 feet above sea level in some places. The region extends the entire length of Oregon from Washington State in the North to the California border in the south. This geographic extent means there is a large amount of geological variation along the coast. Major rivers in the region include Siuslaw, Umpqua, Nehalem, Rogue, Yaquina, Siletz, Nestucca, Trask, Wilson, Coos, and Coquille.

Region 2: North Willamette Valley/Portland Metro

Region 2 is approximately 3,700 square miles in area. The Cascade Mountain Range, Coast Mountain Range, Willamette Valley, Columbia and Willamette Rivers, and associated watersheds shape the region's topography. Region 2 is bordered by the Coast Range to the west and the Cascade Mountain Range and the peak of Mt. Hood to the east. The region extends from the Columbia River in the North to the Northern Willamette Valley in the south. Two rivers shape the region's main watersheds, the Columbia River and the

Willamette River. Their confluence is in the Portland area. The region also contains a portion of the Columbia River Gorge, and Mt. Hood National Forest.

Region 3: Mid/Southern Willamette Valley

Region 3 is approximately 9,800 square miles in area. The Cascade Mountain Range, Coast Range, Willamette Valley and associated watersheds shape the region's topography. Region 3 is bordered by the Cascade Mountain Range to the east and the Coast Range to the west. It extends from the Calapooya Mountains in the south to the Portland suburbs in the north. The main watershed in the region is the Willamette River watershed that is fed by other rivers in the east including the Santiam River and the Mckenzie River. A large portion of the Willamette National Forest falls within the eastern portion of the region. The region is an agriculturally vital and productive area for the State.

Region 4: Southwest Oregon

Region 4 is approximately 9,200 square miles in area. The Cascade Mountains, Coast Range, and Siskiyou Mountains, and the Umpqua and Rogue River watersheds shape the region's topography. Region 4 is bordered by the Cascade Mountain Range in the east and the Coast Range in the west. It extends from the Calapooya Divide in the North to the California border in the south. The region is mountainous, with several converging mountain ranges. The Rogue Valley is the largest valley in the region.

Region 5: Mid-Columbia

Region 5 is approximately 10,200 square miles in area. The Columbia River Gorge, the eastern slope of the Cascades, and numerous tributaries to the Columbia River shape the region's topography. Region 5 is bordered by the Cascade Mountain Range in the west and the Umatilla National Forest in the east. The region is bordered by the Columbia River in the north until the river turns north close to Hermiston. The region extends to the Whitman National Forest and the North Fork of the John Day River in the south. The region's major watershed is the Columbia River with all smaller water bodies feeding it including the John Day River and Umatilla River. The region supports crop farming as well as livestock grazing.

Region 6: Central Oregon

Region 6 is approximately 24,000 square miles in size. It is bordered by the Cascade Mountain range to the west, and the California and Nevada borders to the south. Region 6 has a diverse variety of ecological zones and geological features and is shaped by Deschutes, John Day, and Crooked River watersheds to the north and the Klamath River in the south. Large lakes are common in the southern portions of region 6 including Crater Lake and Upper Klamath Lake.

Region 7: Northeast Oregon

Region 7 is approximately 12,800 square miles in area. The region is bordered by the Snake River to the east, Washington to the north and the Umatilla and Whitman National Forests to the north and west. It is characterized by small mountain ranges and canyons and tributaries to the Snake River. The Columbia River Basalt lava flows formed the high plateaus of the region. The Blue Mountains and Wallowa Mountains are in the region. Major rivers in the region include the Grande Ronde and Snake Rivers.

Region 8: Southeast Oregon

Region 8 is approximately 20,200 square miles in area. The region is bordered to the east by Idaho and to the south by Nevada. Steens Mountain and the Harney Basin are prominent geologic features in the region and major rivers in the region include the Malheur and Owyhee.

2.2 Climate

2.2.1 Climate Change

Climate variability and change strongly influence the risk of nine natural hazards covered in the Oregon Natural Hazards Mitigation Plan:

- Coastal Hazards
- High Hazard Potential Dams
- Droughts
- Extreme Heat
- Floods
- Landslides
- Wildfires
- Windstorms
- Winter Storms

Climate change is already affecting Oregon's natural and human systems (Chang et al. 2023, Fleishman 2025). Climate change will increase the frequency, duration, or magnitude of some natural hazards in Oregon, such as extreme heat, droughts, wildfires, floods, landslides, coastal erosion, and coastal flooding. This section presents an overview of climate change as it pertains to climate-related natural hazards in the state.

Oregon tends to have mild, wet winters and warm, dry summers. East of the Cascade Range, winters tend to be colder, summers hotter, and annual precipitation less than west of the Cascade Range due to the rain shadow created by the Cascade Range. Oregon's climate has considerable variability from year to year. That variability is caused in part by changes in the phase and strength of the El Niño–Southern Oscillation, a natural fluctuation of ocean temperature near the equator in the Pacific Ocean that strongly affects global weather patterns and seasonal climate.

Human activities are changing Earth's climate beyond typical levels of natural variability. Oregon's average temperature increased by more than 2°F since 1900. Hot days are becoming hotter and more frequent, and cold days warmer and less frequent. Warmer winters are causing more precipitation to fall as rain and less as snow. Higher temperatures also tend to cause earlier spring snowmelt and peak stream flows, and lower summer stream flows in many rivers. Drier climate, higher temperatures, and expansion of human settlements into wildlands is increasing the number of wildfires and area burned. Sea-level rise is increasing the frequency of coastal flooding and erosion. Each 10°F rise in daily maximum temperature has led to a three-fold increase in heat-related illness in Oregon (Fleishman 2025).

2.2.2 Adapting to Climate Change

In 2010, the State of Oregon produced the Oregon Climate Change Adaptation Framework, which identified 11 climate-related risks for which the state must plan. The state updated the framework in 2021 to add multi-agency strategies to address those risks. Progress towards implementing the framework strategies can be found in Chapter 9 Appendix. The 2025 Oregon NHMP identifies six of those 11 climate risks: drought, extreme heat, coastal erosion, wildfire, flood, and landslides.

In 2007, the Oregon Legislature created the Oregon Climate Change Research Institute (OCCRI) under House Bill 3543. Much of the material in this introduction to climate change comes from the sixth and seventh Oregon Climate Assessments (Fleishman 2023, 2025). All the Oregon climate assessments are available on OCCRI's website at https://blogs.oregonstate.edu/occri/oregon-climate-assessments/.

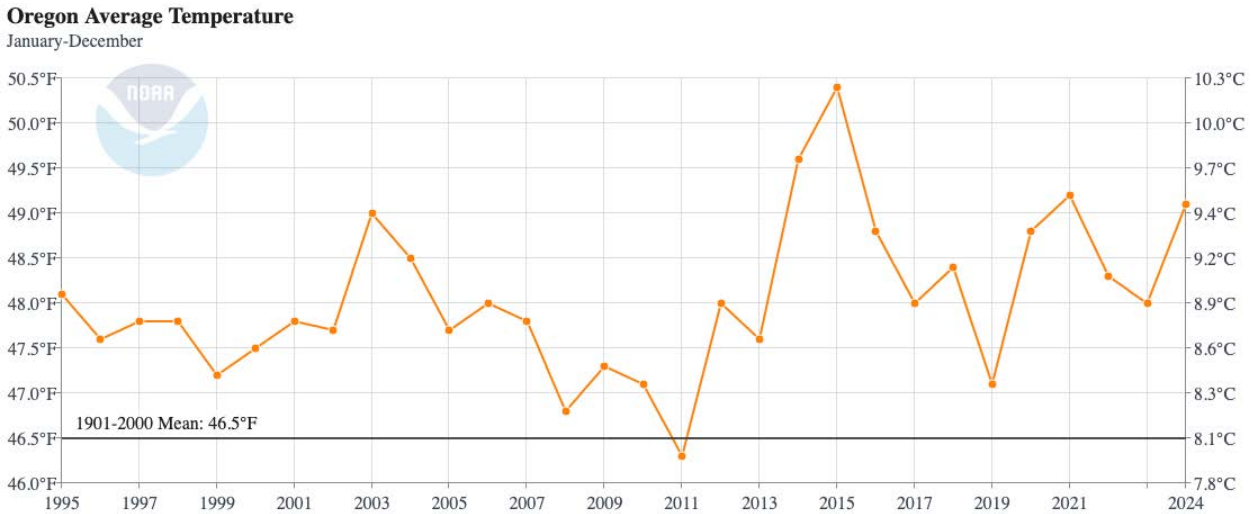
This section does not present a comprehensive assessment of climate change impacts in Oregon or cover all aspects of each hazard. Rather, it presents projections of future temperature, precipitation, and extreme events and describes effects of future conditions on natural hazards in Oregon.

2.2.3 Past and Future Climate in Oregon

2.2.3.1 Historical Climate

The impacts of climate change in Oregon largely result from changes in temperature and precipitation. Oregon's annual average temperature increased by 2.2°F per century from 1895 through 2023 (NCEI 2024). Globally, annual average temperature over the past 30 years (1995–2024) was warmer than the twentieth century average (NCEI 2025). Similarly, from 1995–2024, Oregon's annual average temperature exceeded the twentieth century average except in 2011 (NCEI 2025) (Figure 2.2.3-1).

Figure 2.2.3-1: Annual Average Temperature in Oregon over the Past 30 Years

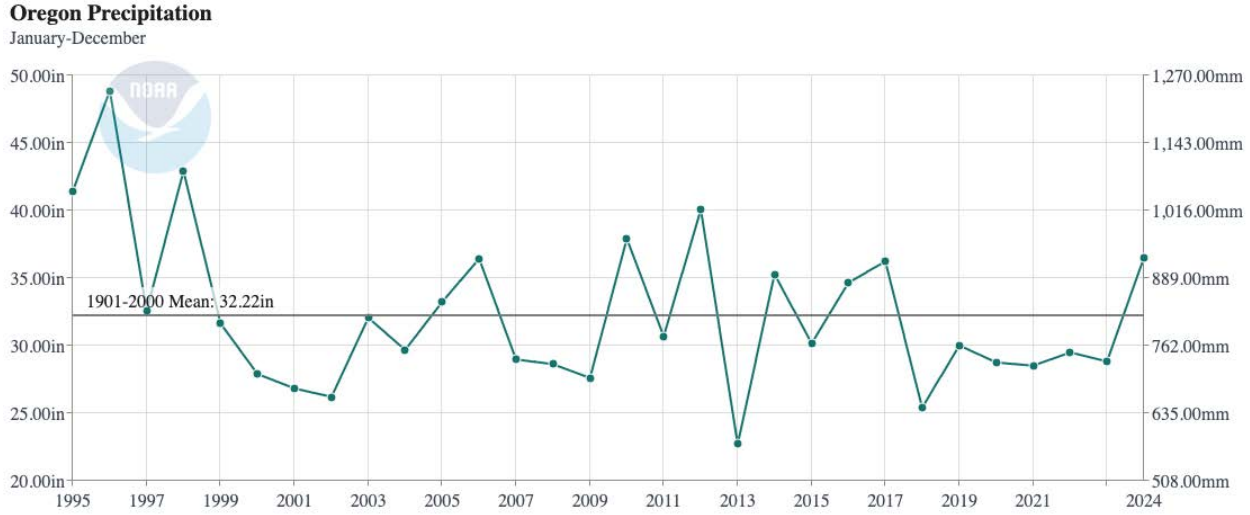


Source: National Centers for Environmental Information.

Oregon's annual precipitation varies considerably among years and has not changed significantly over the observational record. The increase has been about 0.08 inches (0.20 cm) per century from 1895–2023 (NCEI 2024).

In Oregon over the past 30 years precipitation was below the twentieth century average in 18 years and above the average in 12 years.

Figure 2.2.3-2: Annual Statewide Average Precipitation in Oregon over the Past 30 Years



Source: National Centers for Environmental Information.

However, annual precipitation can mask changes in the type, timing, and intensity of precipitation, which have greater impact on social and natural systems than annual totals. For example, statistically significant increases in heavy precipitation have occurred in Oregon (Dalton et al. 2017). Additionally, warmer temperatures are causing more precipitation to fall as rain and less as snow. Annual snowpack is expected to decline by as much as 60 percent by mid-century if emissions continue to rise (Fleishman 2025).

2.2.3.2 Future Climate

Projections of future climate come from computer models of Earth's atmosphere, ocean, and land and their interactions over time and space. Climate models generally refer to both general circulation models (GCMs) and Earth system models (ESMs). GCMs simulate the interactions between the atmosphere and the land and ocean, whereas ESMs also simulate more detailed chemical and biological processes that interact with the physical climate. Global climate models use the fundamental laws of physics and are the most sophisticated tools for understanding the climate. However, they still necessarily simplify the climate system.

Climate modeling institutions worldwide build different global climate models to simulate the future climate with a common set of scenarios of concentrations of greenhouse gases, aerosols, and other external influences on the global climate (climate forcings). The most widely used and most reliable climate projections are based on outputs from downscaled global climate models that were included in the sixth phase of the Climate Model Intercomparison Project (CMIP6; Eyring et al. 2016) and represents the most

current understanding of Earth's climate. The CMIP6 models used three scenarios for the global radiative forcing levels and shared socioeconomic pathways (SSPs) (O'Neill et al. 2016). Radiative forcing is the total amount of energy retained in the atmosphere after absorption of incoming solar radiation, which is affected by the reflectivity of Earth's surface; and emission of outgoing long-wave radiation, which is affected by the concentrations of heat-trapping or greenhouse gases. SSPs are assumptions about future global population, technological, and economic growth by 2100.

Table 2.2.3-1: Carbon dioxide emission scenarios and radiative forcing

Scenario	Assumptions on carbon dioxide emissions	Radiative forcing in watts per square meter (W m-2) by 2100	Social and economic assumptions
SSP 2–4.5	Carbon dioxide emissions plateau and then gradually decline by mid-century	4.5	SSP 2 – Continuation of historical social and economic trends, with moderate challenges to mitigation and adaptation
SSP 3–7.0	Carbon dioxide emissions double by 2100	7.0	SSP 3 – Conflicts among regions and substantial challenges to mitigation and adaptation
SSP 5–8.5	Carbon dioxide emissions double by 2050	8.5	SSP 5 – Dependence on fossil fuels with substantial challenges to mitigation, but minor challenges to adaptation

The radiative forcings reflected in the scenarios are 4.5, 7.0, and 8.5 watts per square meter (W m-2) by 2100. The social and economic assumptions in the scenarios are continuation of historical social and economic trends, with moderate challenges to mitigation and adaptation (SSP2-4.45); conflicts among regions and substantial challenges to mitigation and adaptation (SSP3-7.0); and dependence on fossil fuels with substantial challenges to mitigation, but minor challenges to adaptation (SSP5-8.5) (O'Neill et al. 2016). When paired with radiative forcing levels, the SSPs produce trajectories of greenhouse gas emissions that result in different degrees of warming by 2100. SSP 2–4.5 assumes that carbon dioxide emissions plateau and then gradually decline by mid-century. Under SSP 3–7.0, carbon dioxide emissions double by 2100, and SSP 5–8.5 assumes that carbon dioxide emissions double by 2050.

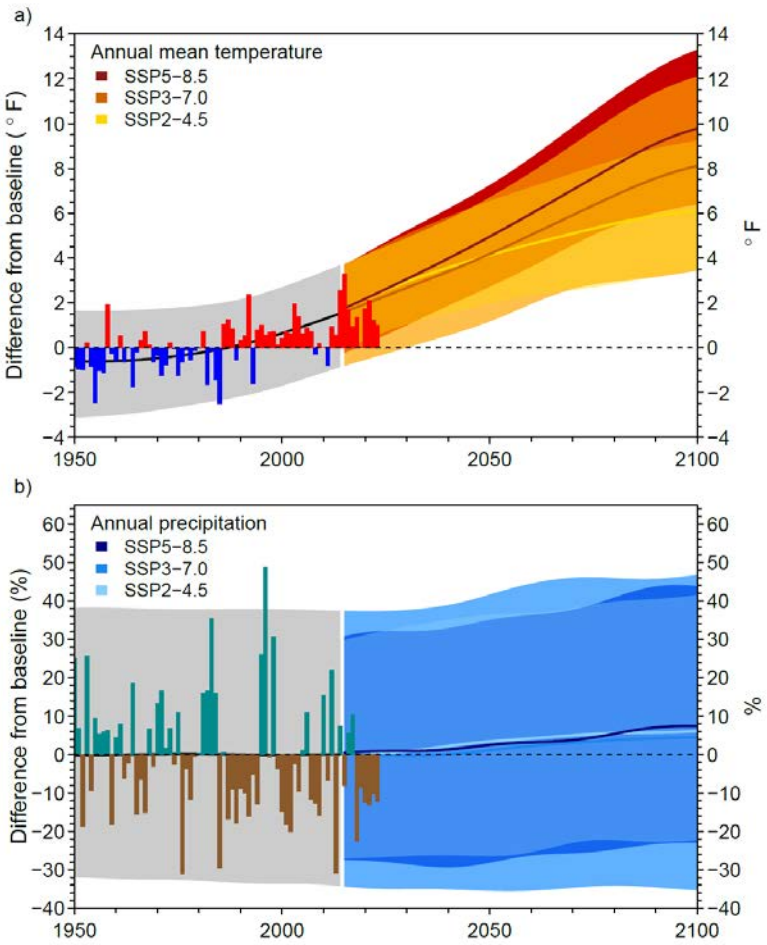
Some climate models are more sensitive than others; they produce greater warming given the same concentration of greenhouse gases. It is best practice to analyze and present an average and range of projections from at least ten global climate models with realistic climate sensitivity that simulate the historical climate well (Mote et al. 2011; Hausfather et al. 2022; Dalton and Bachelet 2023). The equilibrium climate sensitivity is an estimate of the temperature response to carbon dioxide concentrations that have doubled, and remained at that doubled level, after stabilization of temperature over hundreds or thousands of years. The scientific community typically evaluates climate model outputs based on how close they are to the assessed range of climate sensitivity.

Annual

Depending on the scenario, Oregon's annual average temperature is projected to increase by 2.6–3.0°F by 2044, 4.6–5.9°F by 2074, and 5.9–9.1°F by 2100 (Figure 2.2.3-3a). There is no plausible scenario in which Oregon cools in the twenty-first century. At the state level, annual average precipitation is expected to increase by about four to six percent by the late twenty-first century, with wide variability and uncertainty in the projections (Figure 2.2.3-3b).

Colored bars are observed values from the National Centers for Environmental Information. Solid lines are the mean values of simulations from 7–11 downscaled climate models for the years 1950–2100. Shading indicates the range in values from all models. The mean and range were smoothed to emphasize long-term variability.

Figure 2.2.3-3: Observed and projected changes in Oregon's average annual (a) temperature and (b) precipitation relative to 1950–2014 (baseline) under three shared socioeconomic pathways (SSPs).



Source: Fleishman, E., editor. 2025. Seventh Oregon climate assessment. Oregon Climate Change Research Institute, Oregon State University, Corvallis, Oregon. doi: 10.5399/osu/1181.

Seasonal

Projections of annual temperature and precipitation are useful for indicating long-term trends, but projected changes in seasonal averages and extremes generally are more relevant for planning and for addressing some of the hazards addressed in this plan.

Temperatures in Oregon in summer are projected to increase more than those in any other season: 3.4–3.5°F (1.9–2.0°C) by 2044, 5.2–7.0°F (2.9–3.9°C) by 2074, and 6.7–10.9°F (3.8–6.1°C) by 2100 (Table 2.2.3-2). The slightly higher annual and seasonal projections under SSP2–4.5 than SSP3–7.0 for the 2015–2044 period likely reflects that the former were based on a smaller set of climate models and ensemble members.

Values are the average of 18 ensemble members from 8 global climate models (SSP 2–4.5), 52 ensemble members from 11 global climate models (SSP 3–7.0), and 18 ensemble members from 7 global climate models (SSP 5–8.5). Values in parentheses are the 5th to 95th percentile ranges across those models. Winter includes December, January, and February; spring includes March, April, and May; summer includes June, July, and August; and autumn includes September, October, and November.

Table 2.2.3-2: Projected Future Changes in Mean Annual and Seasonal Temperature (°F) in Oregon from the Historical Baseline (1950–2014) to Three Periods of Time under Three Shared Socioeconomic Pathways (SSPs).

	2015–2044			2045–2074			2074–2100		
SSP	**2–4.5**	**3–7.0**	**5–8.5**	**2–4.5**	**3–7.0**	**5–8.5**	**2–4.5**	**3–7.0**	**5–8.5**
Annual	2.9 (2.2, 4.4)	2.6 (1.5, 3.5)	3.0 (2.0, 4.5)	4.6 (3.2, 6.6)	5.0 (3.6, 6.4)	5.9 (4.3, 7.7)	5.9 (3.8, 8.6)	7.6 (5.6, 9.8)	9.1 (6.3, 11.9)
Winter	2.7 (1.4, 3.6)	2.3 (0.7, 3.5)	2.9 (1.7, 4.7)	4.5 (3,0, 7.3)	4.5 (2.5, 6.5)	5.6 (3.7, 8.6)	6.0 (3.8, 8.5)	6.7 (4.1, 9.2)	8.5 (6.8, 11.4)
Spring	2.5 (1.5, 4.6)	2.1 (1.3, 2.9)	2.5 (1.3, 4.0)	3.8 (2.0, 5.9)	4 (2.6, 5.5)	4.9 (3.4, 6.9)	4.9 (3.1, 6.9)	6.0 (4.1, 8)	7.3 (5.6, 9.6)
Summer	3.4 (2.4, 4.8)	3.4 (2.1, 4.7)	3.5 (2.3, 5.1)	5.2 (3.5, 7.5)	6.2 (4.4, 8.4)	7.0 (4.6, 9.9)	6.7 (3.9, 10.1)	9.6 (6.5, 12.8)	10.9 (6.8, 15.7)
Autumn	3.0 (1.9, 4.8)	2.7 (1.4, 3.7)	3.2 (1.8, 5.0)	4.9 (3.1, 7.1)	5.2 (3.7, 6.9)	6.2 (4.5, 8.2)	6.0 (3.7, 8.8)	8.0 (6.1, 10.8)	9.6 (6.0, 13.0)

Source: Fleishman, E., editor. 2025. Seventh Oregon climate assessment. Oregon Climate Change Research Institute, Oregon State University, Corvallis, Oregon. doi: 10.5399/osu/1181.

Regardless of SSP and time period, average statewide summer precipitation is projected to decrease (Table 2.2.3-3).

Values are the average of 18 ensemble members from 8 global climate models (SSP 2–4.5), 52 ensemble members from 11 global climate models (SSP 3–7.0) and 18 ensemble members from 7 global climate models (SSP 5–8.5). Values in parentheses are the 5th to 95th percentile range across those models. Winter includes December, January, and February; spring includes March, April, and May; summer includes June, July, and August; and autumn includes September, October, and November.

Table 2.2.3-3: Projected Future Changes in Total Annual and Seasonal Precipitation (Percentages) in Oregon from the Historical Baseline (1950–2014) to Three Periods of Time under Three Shared Socioeconomic Pathways (SSPs).

	2015–2044			2045–2074			2074–2100		
SSP	**2–4.5**	**3–7.0**	**5–8.5**	**2–4.5**	**3–7.0**	**5–8.5**	**2–4.5**	**3–7.0**	**5–8.5**
Annual	0.9 (-3.3, 6.2)	-0.5 (-6.9, 5.6)	0.6 (-6.4, 5.9)	3.9 (-4.4, 15.1)	2.3 (-3.4, 7.6)	3.6 (-4.7, 11.3)	6.2 (1.1, 13.6)	4.3 (-3.1, 12.5)	6.6 (-1.1, 16.4)
Winter	4.1 (-5.7, 13.1)	2.5 (-8.7, 13.5)	3.2 (-11.4, 16)	8.2 (-1.6, 28.2)	7.1 (-3.1, 22.1)	8.8 (-9.3, 25)	10 (-3.4, 21.5)	9.5 (-1.4, 25)	12.7 (-3.7, 35.5)
Spring	1.2 (-5.8, 8.7)	-0.5 (-10.3, 9)	1.8 (-7.6, 8.1)	3.3 (-7.6, 9.7)	1.1 (-6.2, 9.1)	3.0 (-4.9, 17.3)	5.6 (-10.8, 25.6)	2.6 (-8.9, 13.8)	4.0 (-12.8, 18.1)
Summer	-6.2 (-18.8, 3.2)	-8.5 (-22.9, 7)	-8.1 (-25.3, 11)	-5.8 (-19.5, 3.2)	-8.9 (-34.3, 8.8)	-6.8 (-21.8, 10.2)	-3.9 (-26.4, 17.6)	-6.6 (-41.5, 33.9)	-9.2 (-27.1, 23.7)
Autumn	-2.2 (-12.3, 8.0)	-2.7 (-12.3, 7.9)	-1.9 (-12.1, 14.4)	0.9 (-15.7, 12.6)	-0.7 (-13.9, 15.5)	-1.0 (-16.3, 18.7)	4.2 (-13.7, 26.9)	1.2 (-14.3, 25.3)	4.5 (-14.2, 26.3)

Source: Fleishman, E., editor. 2025. Seventh Oregon climate assessment. Oregon Climate Change Research Institute, Oregon State University, Corvallis, Oregon. doi: 10.5399/osu/1181.

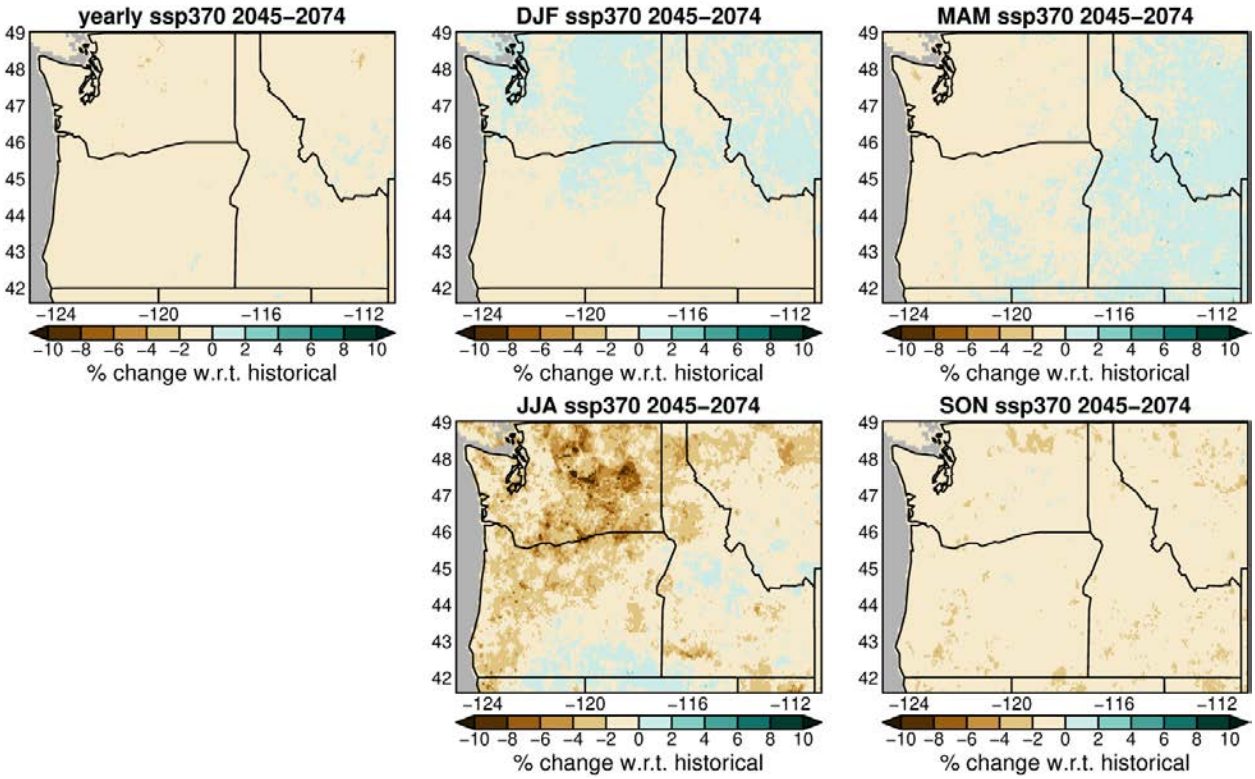
Extremes

Natural hazards are often an expression of extreme conditions. Examples include windstorms, heavy precipitation, floods, droughts, and heat waves.

Precipitation

Extreme precipitation is one of the most common and widespread natural hazards in Oregon. Extreme precipitation events west of the Cascade Range are generally associated with atmospheric rivers—long, narrow swaths of warm, moist air that carry large amounts of water vapor from the tropics to mid-latitudes. Closed low pressure systems often lead to isolated precipitation extremes east of the Cascade Range (Parker & Abatzoglou, 2016). From 1950–2014, precipitation (≥0.5 mm / day) fell on over 65 percent of winter days in the coastal Pacific Northwest and Cascade Range. Over much of Oregon, especially east of the Cascade Range and in the Columbia Plateau, less than 15 percent of summer days were wet. By the middle of the twenty-first century (2045–2074) under an intermediate emissions scenario, the annual average projected increase in precipitation over the Pacific Northwest is about 7.3%. Projections suggest a 0–6 percent decrease in the proportion of wet days in summer, and negligible changes during other seasons (Figure 2.2.3-4). Projected decreases in summer precipitation and the proportion of wet days during summer roughly coincide. These changes, and the fact that the projected reduction in precipitation is stronger than that of proportion of wet days, suggest that reductions in mean summer precipitation are not solely a result of fewer wet days.

Figure 2.2.3-4: Annual and projected average change in the proportion of wet days between 1950–2014 and 2045–2074 given shared socioeconomic pathway (SSP) 3–7.0. DJF, December, January, February; MAM, March, April, May; JJA, June, July, August; SON, September, October, November.

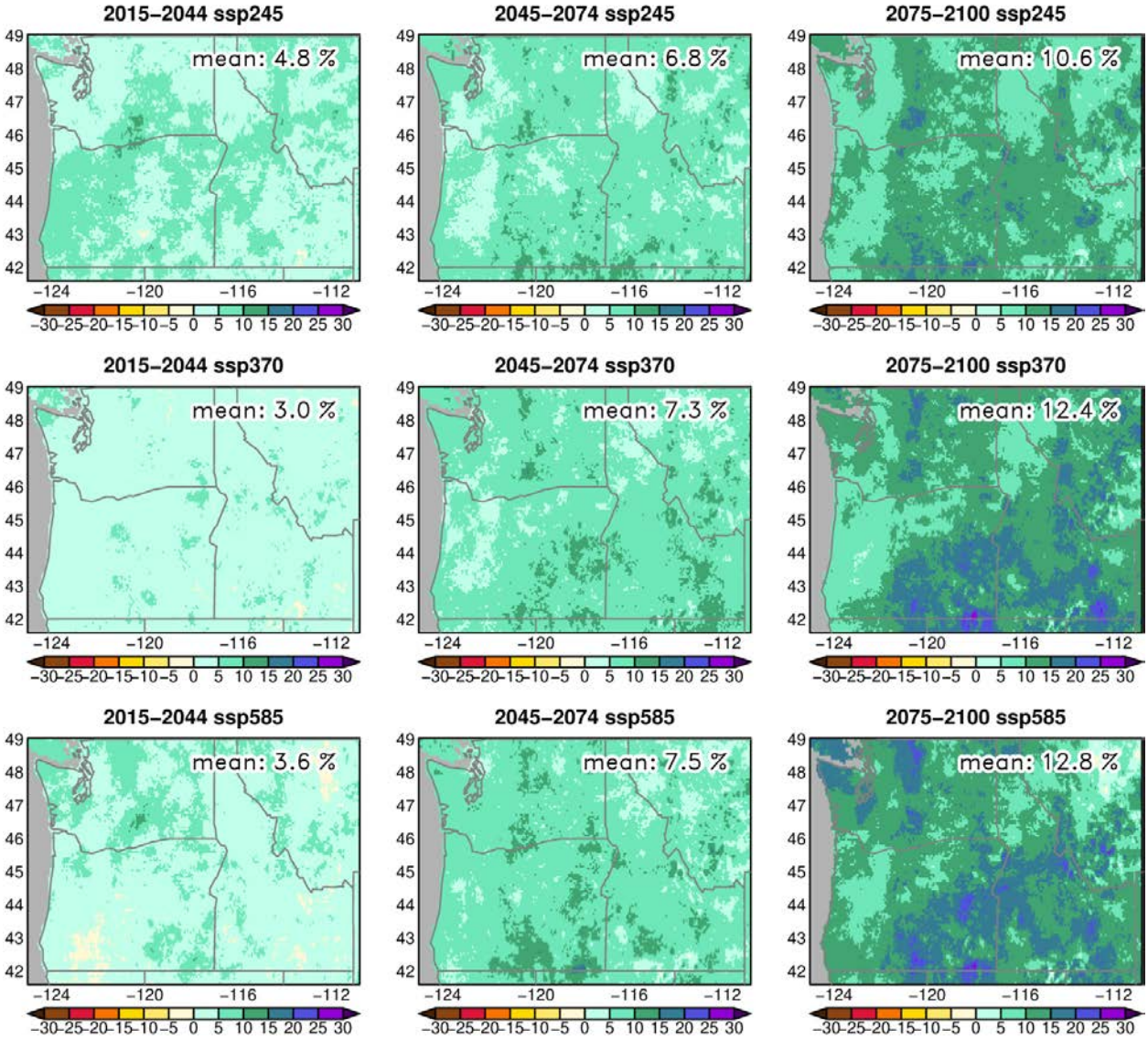


Source: Pierce, D.W., and D.A. Cayan. 2025. Projected changes in Oregon precipitation. Pages 54-78 in E. Fleishman, editor. Seventh Oregon climate assessment. Oregon Climate Change Research Institute, Oregon State University, Corvallis, Oregon. doi: 10.5399/osu/1181.

As the atmosphere warms, it holds more water vapor that can precipitate onto Earth (Westra et al. 2014, Kroner et al. 2017, Norris et al. 2019, Harp and Norton 2022). As a result, the intensity of extreme precipitation events is expected to increase. In addition, regional climate modeling results suggest that the rain shadow effect in winter may weaken, leading to relatively larger increases in seasonal precipitation and extreme wet day precipitation east of the Cascade Range and smaller increases west of the Cascade Range (Fleishman 2025).

There are multiple ways to define extreme precipitation, for example, days on which precipitation totals exceed the 95th, 99th, or 99.9th percentiles. At the 99th percentile, by the mid-twenty -first century (2025–2074) and beyond, regardless of emissions scenario, all projected changes across the Pacific Northwest are increases, and the magnitude of the increase becomes larger over time (Figure 2.2.3-5). In Oregon, these changes are greatest in winter, particularly in southeastern Oregon. In western Oregon and the Willamette Valley, the largest projected increases in extreme daily precipitation occur in autumn, with values approaching 10 percent for the 99th percentile and 20 percent for the 99.9th percentile by mid-century.

Figure 2.2.3-5: Average percentage change in precipitation at the 99th percentile of wet days between the historical period (1950–2014) and three periods during the twenty-first century (columns) given three shared socioeconomic pathways (SSPs) (rows). Means over the geographic domain are in the upper right of each panel.



Source: Pierce, D.W., and D.A. Cayan. 2025. Projected changes in Oregon precipitation. Pages 54-78 in E. Fleishman, editor. Seventh Oregon climate assessment. Oregon Climate Change Research Institute, Oregon State University, Corvallis, Oregon. doi: 10.5399/osu/1181.

Extreme Heat

Extreme heat first was included as a natural hazard in the 2020 Oregon NHMP. The inclusion reflected the recognition that as the climate continues to warm, extreme heat poses greater threats to public health and infrastructure. There is no single definition of a heat wave, but heat waves usually are defined with respect to both the relative magnitude of temperature anomalies

(e.g., temperatures above the 99th percentile for a given location and season) and the duration of those anomalies (e.g., at least three consecutive days). By this definition, a prolonged period with temperatures exceeding 100°F would not be considered a heat wave if it occurred in Phoenix, Arizona, in July, but would be considered a heat wave if it occurred in Portland, Oregon, in July or in Phoenix in March. Heat waves can occur during any season, although the term "heat wave" is generally reserved for prolonged stretches of extreme heat that pose a substantial health and safety risk. Temperatures in Oregon are most likely to be dangerously high during summer (June–September). Although extremely warm daytime highs often generate the most press coverage and public interest, extremely warm overnight lows often are a greater threat to human health, especially where access to air conditioning is limited (Gershunov et al. 2011).

Extreme warm temperatures are often defined based on absolute thresholds. A common definition of an extremely warm day in the Pacific Northwest is a day on which the maximum temperature is 90°F or above. By this definition, the number of extremely warm days increased significantly across Oregon since 1951.

It is unclear whether extreme heat in the Pacific Northwest is increasing at a faster rate than mean temperature. For example, soil moisture during summer is likely to decrease as summer precipitation decreases, increasing the potential for heat extremes (Rupp et al. 2017, Zhang et al. 2023). However, because soil moisture in the region during summer already is low and the absolute projected decrease in precipitation is small, any effect on temperature also is likely to be small (Rupp et al. 2017, Bercos-Hickey et al. 2022). Climate change also may cause changes in atmospheric circulation patterns that can increase the frequency, intensity, or duration of high-pressure anomalies conducive to heat waves (e.g., Horton et al. 2015, Zhang et al. 2023). In contrast, some models indicated a weakening of strong easterly summer winds since 1970, effectively reducing offshore flow and downslope warming on leeward (in this case, west side) mountain slopes (Mass et al. 2022).

Regardless, climate change will continue to affect extreme heat events in two ways. First, the intensity of extreme heat events will increase further. Second, humans' perception of extreme heat will change as the frequency of events currently considered to be extreme increases. For example, temperatures that historically occurred on 0.5 percent of days are projected to become more than twice as common. In Portland during the twentieth century, 100°F temperatures occurred about once every 10 years. By 2025, they are likely to occur about once every 2 years.

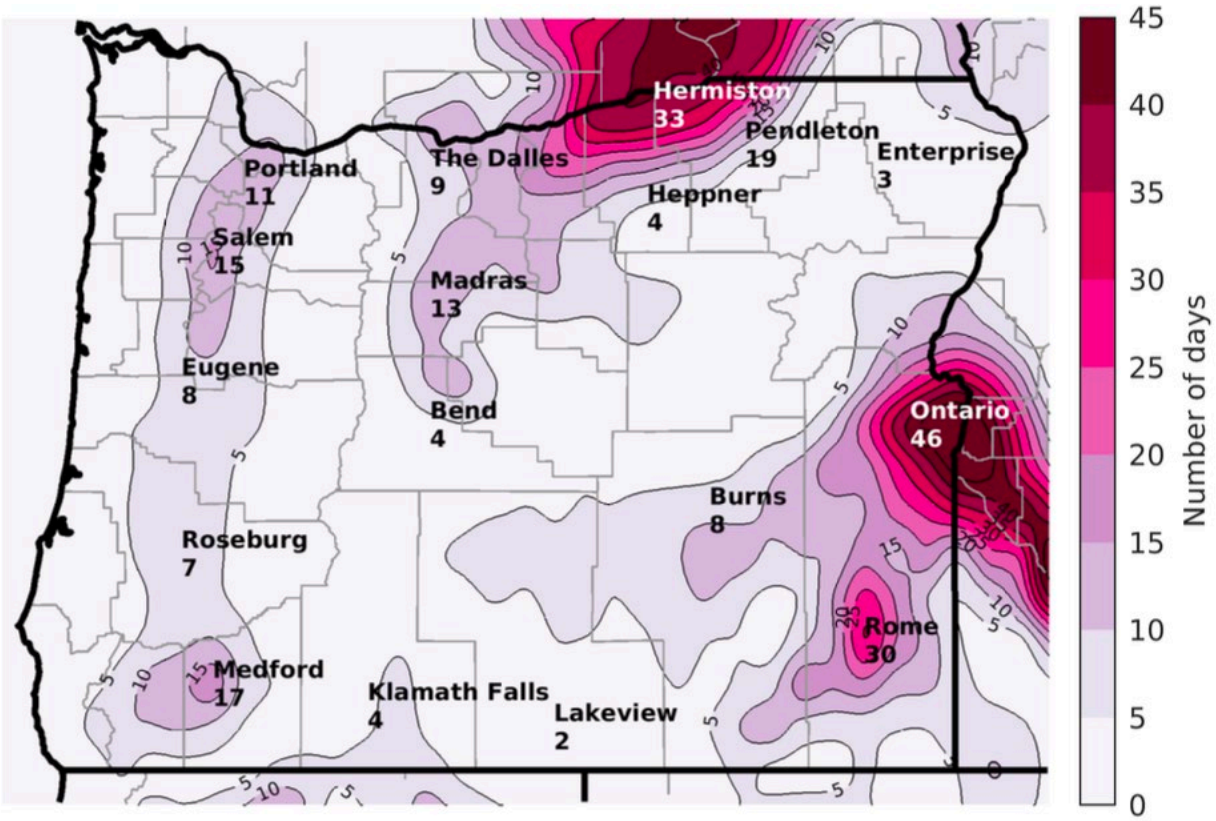
As air becomes more humid, the human body is less able to cool through the evaporation of perspiration. Therefore, the incidence of heat illness is not necessarily directly correlated with air temperature. The heat index, also known as the apparent temperature, is what the temperature feels like to the human body when relative humidity is combined with air temperature. The heat index describes human health impacts better than air temperature and is now the primary metric Oregon uses for regulating heat in work environments.

When relative humidity is low, the heat index is roughly the same as, or slightly cooler than, the air temperature. As relative humidity increases, the heat index becomes higher than the air temperature, and the difference between the heat index and the air temperature increases. For example, when the air temperature is 90°F, the heat index will be 88°F if the relative humidity is 30 percent, but 100°F if the relative humidity is 60 percent. Historically, heat waves across Oregon rarely were humid (Rastogi et al. 2020). Because high heat and low relative humidity tend to co-

occur in Oregon, the heat index is generally a few degrees lower than the actual air temperature. As a result, approximating the heat index with only air temperature would significantly overestimate the number of high heat-index days in Oregon.

The occurrence of high heat-index days varies considerably across Oregon (Figure 2.2.3-6). In western Oregon from 1991–2020, the greatest number of days per year with a heat index above 90°F occurred in the Willamette Valley and Rogue Valley, ranging from an average of 17 days in Medford to 7 days in Roseburg. In much of Oregon east of the Cascade Range, the heat index exceeded 90°F on fewer than 10 days per year. However, the heat index exceeded 90°F in Ontario and Rome (Malheur County) on an average of 46 and 30 days per year, respectively. In northeastern Oregon, the heat index exceeded 90°F in Hermiston and Pendleton on an average of 33 and 19 days per year, respectively. Since 2011, the average number of hours during which most Oregonians were exposed to heat indexes above either 80°F or 90°F increased relative to 1981–2010. In Portland, for example, the average number of exposure hours in 2021 and 2022 was more than three times greater than from 2011–2020.

Figure 2.2.3-6: Average annual number of days from 1991–2020 on which the heat index was 90°F or above. Heat indexes derived from ERA5 atmospheric reanalysis data.



Source: O'Neill, L., N. Siler, P. Loikith, and A. Arends. 2023. Extreme temperatures. Pages 40-51 in E. Fleishman, editor. Sixth Oregon climate assessment. Oregon Climate Change Research Institute, Oregon State University, Corvallis, Oregon. doi: 10.5399/osu/1161.

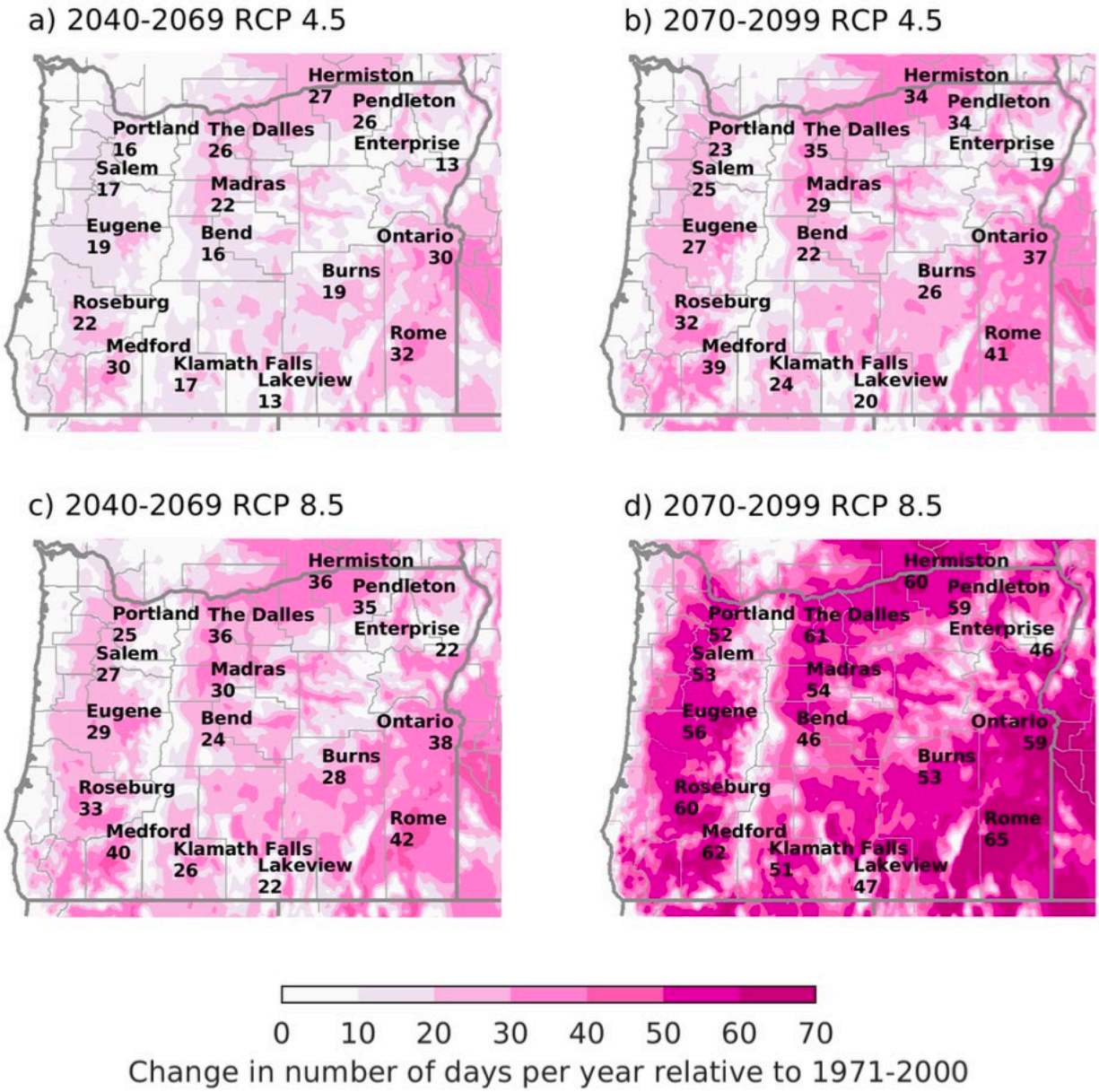
Climate change is projected to alter both temperature and relative humidity, and thus the heat index. Climate models project little change in relative humidity in Oregon, with a decrease of only a few percent in eastern Oregon during summer by the end of the century. Warming over extensive

areas is the primary driver of projected future changes in extreme heat index values in the Pacific Northwest (Schoof et al. 2019).

Because the heat index has a nonlinear relation to relative humidity, the projected trends in the heat index are not necessarily constrained to follow those in air temperature. The number of days on which the heat index exceeds 90°F is projected to increase throughout Oregon except at high elevations and on the west side of the Coast Range (Figure 2.2.3-7).

Values are means of 18 downscaled models from the fifth phase of the Coupled Model Intercomparison Project (CMIP5) (Dahl et al. 2019). Note: these figures illustrate change in heat days over a longer time period than the analysis and illustration in the NHMP Extreme Heat chapter.

Figure 2.2.3-7: Increase in the Projected Number of Days per Year with a Heat Index of 90°F or Above Relative to 1971–2000.



Data source: O'Neill, L., N. Siler, P. Loikith, and A. Arends. 2023. Extreme temperatures. Pages 40-51 in E. Fleishman, editor. Sixth Oregon climate assessment. Oregon Climate Change Research Institute, Oregon State University, Corvallis, Oregon. doi: 10.5399/osu/1161.

Across the majority of Oregon by the mid-twenty-first century, the mean annual number of days with a heat index above 90°F is projected to increase by 15–30 days assuming moderate increases in emissions of greenhouse gases and 25–40 days assuming higher increases in emissions.

In the Willamette Valley, for example, the annual number of days with an extreme heat index will be double or triple that from 1991–2020. The greatest increases in the number of extreme heat

index days by the late twenty-first century, 20–40 days assuming RCP 4.5 and 45–65 days assuming RCP 8.5, will occur near Hermiston, Rome, and Ontario. The number of days with an extreme heat index in these areas is already among the highest in Oregon. In some parts of eastern Oregon given a high-emissions scenario, the heat index is projected to exceed 90°F on most summer days. In large part, these exceedances reflect projected increases in warming in eastern Oregon, which are greater than those in western Oregon, throughout the twenty-first century.

2.2.4 Effect of Oregon's Future Climate Conditions on Natural Hazards

In 2010, Oregon achieved a significant milestone with the publication of two documents that addressed climate change across the state. OCCRI released the first Oregon Climate Assessment (Dello & Mote, 2010), a comprehensive scientific assessment of climate change and its effects on natural and human systems in the state. The state released the Oregon Climate Change Adaptation Framework, which represented the initial efforts of over a dozen state agencies and institutes, including OCCRI, to establish a rigorous means of addressing the effects of climate change across the state.

OCCRI has since produced six biennial assessments (2013, 2017, 2019, 2021, 2023, 2025) (https://blogs.oregonstate.edu/occri/oregon-climate-assessments/). The second Oregon Climate Assessment (Dalton, M.M., P.W. Mote, and A.K. Snover, 2013) first introduced climate change information in the 2015 Oregon NHMP. The third and fourth Oregon Climate Assessments (Dalton, Dello, Hawkins, Mote, & Rupp, 2017) (Mote, Abatzoglou, Dello, Hegewisch, & Rupp, 2019) contributed to updates of the climate change information in the 2020 Oregon NHMP.

Development of Oregon's 2010 Climate Change Adaptation Framework was significant in that the state began to address the need to plan for the effects of future climate conditions. Furthermore, Oregon's 2010 Framework was the first state-level adaptation strategy based on climate risks as opposed to affected sectors. Oregon's 2010 Framework laid out 11 climate risks that are of concern to the state. The risks provided a consistent basis for agencies and communities to review plans and decisions to identify measures to reduce those risks. Many of the risks in the 2010 Oregon Framework are natural hazards. DLCD revised the 2010 Climate Change Framework in 2021 to include interagency strategies to respond to climate risks. Governor Brown adopted the revised Framework and the State IHMT appended it to the Oregon NHMP in 2021. The state's Climate Change Adaptation Framework Implementation Team is updating the 2020 Framework and the 2025 Oregon NHMP concurrently.

A summary of the principal effects of climate change on the natural hazards addressed in the 2025 Oregon NHMP, and their effects on different Oregon Natural Hazard Mitigation Planning Regions where relevant, follows. DLCD has renamed the 2010 Framework's "climate risks" as "climate drivers of change" for clarity in Table 2.2.4-1 and the following discussion.

Table 2.2.4-1: Relationship Between Climate Change Adaptation Framework Climate Drivers of Change and Hazards in the Oregon NHMP

	Oregon NHMP Hazards						
Climate Change Adaptation Framework Climate Drivers of Change	Coastal Hazards	Droughts	Extreme Heat	Wildfire	Floods	Landslides	Winter Storms
Increased temperatures*	X	X	X	X	X	X	X
Changes in hydrology*	X	X			X	X	X
Increased wildfires		X		X	X	X	
Increase in ocean temperatures and changes in ocean chemistry	X				X		X
Increased drought		X		X			
Increased coastal erosion	X					X	
Changes in habitat	X						
Increase in invasive species and pests		X		X			
Loss of wetland ecosystems and services					X		
Increased frequency of extreme precipitation events and flooding	X				X	X	X
Increased landslides						X	

*Primary climate drivers of natural hazards

Source: DLCD

2.2.4.1 Coastal Hazards

Regions affected: 1

Sea level rise plays a key role in increased incidence of coastal erosion and flooding. The Oregon coast is within Cascadia, which is defined by the subduction of the Juan de Fuca Plate under the North American Plate. Tectonics has a substantial effect on the region's exposure to chronic coastal hazards through its influence on geomorphology and rates of relative sea-level rise (Burgette et al. 2009, Komar et al. 2011). Primarily due to tectonic uplift, relative sea-level rise rates are slower in Oregon than in many other coastal regions of the United States. In some areas of the Oregon coast, tectonic uplift has kept pace with increases in sea level. However, relative sea-level rise rates along much of the Oregon coast are at least 1 mm per year less than the current global average (~3.4 mm [0.13 in] per year; Sweet et al. 2022).

In 2022, the National Oceanic and Atmospheric Administration (NOAA) released regional sea-level rise scenarios for the United States coastline from 2000–2150 that incorporate the best estimates of uplift. By 2050, the expected rise in sea level will cause total water levels to increase and change coastal flood regimes throughout the United States, with major and moderate high-tide flood events occurring as frequently as moderate and minor high-tide flood events occur today.

Substantial uncertainties hamper quantification of how climate change will affect storminess patterns. Historically, for example, major coastal flooding and erosion along the Oregon coast was more likely during El Niño years (e.g., Barnard et al. 2015). Due to anomalies in physical processes, such as elevated water levels and higher wave energy from the southwest, local erosion along the west coast of the United States tends to be high during strong El Niño events. Coastal flooding and erosion deplete sand from beaches and make them more susceptible to elevated water levels and enhanced wave energy during future storms.

Higher precipitation rates during El Niño events can increase runoff and compound flooding hazards by elevating the local sea surface.

Relative sea-level rise narrows the gap in elevations between commonly occurring high tides and the thresholds above which coastal flooding and erosion begin. Therefore, increases in extreme coastal water levels along the Oregon coast increase coastal erosion and coastal flooding impacts. A multi-decadal, statewide analysis identified both a general increase in shoreline erosion along the Oregon coast in recent decades and significant spatial variation within and among littoral cells (coastal compartments within which sediment movement is self-contained) (Light 2021). Shoreline change was statistically significant in 17 of the 18 primary littoral cells along the Oregon coast from 2002–2016. The average statewide rate of change from 2002–2016 was -2.3 ft per year. The highest average erosion rates tended to be in southern Oregon.

Taherkhani et al. (2020) used data from tide gauge stations and projections of future sea-level rise (Kopp et al. 2014) to investigate continuous shifts in flooding along coastlines in the United States. They found that approximately 2.8 in of sea-level rise along the Oregon coast doubles the odds that annual flood levels will exceed the 50-year event threshold (a level with a 2 percent chance of occurring in a given year). The odds of this magnitude of flooding double approximately every 6 years until 2075.

Increases in water levels due to sea-level rise and possible changes in patterns of storminess will increase the frequency and magnitude of coastal erosion and flooding. The U.S. Army Corps of Engineers used Climate Central's (2021) Surging Seas Risk Finder to estimate the potential effects of 1 and 2 feet of sea-level rise on populations, land, property, and infrastructure within the United States (USACE 2022). On the Oregon coast, approximately 781 homes and 1318 people are within the area that would be inundated by 1 foot of sea-level rise (USACE 2022). An estimated 18 percent of those individuals have high social vulnerability as estimated based on 29 variables related to wealth, racial and social status, ethnicity, age, health insurance, special needs, ethnicity, employment, and gender. An additional 307 homes and 627 individuals, 157 of them with high social vulnerability, are located within the area that would be inundated by 2 feet of sea-level rise.

Many residents in coastal cities may need evacuation assistance during a flood. Sea-level rise on the Oregon coast also may lead to changes in navigation channels (e.g., leading to an increase in dredging and adjustment of channel location and dimensions), increased scouring at structure foundations, and decreased clearance under bridges and port infrastructure (USACE 2022). U.S. Highway 101 and other major transportation routes and facilities along the Oregon coastline will become increasingly susceptible to erosion, flooding, and landslides as climate changes.

Public access is one of the coastal resources most at risk from accelerating sea level rise. Rising seas may dramatically impact beaches, accessways, and recreational amenities (e.g., parking lots, bathrooms, signs). Public access to the coast is important to the economic viability, quality of life, and health and well-being of members of the community, including low-income and underserved populations. By providing low-cost outdoor recreational opportunities through public access to Oregon's beaches and estuaries, communities can improve their overall economic and health outcomes. Where development already exists, and particularly where there is substantial shoreline armoring to protect this development, Oregon may lose significant recreational beach areas. Additional shoreline armoring and riprap can decrease access to public sandy recreational beaches, remove or impact public access locations to the water, diminish the ability to include accessibility features at public access sites, hinder lateral beach access, require increased costs and maintenance of public access amenities, and contribute to a general loss of public access locations. These places that are at increased risk provide economic, health, and environmental benefits for everyone. The

potential loss of beach and shoreline recreation areas represents a significant potential impact to an important and treasured resource.

The Oregon Coastal Program produced a Sea Level Risk Planning Guide for Coastal Oregon in 2022 to assist communities with addressing the consequences of sea level rise. (SLR_Planning_Guide_V1.pdf)

2.2.4.2 Extreme Heat

Regions affected: 1-8

The frequency, duration, and magnitude of extreme heat is projected to increase in all eight NHMP planning regions. By mid-century (2045–2054), the projected mean number of days with maximum temperatures above the 90th percentile for the region from 1981–2010 ranges from 34.7 (region 1) to 46.5 (region 8), and the mean number of days above 90˚F from 1 (region 1) to 53.3 (region 8).

Certain populations are considered at particularly high risk of heat-related illness and death. Extreme heat also exacerbates interpersonal violence (Miles-Novelo and Anderson, 2019; Stechemesser et al., 2022). Vulnerable populations include outdoor workers in agriculture, forestry, and other sectors; residents of urban heat islands; people with preexisting conditions or without housing or air conditioning; pregnant people; older adults; children; low-income communities; and communities of color (York et al., 2020; Ho et al., 2021). Extreme heat events can disrupt transportation, leading railroad track to bend or roadway joints to buckle (Jacobs, et al., 2018). In addition, heat waves can increase the demands on electric power for cooling, increasing the risk of cascading failures within the electric power network (Clarke, et al., 2018).

2.2.4.3 Droughts

Regions affected: 1-8

There are many conceptual and quantitative definitions of drought (Wilhite and Glantz 1985, Rasmussen et al. 1993), some of which are objective and some of which are subjective. The simplest definition of drought is insufficient water to meet demand (Redmond 2002, Swann 2018). However, the precise definition of drought depends on the location and context. Meteorological drought traditionally has been defined just by lack of precipitation but is better defined as evaporative demand that exceeds precipitation over a prolonged period. Hydrological drought occurs when extended periods of meteorological drought affect surface water supply or soil moisture and is most consequential for society when water supply does not meet human demand. Meteorological and hydrological drought are driven by physical factors and do not describe impacts on humans or ecosystems. Several other types of drought are defined based on their effects on particular components of human and natural systems. For example, agricultural drought occurs when lack of surface or subsurface water supply adversely affects agricultural production.

Another noteworthy type of drought is flash drought. Flash droughts, which occasionally occur throughout Oregon (Pendergrass et al. 2020, Otkin et al. 2022), are characterized by rapid-onset periods of elevated surface temperatures, low relative humidities, precipitation deficits, and rapid declines in soil moisture. These conditions often occur in Oregon during heat waves in late spring and summer, and the adverse impacts of flash drought can emerge in as little as a week (Mo and Lettenmaier 2015, Rupp et al. 2017).

Regional climate model simulations indicate that precipitation will likely increase across much of Oregon during the twenty-first century, particularly east of the Cascade Range. Projected changes in precipitation in western Oregon are more uncertain. In contrast, potential evapotranspiration is projected to increase across the state. Although many plants are expected to transpire less water as carbon dioxide (CO_2) concentrations increase over the next century (Swann et al. 2016, Yang et al. 2019), that increase in water-use efficiency only partially will offset he increase in atmospheric dryness due to warmer temperatures. Climate models suggest that drought risk likely will increase over the twenty-first century on the western slopes of the Cascade Range and the southern Coast Range, decrease in the Deschutes and John Day basins in north-central Oregon, and change little elsewhere. However, due to a shift in the seasonal distribution of precipitation, drought risk during summer is likely to increase statewide.

2.2.4.4 Wildfires

Regions affected: 1-8

Contemporary wildfire risk is affected by interactions among plant physiology, climate, and human activities. High temperatures are a major contributor to desiccation of dead vegetation, whereas dry air reduces moisture in live vegetation. The drier the air, the more plants transpire and lose water. Dry dead or living vegetation is more likely to burn than wet vegetation. Extreme wildfires are more likely to occur when vegetation is dry and weather conditions conducive to fire, including high temperatures, aridity, and wind speeds (Reilly *et al.*, 2022), coincide. Coincidence among these extremes is becoming more common (Abatzoglou *et al.*, 2021a). Such wildfires can cause widespread loss of structures and the loss of human lives (Abatzoglou *et al.*, 2021b).

Historically, wildfires were less active overnight, and the probability of fire expansion generally was evaluated based on daytime conditions. However, across the western United States, the number of nights during which atmospheric conditions are conducive to burning has increased by 45 percent since 1979 (Balch et al., 2022). The intensity and duration of wildfires is expected to increase as nights continue to become hotter and drier (Chiodi et al., 2021; Balch et al., 2022).

Human activities have modified fire dynamics in the western United States through fragmentation and exploitation of these ecosystems, increased recreational activity, and the introduction of highly flammable, non-native annual grasses. Over 80 percent of ignitions in the United States are now human-caused (Balch et al., 2017). Projections that include concurrent increases in aridity, temperature, and intensification of land use indicate that area burned and the frequency of wildfires will continue to increase in the Pacific Northwest, and wildfire intensity will increase (Sheehan et al., 2015; Dalton et al., 2017; Mote et al., 2019; Dalton and Fleishman, 2021; Rupp and Holz, 2023).

The duration of the fire weather season in forests of the Northwest increased by 43 percent from 1979 through 2019 (Jones *et al.*, 2022). Similarly, the number of days per year on which fire danger was extreme increased by 166 percent from 1979 through 2019 (Jones *et al.*, 2022). Multiple metrics of fire danger and climate models projected that in Oregon, the number of summer days with high fire danger will increase through the end of the twenty-first century, particularly in the Cascade Range, Coast Range, and Klamath Mountains (Gergel et al., 2017, Brown et al., 2021).

Wildfire Smoke

Wildfire smoke poses a much greater threat, in terms of deaths and total costs to society, than wildfire flames per se (Fleishman, 2023). Wildfire smoke also impairs visibility near ground level and at altitudes

where firefighting aircraft and evacuation helicopters fly (Nolte et al., 2018). Hazardous levels of air pollution are most common near wildfires, but extensive fires in the western United States and Canada in recent decades have generated taller plumes of smoke and injected a greater volume of fine particulate matter (particles less than 2.5 micrometers in diameter [$PM_{2.5}$]) at high altitudes, increasing long-range transport of these particulates and posing a health hazard to larger numbers of people both near to and far from those wildfires (Wilmot *et al.*, 2022; Rupp and Holz, 2023).

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), particularly in August and September (Wilmot et al., 2021). Across the western United States, $PM_{2.5}$ concentrations from wildfires were projected to increase 160 percent by 2046–2051, relative to 2004–2009, under a moderate emissions scenario (Liu *et al.*, 2016). Global climate models that were integrated with an empirical statistical model projected that $PM_{2.5}$ concentrations in August and September in the Northwest will double under a lower (emissions scenario and triple under a higher emissions scenario by 2080–2100 compared to 1997–2020 (Xie et al., 2022).

Exposure to $PM_{2.5}$ aggravates chronic cardiovascular and respiratory illnesses (Cascio, 2018). In addition, exposure to $PM_{2.5}$ increases susceptibility to viral respiratory infections (Henderson, 2020). Furthermore, wildfire smoke can disrupt outdoor recreational and social activities, in turn affecting physical and mental health (Nolte et al., 2018). Excess asthma events due to $PM_{2.5}$ from wildfire smoke were projected to increase in Oregon by about 42 per 10,000 persons, resulting in a projected increase in cost of more than $250,000 per 10,000 persons (Stowell et al., 2021). Those at high risk of adverse health outcomes as a result of wildfire smoke include people with preexisting conditions, outdoor workers, children, pregnant people, older adults, and rural and tribal communities (York et al., 2020; Ho et al., 2021). Poor air quality and increases in airborne allergens are most likely to affect communities with low incomes, high non-White or farmworker populations, or that are near highways and industrial facilities; outdoor workers; and those with preexisting conditions (York et al., 2020; Ho et al., 2021).

2.2.4.5 Winter Storms

Regions affected: 1-8

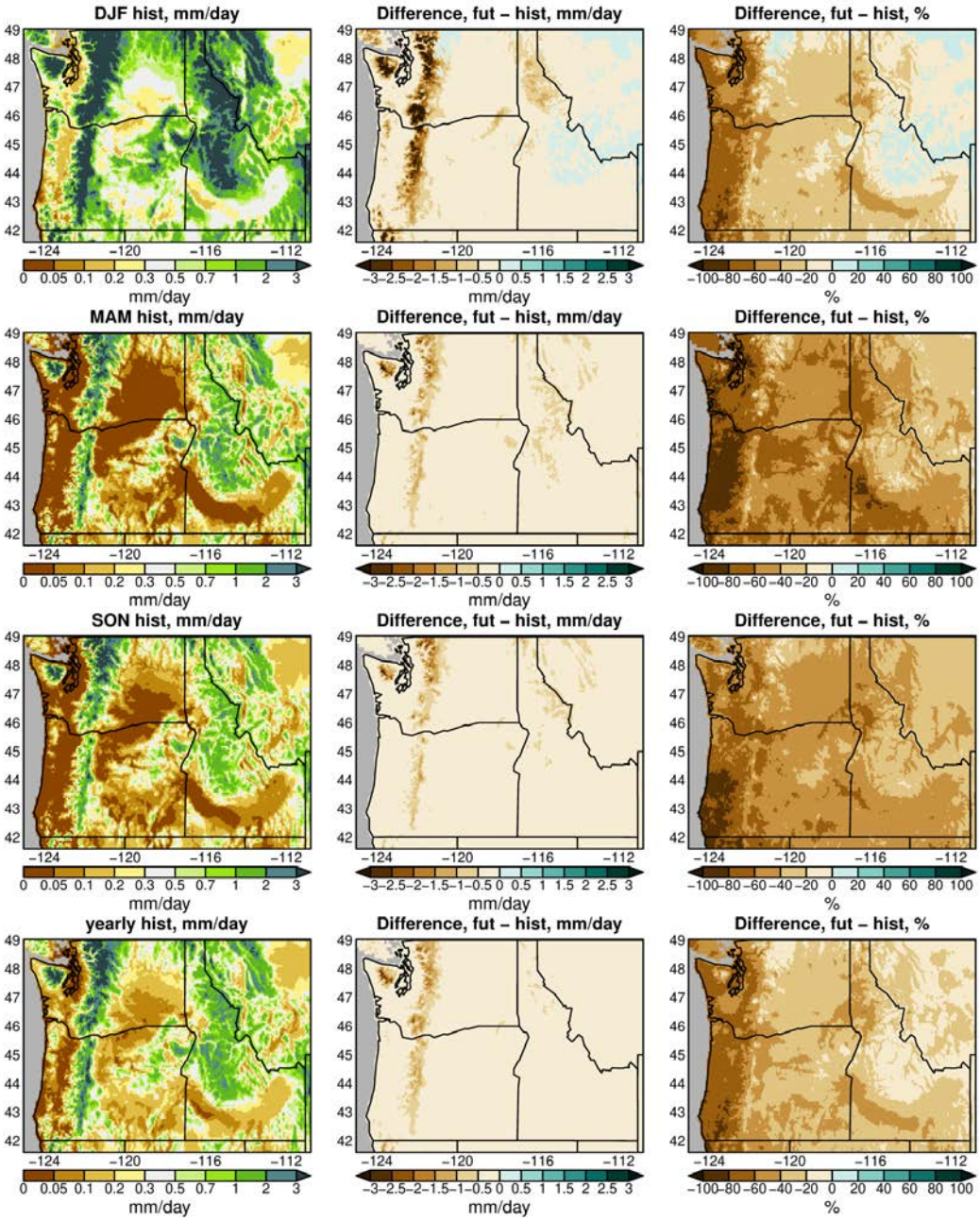
Diverse human and natural systems are affected by the proportions of precipitation that fall as rain and snow. Snow acts as a large, natural reservoir of water that accumulates during winter and is released slowly during spring and summer. Lack of snow in winter increases the likelihood of hydrological or agricultural drought during the following spring and summer. Rather than estimating snow depth, we estimated the water content of the snow that falls (the snow water equivalent, SWE). For example, if 10 cm of snow falls on a given day and that snow contains 1 cm of water, the SWE snowfall is 1 cm.

In Oregon, the proportion of annual total precipitation that falls as snow is projected to decrease by 10–20 percent from the Cascade Range and to the east by the middle of the twenty-first century. The largest decreases, 40–80 percent across much of the state, are in spring. Over the period 1950–2100, snowfall is projected to decrease by no less than 50 percent in any part of Oregon, with decreases of 65 percent or more in the Cascade Range and foothills of the eastern Cascade Range and over 85 percent in western Oregon.

Absolute snowfall (SWE) is another way to evaluate changes in precipitation type. In Oregon, the largest projected annual changes in absolute snowfall between 1950–2014 and mid-century are in winter in the Cascade Range, where decreases in SWE of 2–3 mm/day are common (Figure 2.2.4-1). These changes represent relative decreases in SWE of 20–60 percent. The largest relative seasonal changes in absolute

snowfall occur during spring, with decreases exceeding 80 percent in western Oregon, albeit snow rarely falls in this region. Projected changes during autumn are similar to those during spring. Winter SWE snowfall is projected to decrease by mid-century across most of Oregon, in many regions by 40 percent or more. In parts of the northern Cascade Range, however, SWE snowfall is projected to increase by mid-century before declining toward the end of the century.

Figure 2.2.4-1: Left column: Historical (1950–2014) seasonal and annual snow water equivalent. Middle column: Average projected absolute change in snow water equivalent between the historical period and the mid-twenty-first century (2045–2074) given shared socioeconomic pathway 3–7.0. Right column: Multi-model ensemble average projected percentage change in snow water equivalent between the historical period and the mid-twenty-first century. DJF, December, January, and February (winter); MAM, March, April, and May (spring); SON, September, October, and November (autumn).



Source: Pierce, D.W., and D.A. Cayan. 2025. Projected changes in Oregon precipitation. Pages 54-78 in E. Fleishman, editor. Seventh Oregon climate assessment. Oregon Climate Change Research Institute, Oregon State University, Corvallis, Oregon. doi: 10.5399/osu/1181.

2.2.4.6 Floods

Regions affected: 1-8

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 as a result of increases in the intensity of heavy precipitation; warmer temperatures that cause more precipitation to fall as rain and less as snow, and snow to melt earlier in spring; and increasing winter precipitation and decreasing summer precipitation (Dalton et al., 2017, 2021; Mote et al., 2019).

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). Regional hydroclimate models projected 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). 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).

Across the western United States, the average magnitudes of major floods are projected to increase by 14–19 percent by 2010–2039, 21–30 percent by 2040–2069, and 31–43 percent by 2070–2099, compared to the 1971–2000 historical baseline, under a higher emissions scenario (Maurer et al., 2018). Major floods are defined as daily peak flow magnitudes that are associated with 100-year to 10-year return periods (1–10 percent probability that this daily flow magnitude will be exceeded in a given year).

Some of the Northwest's highest floods occur when large volumes of warm rain from atmospheric rivers fall on a deep snowpack (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 increases the likelihood of flooding (Konrad and Dettinger, 2017).

Future changes in the frequency of rain-on-snow events likely will vary along elevational gradients. 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). The likely effects on streamflow of such changes in frequency of rain-on-snow events vary. For example, projections for the Santiam River, Oregon, indicated an increase in annual peak daily flows with return intervals less than 10 years, but a decrease in annual peak daily flows with return intervals of 10 or more years (Surfleet and Tullos, 2013). Average runoff from rain-on-snow events in watersheds in western Oregon and the mid-Columbia River basin was 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 rainfall that exceeds soil capacity (Berghuijs et al., 2016; Musselman et al., 2018).

Populations considered particularly vulnerable to the direct and indirect effects of extreme precipitation, from the storms themselves to floods and landslides, include people dependent on medical equipment that requires electricity, older adults, children, and pregnant people (York et al., 2020; Ho et al., 2021). Some utility companies provide consultation and additional outreach to individuals who are dependent on electricity for a medical device. Among the diverse health risks associated with extreme precipitation are

injuries, toxic exposures, displacement, disruptions in medical care, and negative mental health outcomes (York et al., 2020; Ho et al., 2021).

2.2.4.7 Landslides

Regions affected: 1-8

In Oregon, the incidence of landslides is strongly correlated with rainfall when the soil becomes saturated, so projected increases in extreme precipitation likely will increase the probability of landslides. Landslide risk also can become high when heavy rain falls on an area that burned within approximately the past five to ten years. The probability that extreme rainfall will occur within one year after an extreme fire-weather event in Oregon or Washington was projected to increase by 700 percent from the period 1980–2005 to 2100 under a higher emissions scenario (Touma et al., 2022). Similarly, projections suggested that by 2100, 90 percent 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. An increase in the number of landslides will increase risks to life and damage to property and infrastructure, and disrupt transportation and the distribution of water, food, and essential services.

2.2.4.8 Windstorms

Regions affected: 1-8

Mean near-surface wind speeds in Oregon are expected to decrease slightly in the future in response to global climate change (Pryor et al. 2012, Jeong and Sushama 2019, Chen 2020, Mass et al. 2022). However, this decrease in the mean wind speed may not translate to a decrease in extreme winds. Although projections are highly uncertain, climate models tend to agree that the magnitude of extreme wind speed will increase in western Oregon (Pryor et al. 2012, Jeong and Sushama 2019). An extreme wind refers to an annual maximum wind speed with a given probability of being exceeded, such as 5 percent probability of exceedance (a 20-year mean return period) or 2 percent probability of exceedance (a 50-year mean return period). Such increases are not projected in eastern Oregon.

Oregon's location accounts for some of the uncertainty in the response of strong winds to climate change. In Oregon, the most severe windstorms occur from October through April and are associated with extratropical cyclones (cyclones that occur from 30–60° latitude) (Read 2003, 2007; Mass and Dotson 2010). Although future changes in wind speeds in extratropical cyclones are expected to be small, the projected poleward shift in the storm tracks of these cyclones could lead to substantial changes in extreme wind speeds in some regions (Seneviratne et al. 2021). Whether the speed of strong winds in Oregon changes depends on the current and future mean and variability of the storm tracks' locations. One study indicated that by 2081–2099 relative to 1981–1999, assuming a high emissions scenario, extratropical cyclones that generate severe winds will shift northward by an average of 2.2° over the North Pacific (Seiler and Zwiers 2016). Therefore, such cyclones will become more frequent north of 45°N and less frequent and weaker south of 45°N. Oregon lies between about 42°N and 46°N. Accordingly, it is highly uncertain whether the frequency of extratropical cyclones with severe winds in Oregon will change.

The intensity of strong offshore (easterly) winds typically is less than that of winter windstorms. Nevertheless, offshore winds play a major role in summer heat waves in Oregon because they displace cooler marine air west of the Cascade Range (Brewer and Mass 2016). Projections from global climate models, assuming a high emissions scenario, suggested a decrease in the frequency of strong offshore winds over western Oregon and Washington in July and August (Brewer and Mass 2016).

In late summer and autumn and prior to the onset of the autumn rains, particularly strong and dry easterly winds promote the rapid spread of wildfire. East winds were key drivers of the largest wildfires on record in western Oregon, including the 2020 Labor Days fires (Abatzoglou et al. 2021, Mass et al. 2021, Reilly et al. 2022). Research that incorporated regional climate models and accounted for the effects of the Cascade Range indicated that from the preindustrial to the current era, the frequency of autumn (September through November) east winds along the Cascade Range in Oregon decreased by ~2 percent (Hawkins et al. 2022). There are some indications that by the year 2099 relative to 1970, assuming a high emissions scenario, the frequency of notably strong easterly winds will decrease modestly west of the Cascade Range.

Understanding of how anthropogenic emissions may affect local winds in Oregon remains limited. Due to their coarse spatial resolution, global climate models and all but the highest-resolution regional climate models cannot adequately simulate mountain slope and valley winds, coastal winds, sea breezes, and winds associated with thunderstorms (Doblas-Reyes et al. 2021). Large numbers of simulations from multiple high-resolution (0.6 to 6 mi) regional climate models ultimately will be required to estimate, with high confidence, changes in these types of winds across Oregon.

2.2.5 Evolving Climate Science and the Oregon NHMP

Oregon is committed to planning and understanding how climate change will impact its residents and their livelihoods, cultural identity, and well-being. Climate change will exacerbate natural hazards such as drought, wildfire, and extreme heat in Oregon.

Oregon sits at the forefront of climate change research in the United States. For example, the Oregon Climate Change Research Institute (OCCRI) facilitates research on physical, biological, and social sciences among Oregon's public universities that supports the needs of Oregon state agencies and communities. OCCRI and numerous state agencies and federal partners conduct annual or biennial assessments of climate change, its effects, and efforts to mitigate and adapt to climate change.

The 2025 NHMP relied in part on outputs from global climate models that were included in the sixth phase of the Coupled Model Intercomparison Project (CMIP6). The spacing of grid cells in the CMIP6 climate models is relatively coarse, typically in the range of 43 to 124 mi. Therefore, the models are unable to resolve many topographic features that affect local climate. In Oregon, these features include the Coast Range, Willamette Valley, and Cascade Range. For this reason, the NHMP used outputs of global climate model data that were statistically downscaled to a roughly 3.7-mile grid. Downscaling adds the effects of local topography to the original global climate model results, which is necessary to accurately represent climate in regions with complex terrain. The models that contributed to the NHMP were selected following evaluation of their ability to realistically capture major weather processes that affect the west coast of the United States.

Oregon committed to addressing how climate change affects each climate-related hazard in this 2025 plan to the extent that the science allowed doing so, and to acknowledging uncertainties in the science. As a result, this plan reflects emerging understanding of the effects of climate change on extreme heat, drought,

flood, wildfire, and coastal hazards, and in turn the effects of those hazards on Oregonians. Such knowledge will inform investments that better enable all of Oregon's populations and communities to avoid, prepare for, and recover from hazard events.

2.2.6 Social and Public Health Consequences of Changing Conditions

More days of extreme heat, wildfire, smoke, harmful algae blooms, floods and other environmental consequences of a changing climate affect people's mental and physical health as well as causing physical harm. State agencies are taking action to understand and address these challenges.

The Department of Land Conservation and Development produced a social vulnerability assessment to better understand how communities and individuals are experiencing and coping with changing climate conditions. DLCD learned that people across the state value access to the outdoors, community gatherings, clean air and water, high-quality food, and local decision-making authority. Many Oregonians are concerned about how climate change might impact their wellbeing, livelihoods, and sense of place. Workshop and survey participants want their state government and local governments to support and facilitate locally relevant adaptation actions intended to strengthen the built and social environment.

The Oregon Health Authority's 2023 climate and health report summarizes some of these measures. In 2023, OHA's Public Health Division established indicators to measure the public health system's progress in building community resilience to health effects of a changing climate. In 2023, state and federal leaders increased investments to protect people in Oregon at the highest risk of health impacts from climate change-driven health risks; to make homes more resilient to extreme weather; and to increase tree canopy across the state to reduce heat island effects. The 2023 Legislature directed and provided funding to OHA and the Department of Environmental Quality (DEQ) to establish a state Harmful Algae Blooms monitoring and advisory program to protect Oregonians recreating in the state's rivers, lakes and reservoirs, and strengthen protections for surface waters that are the source of drinking water for public water systems. The Oregon Climate Action Commission added to their workplan the intention to establish in 2025 a resilience and adaptation work group to coordinate implementation of the Climate Change Adaptation Framework.

These findings and initiatives highlight that natural hazards mitigation must include more than just hardening buildings and infrastructure. It must take a well-being-centered approach that includes strengthening communities' ability to benefit from, cope with, and respond to change.

2.3 Human Geography

2.3.1 Tribal Nations

According to the 2020 U.S. census, a total of 185,723 American Indian people live in the Oregon, making up approximately 4 percent of the population. They include enrolled members of Oregon's nine federally recognized tribes as well as enrolled members of tribes based outside of Oregon. A federally recognized tribe is an American Indian tribal entity that has a government-to-government relationship with the United States and has inherent rights of self-government and sovereignty. They also are entitled to certain federal benefits, services, and protections. (US Department of the Interior, 2020) The nine federally recognized tribes in Oregon are all separate and sovereign governments with unique cultures and mitigation needs

based on their histories, locations, and relationships to the United States federal government. Tribal members in Oregon are both citizens of their tribe and citizens of Oregon and the United States. The sections below describe each of the nine federally recognized tribes in more detail and provide links to further information from the tribes themselves. (Oregon Blue Book, 2025)

Burns Paiute Tribe

The Burns Paiute tribe is made up of primarily the Wadatika Band of Northern Paiute people but also has ties to all other Northern Paiute Bands. They were forcibly removed from their lands in 1879 to live in Ft. Simcoe, WA until they were able to gain federal recognition in 1969. (LCIS, 2025) The traditional homelands of the Burns Paiute include 5,250 square miles of land in Central-Southeastern Oregon, Northern Nevada, Northwestern California and Western Idaho. The Burns Paiute still maintain title to much of their territory. The Tribe currently has 402 enrolled members with 142 people living on the reservation. For more information on their history, culture, and government see their website: About the Tribe – BPT (ODHS, 2025)

Confederated Tribes of Coos, Lower Umpqua and Siuslaw Indians (CTCLUSI)

The Confederated Tribes of Coos, Lower Umpqua and Siuslaw Indians (CTCLUSI) are made up of the Hanis and Miluk bands of the Coos Tribe, the Lower Umpqua Tribe and the Siuslaw Tribe. Their homelands are in the central and southern Oregon Coast, making up approximately 1.6 million acres between the Coast Range and Pacific Coast. (LCIS, 2025)

Although both Coos bands lived near one another on the Coos River tributaries, they spoke different dialects of the Coos language and had their own unique history and cultural differences. The Tribes trace their ancestry back to the inhabitants of the South-Central coast of Oregon. They regained their federal recognition in 1984, almost thirty years after the Western Oregon Termination Act in 1954. For more information on their history, culture, and government, see their website: https://ctclusi.org/history/ . (ODHS, 2025)

Confederated Tribes of Grand Ronde

The Confederated Tribes of the Grand Ronde Community of Oregon is made up of over 30 Tribes and bands from Western Oregon, Northern California, and Southwest Washington. However, there are five main bands: Molalla, Rogue River, Kalapuya, Chasta, and Umpqua. The tribe is governed by a nine-member Tribal Council that is elected by the Tribe's voting membership. They have approximately 5,400 enrolled Tribal members. (LCIS, 2025)

Tribal members were forcefully removed from their homelands with ratified and unratified treaties with the U.S. government between 1853 and 1855. Their federal recognition was terminated in 1954 which stripped them of their land. Federal recognition was restored through the hard work of tribal leadership in 1983. The Confederated Tribes of the Grand Ronde regained 9,811 acres of their original reservation in 1988. The Tribe is active throughout its ancestral homelands but located in Western Oregon, where it has an 11,500-acre reservation in Yamhill and Polk Counties. For more information on their history, culture, and government, see their website: https://www.grandronde.org/history-culture/history/our-story/. (ODHS, 2025)

Confederated Tribes of Siletz Indians

The Confederated Tribes of Siletz Indians is a federally recognized confederation of 27 bands representing at least ten languages, originating from Northern California to Southern Washington. (LCIS, 2025) They include members of the Clatsop, Chinook, Klickitat, Molala, Kalapuya, Tillamook, Alsea, Siuslaw/Lower Umpqua, Coos, Coquille, Upper Umpqua, Tututni, Chetco, Tolowa, Takelma, Galice/Applegate and Shasta. Each tribe has a unique history, culture, and legal relationship with the federal government. Federal recognition of the Confederated Tribes of Siletz Indians was terminated by the United States government in 1955. In November 1977, they were the first Tribe in Oregon and second in the United States to be fully restored to federal recognition. The Tribe manages a 3,666-acre reservation located in Lincoln County, Oregon. For more information on their history, culture, and government, see their website: https://www.ctsi.nsn.us/introduction/. (ODHS, 2025)

Confederated Tribes of the Umatilla Indian Reservation

The Confederated Tribes of the Umatilla Indian Reservation (CTUIR) is made up of three Tribes: Cayuse, Umatilla and Walla Walla. The CTUIR has over 3,100 Tribal members, nearly half of whom live on or near the Umatilla Reservation. The Reservation is about 172,000 acres (about 273 square miles) located in Northeastern Oregon. CTUIR is governed by a constitution and bylaws adopted in 1949. (LCIS, 2025) The governing body is the nine-member Board of Trustees, elected every two years by the General Council. In 1855, the three Tribes signed a treaty with the U.S. government, in which they ceded over 6.4 million acres to the United States. In the treaty, the Tribes reserved rights to fish, hunt and gather foods and medicines such as roots and berries, and pasture livestock on unclaimed lands. Tribal members continue to exercise these rights throughout the CTUIR's area of traditional use, which includes harvesting fish at Willamette Falls in Western Oregon and hunting buffalo in the Greater Yellowstone area. For more information on their history, culture, and government see their website: https://ctuir.org/about/. (ODHS, 2025)

Confederated Tribes of the Warm Springs

The Confederated Tribes of Warm Springs is made up of the Wasco, Paiute, and Warm Springs Tribes. The Warm Springs Indian Reservation is in North Central Oregon. In 1937, the three Tribes organized as the Confederated Tribes of the Warm Springs Reservation of Oregon by adopting a constitution and bylaws for tribal government. (LCIS, 2025) Despite the great loss of traditional culture that occurred because of settlement on the reservation, the people of the Warm Springs Reservation have succeeded in maintaining many of their ancient traditions and values. For more information: https://warmsprings-nsn.gov/history/. (ODHS, 2025)

Cow Creek Band of Umpqua Tribe of Indians

The Cow Creek Tribal Nation is in Southwestern Oregon between the Cascades and Coast ranges in the Umpqua and Rogue River watersheds. The tribal nation has over 1,800 members. They are governed by an elected eleven-member council known as the Tribal Board of Directors. They were one of the first tribes to secure a treaty with the United States government in 1854, ceding more than 800 square miles of land. They were never given the reservation their Treaty promised. (LCIS, 2025) Without a reservation, tribal members remained in their homelands. Their Tribal Government Office in Roseburg, Oregon, houses the Tribal Government body and programs, the Cow Creek Tribal Gaming Commission, and the Cow Creek Health and Wellness Center. For more information on their history, culture, and government see their website: https://www.cowcreek-nsn.gov/tribal-story/. (ODHS, 2025)

Coquille Indian Tribe

The Coquille Tribe has more than 1,100 members whose ancestors were Athabaskan and Miluk speakers who lived in the Coquille River watershed and lower Coos Bay. Their treaty with the U.S. government was never ratified, and they lost federal recognition in 1954 with termination. They regained their federal recognition in 1989 and have regained more than 10,000 acres of their ancestral homeland. (LCIS, 2025) The Coquille Indian Tribe's service area covers 15,603 square miles of Coos, Curry, Douglas, Jackson and Lane counties. Approximately 350 Tribal members live in Coos County. After the tribe regained federal recognition and their full sovereignty rights were restored in 1989, the Coquille Tribal government created an administrative program that now provides housing, health care, education, elder care, law enforcement and judicial services to its members. For more information on their history, culture, and government, see their website: https://www.coquilletribe.org/our-people/. (ODHS, 2025)

Klamath Tribes

The Klamath Tribes consists of the Klamath, Modoc and Yahooskin-Paiute people. Thay have over 5,700 enrolled members, with a government headquarters in Klamath County. The present-day Klamath Indian Reservation consists of 12 small, non-contiguous parcels of land in Klamath County. (LCIS, 2025) These land areas are generally located in and near the communities of Chiloquin and Klamath Falls. Their government's function is to protect human and cultural resources and treaty rights, and to provide for the development and delivery of social and economic opportunities. For more information on their history, culture, and government: https://klamathtribes.org/history/. (ODHS, 2025)

2.3.2 Land Use

Balancing growth and land use with hazard mitigation is key to planning resilient communities. Understanding where development is occurring or is likely to occur based on land use patterns is integral to developing mitigation actions.

In 1973, Oregon passed Senate Bill 100 which created a statewide land use planning system and established the Land Conservation and Development Commission (LCDC) and the Department of Land Conservation and Development (DLCD). The bill was a response to concerns around rapid population growth in Oregon and a desire to curb suburban sprawl and preserve open space, agricultural land, and forest land. LCDC's first task was to develop Oregon's statewide planning goals to guide the development of local comprehensive land use plans. LCDC initially developed 14 goals that were adopted in 1974. The list of goals has since grown to 19 goals that express the state's policies on land use and related topics like citizen involvement, housing, and natural resources. As a result of Senate Bill 100 and the Statewide Planning Goals, Oregon has been able to maintain a distinct separation between urban and rural land uses and maintain a large proportion of its open space and rural farm and forest land. The following sections describe how some of these goals relate to understanding Oregon's land use and development patterns.

Goal 3: Agricultural Lands

Under Goal 3, counties are required to inventory, preserve, maintain agricultural land through exclusive farm use (EFU) zoning. EFU zoning restricts developments that are not related to agriculture to minimize uses that conflict with farming. As a result, while many Oregonians live in

agricultural land, minimum parcel size requirements of 80 acres leads to far less density of development in agricultural areas.

Goal 4: Forest Lands

Goal 4 is designed to protect working forest land around the state, preserving it for commercial forestry. Goal 4 requires that counties identify and designate forest land in their comprehensive plan and conserve forest lands for forest uses. Goal 4 places development restrictions on forest lands that prevent it from being divided into parcels that are too small to manage for timber, habitat, recreation, and watershed protection. Some forest land is qualified for development of dwellings, but development is far less dense than in urban areas.

Goal 7: Areas Subject to Natural Hazards

Goal 7 requires that jurisdictions apply the appropriate safeguards when planning for development in places subject to natural hazards such as floods or landslides. This especially pertains to local floodplain regulations that meet the minimum of the National Flood Insurance Program as well as additional safeguards to prevent development in hazard areas.

Goal 14: Urbanization

Goal 14 requires that cities plan for twenty years of future growth and land needs and that they zone enough land to meet those needs. Each incorporated city has an established Urban Growth Boundary which separates urbanizable land from rural land. Most Oregonians live in Urban areas. Approximately 65 percent of Oregon's population lives in urban areas, vs. 33 percent in rural areas and 2 percent in frontier areas or counties with six or fewer people per square mile. (OHSU, 2024)

Goal 16: Estuarine Resources

Goal 16 guides planning and management of estuaries in Oregon. Estuaries are the tidal mouth of a river where fresh river water meets tidal ocean water. Estuaries are delicate ecosystems that have adapted to the brackish water of the environment and are some of the most productive ecosystems in the world. Goal 16 aims "to recognize and protect the unique environmental, economic, and social values of each estuary and associated wetlands." Goal 16 requires that locally adopted estuary management plans designate uses for different areas within each estuary based on biological and physical characteristics, that function similarly to zoning codes.

Goal 17: Coastal Shorelands

Goal 17 guides planning and management requirements for lands bordering estuaries, ocean shore, and coastal lakes. Goal 17's requirements are generally combined with other planning goals to direct the use of shoreland areas. The Goal 17 requirement states that shorelands especially suited for water dependent uses be protected for that use and that local zoning regulations prevent other uses in designated coastal shoreland areas.

Goal 18: Beaches and Dunes

Goal 18 guides the conservation and protection of beach and dune resources and reducing exposure to coastal hazards. Local governments are required to inventory beaches and dunes and describe their stability, movement, groundwater resources, hazards, and values. Goal 18 prohibits development on the most sensitive and hazardous landforms including beaches and dunes and other areas subject to severe erosion and flooding.

2.3.2.2 Settlement Patterns

Oregon's settlement patterns have evolved significantly over time, influenced by factors that include geography, economy, cultural shifts, and Oregon's statewide planning system. Before 1750 when white settlers began entering the region, the Pacific Northwest was home to approximately 200,000 indigenous people with populations concentrated along the Columbia River, in the western valleys and around coastal estuaries and inlets. People who lived in the great basin, Columbia plateau, and valleys tended to move to different places throughout the year for subsistence food. Coastal groups tended to live in fixed village sites because there were abundant year-round food sources. (Oregon History Project, 2002)

The modern era of white settlement began in 1830 when people from New England and the Midwest migrated to the area and established their first permanent settlement in the Willamette River valley. Settlement patterns followed fertile lands for agriculture and forests for timber and by the turn of the 20th century, two-thirds of Oregon's population lived in rural areas. The railroad was finished in 1883, giving Oregon a stronger link to the rest of the country and improving the opportunity for economic growth. The development of the railroad especially stimulated agriculture and forestry. Cities began to grow rapidly as industrial and manufacturing bases expanded. By the early twenty-first century, three-fourths of the state population lived in urban areas. In 1973, Oregon's government established the statewide land use planning program which included land use planning goals for the state. The establishment of the program included the designation of urban growth boundaries that further restricted development outside of cities. As of 2024, approximately 65 percent of Oregon's population lived in urban areas. (OHSU Office of Rural Health, 2024)

Recently, Oregon has experienced episodic and explosive growth with reasons for migrating including the state's clean air and water, small cities, and scenic natural environment. (Highsmith, 2024) Populations tend to cluster around major road corridors and waterways. Table 2.3.2-1 outlines the settlement patterns in each mitigation planning region.

Table 2.3.2-1: Settlement Patterns by Mitigation Planning Region

Region 1: Oregon Coast	The region's population is clustered around the Oregon Coast Highway 101 corridor and the cities of Astoria, Tillamook, Newport, Florence, Coos Bay, Brookings, and some unincorporated areas.
Region 2: North Willamette Valley/Portland Metro	The region's largest population is clustered around the Portland Metro area and numerous major transportation corridors and waterways.

Region 3: Mid/Southern Willamette Valley	The region's population is clustered around the I-5 corridor, other highway corridors, and various waterways. Population centers of this region include the cities of Eugene, Albany, Corvallis, and Salem.
Region 4: Southwest Oregon	The region's population is clustered around the I-5 corridor, other highway corridors, and various waterways. The region's major population centers include the cities of Ashland, Medford, Grants Pass and Roseburg.
Region 5: Mid-Columbia	The region's population is clustered around the I-84 corridor and the cities of Hood River, Pendleton, and The Dalles.
Region 6: Central Oregon	The region's population is clustered around the US-97 corridor, other highway corridors, and various waterways. The region's major population centers include the cities of Bend, Klamath Falls, Madras, and Redmond.
Region 7: Northeast Oregon	The region's population is clustered around the I-84 corridor and the cities of Baker City, La Grande, John Day, and Enterprise.
Region 8: Southeast Oregon	The region's population is clustered around the I-84 corridor, US-97 corridor, and the cities of Burns, Hines, Ontario, and Vale.

2.3.2.3 Land Ownership

Oregon's 95,997 square miles of land area is owned by a mix of landowners including federal government agencies, state government agencies, tribal governments, cities and counties, and private landowners. Lands owned by federal, state, and tribal land entities are summarized below in the following sections.

Federal Lands

Four major federal land management agencies administer lands within the State of Oregon: Bureau of Land Management (BLM), U.S. Fish and Wildlife Service (USFWS), National Park Service (NPS) in the Department of the Interior (DOI), and the U.S. Forest Service (USFS) in the Department of Agriculture. The Department of Defense (DOD) also administers lands within Oregon. DOD land consists of military bases, training ranges, and other military associated uses. This does not include federal lands managed by other agencies such as the Bureau of Reclamation or Tribal lands, many of which are held in trust by the federal government but are not owned by the federal government. (CRS, 2020)

32,244,257 acres, or 52 percent of the total land area of Oregon is administered by these federal land management agencies. The areas of land they manage are shown in Table 2.3.2-2. Between 1990 and 2018, Oregon saw a 0.6 percent increase in federal land area.

Table 2.3.2-2: Federal Land Ownership by Agency

Agency	Land Ownership Area (acres)
Bureau of Land Management	15,742,384
U.S. Forest Service	15,697,445

U.S. Fish and Wildlife Service	575,379
National Park Service	196,197
Department of Defense	32,852

Source: Congressional Research Service. (2020, February 21). *Federal Land Ownership: Overview and Data.* Retrieved February 19, 2025 from https://crsreports.congress.gov/product/pdf/R/R42346

State Lands

The Department of State Lands (DSL) and 27 other Oregon state agencies and universities own and manage land across the state. DSL also oversees the beds and banks of lakes, river segments, territorial sea, and tidally influenced bays and estuaries. According to DSL's 2024 State Land Inventory System Report, state-owned and managed land totals to 1,777,583 acres. DSL and the Department of Forestry own and manage the largest segments, with 774,515 acres (44%) and 711,225 acres (40%), respectively. Department of Fish and Wildlife owns and manages the third largest amount at 139,534 acres (8%), followed by Parks and Recreation Department at 97,031 acres (6%). The remaining agencies own or manage 1 percent or less of state-owned land. (DSL, 2024)

Tribal Lands

Two types of Tribally owned land exist in Oregon: reservations and land held in trust by the United States for the use or benefit of tribes. Reservations are lands reserved for a tribe by the federal government as permanent tribal homelands. Lands held in trust are held in trust by the United States Federal Government for use or benefit of tribes. Trust lands are often located in or near reservations. Tribes have the authority to purchase land and petition the United States Federal Government to hold it in trust. As of 2016, about 897,535 acres of land in Oregon were tribal reservation or trust lands. "Ceded lands" is another type of land that is mentioned in this plan in relationship to the Tribes. "Ceded lands" refers to lands that tribes did not claim in treaties. Often, Native people who lived on ceded lands were not consulted or did not give their consent in the treaty making process. (ODE, 2025) Refer to the section of this chapter entitled *Tribal Nations* for more information on the Nine Federally Recognized Tribes' reservation land. (LPRO, 2016)

2.3.3 Demographics

Demographic characteristics describe the distinguishing features of the state's population including age, gender, race, ethnicity, and income. Demographic attributes can help to understand the vulnerabilities of a community or region and the state's ability to cope with, adapt to, and recover from natural disasters.

2.3.3.1 Population

Historical and projected population change are key factors in understanding where people live now and where they may live in the future and how they may be affected by natural disasters. Population change includes two major components: natural increase (births minus deaths) and net migration (in-migrants minus out-migrants) (USDA, 2025). If a population increases substantially, a community's capacity to

provide adequate housing stock, services, or resources for all populations after a disaster may be stressed or compromised.

Table 2.3.3-1 shows population change between 2020 and 2023, according to the U.S. Census Bureau American Community Survey, and projected population change between 2023 and 2040 based on Portland State University's Population Research Center's population projections. Population data shows that the population across the state is generally growing with the most growth since 2020 in Region 6 (5.3%) followed by Regions 5 (3.5%) and 8 (3.4%). Projected growth between 2023 and 2040 is expected to be highest in Region 2 (24.4%) and Region 6 (25.2%).

Table 2.3.3-1: Population estimate and forecast by region and county

	2020	2023	Percent Change (2020-2023)	2040 Projected	Percent Change (2023-2040)
Oregon	4,176,346	4,238,714	1.5%	4,999,744	18.0%
Region 1	202,838	207,741	2.4%	220,434	6.1%
Clatsop County	39,656	41,343	4.3%	45,579	10.2%
Coos County	64,175	64,832	1.0%	65,046	0.3%
Curry County	22,889	23,463	2.5%	24,881	6.0%
Lincoln County	49,336	50,632	2.6%	54,558	7.8%
Tillamook County	26,782	27,471	2.6%	30,369	10.5%
Region 2	1,872,831	1,879,615	0.4%	2,338,532	24.4%
Clackamas County	415,084	422,308	1.7%	484,850	14.8%
Columbia County	52,117	53,178	2.0%	57,857	8.8%
Multnomah County	809,869	803,863	-0.7%	1,065,047	32.5%
Washington County	595,761	600,266	0.8%	730,778	21.7%
Region 3	1,131,692	1,151,988	1.8%	1,281,588	11.3%
Benton County	92,168	96,359	4.5%	107,674	11.7%
Lane County	377,749	382,628	1.3%	406,335	6.2%
Linn County	127,216	129,794	2.0%	144,960	11.7%
Marion County	343,742	346,532	0.8%	386,083	11.4%
Polk County	84,730	88,553	4.5%	109,059	23.2%
Yamhill County	106,087	108,122	1.9%	127,477	17.9%
Region 4	415,893	422,439	1.6%	478,563	13.3%
Douglas County	110,015	111,807	1.6%	115,610	3.4%
Jackson County	218,781	222,563	1.7%	264,909	19.0%
Josephine County	87,097	88,069	1.1%	98,044	11.3%
Region 5	141,870	146,807	3.5%	162,541	10.7%
Gilliam County	1,896	2,002	5.6%	2,197	9.7%
Hood River County	23,270	23,958	3.0%	27,487	14.7%
Morrow County	11,425	12,249	7.2%	13,317	8.7%

	2020	2023	Percent Change (2020-2023)	2040 Projected	Percent Change (2023-2040)
Sherman County	1,686	1,908	13.2%	1,892	-0.8%
Umatilla County	77,319	80,087	3.6%	88,881	11.0%
Wasco County	26,274	26,603	1.3%	28,767	8.1%
Region 6	316,449	333,150	5.3%	417,151	25.2%
Crook County	23,733	25,651	8.1%	31,410	22.5%
Deschutes County	191,749	203,026	5.9%	275,905	35.9%
Jefferson County	24,048	24,973	3.8%	28,338	13.5%
Klamath County	67,606	69,812	3.3%	71,597	2.6%
Lake County	7,896	8,254	4.5%	8,451	2.4%
Wheeler County	1,417	1,434	1.2%	1,450	1.1%
Region 7	56,831	57,758	1.6%	57,508	-0.4%
Baker County	16,090	16,796	4.4%	16,810	0.1%
Grant County	7,174	7,238	0.9%	6,762	-6.6%
Union County	26,502	26,192	-1.2%	26,977	3.0%
Wallowa County	7,065	7,532	6.6%	6,959	-7.6%
Region 8	37,942	39,216	3.4%	43,426	10.7%
Harney County	7,310	7,515	2.8%	7,520	0.1%
Malheur County	30,632	31,701	3.5%	35,906	13.3%

Sources: U.S. Census Bureau American Community Survey 2023 5-Year Estimates; Population Research Center, Portland State University, 2022-2025 Population Forecasts; Metro Population Forecasts

2.3.3.2 Social Vulnerability

Natural disasters do not affect everyone equally. Social vulnerability describes that difference in susceptibility to the adverse impacts of natural hazards based on social groups and access to certain resources. Factors of social vulnerability include poverty status, race, disability status, or access to a vehicle. Identifying social vulnerability helps to identify the unique needs of different groups or people who are part of multiple groups in a natural disaster.

Social vulnerability can be defined and measured in many ways. Each method and definition includes groups and metrics differently. This NHMP's risk assessment includes several metrics for social vulnerability. The list below describes the complete list of social data used in the risk assessment.:

- Census Community Resilience Estimates which include:
    - Poverty status
    - Number of caregivers in a household
    - Housing unit level crowding
    - Communication barrier
    - Employment status
    - Disability status
    - Health insurance coverage

    - Age (65+)
    - Vehicle Access
    - Broadband Internet access
- Race
- Members of religious groups
- Number of cultural organizations that are funded by Oregon Cultural Trust
- Center for Disease Control and Prevention (CDC): Pregnancy Risk Assessment Monitoring System (PRAMS) Data which gives information on social cohesion
- Number of mobile homes
- Housing Tenure
- Number of hospital beds
- Distance to a hospital

Chapter 3: Hazard Identification and Risk Assessment gives a deeper analysis of how these metrics are specifically used to measure social vulnerability for the State NHMP. The remainder of the social vulnerability section gives a more general statewide overview of these demographic data and compares them to national data.

Community Resilience Estimate Related Data

The Census's Community Resilience Estimate measures vulnerability and resilience based on poverty, caregivers in the household, household crowding, language barrier, employment status, disability status, health insurance coverage, age, vehicle access, and broadband access. Table 2.3.3-2 shows how the state of Oregon compares to the United States in each of these categories. Oregon has a higher percentage of persons with disabilities (15 percent and 13 percent respectively) and a higher percentage of persons over age 65 (19 percent and 17 percent respectively) than the United States as a whole. The state is similar to the United States in the remaining categories, except that a lower percentage of Oregonians (15%) than Americans as a whole (22%) speak a language other than English at home.

Table 2.3.3-2: Community Resilience Estimate (CRE) Related Data

Category	Oregon	United States
Percentage of population below the poverty line	12%	12%
Percentage of single householder with children households	5%	6%
Percentage of housing units considered crowded*	3%	3%
Percentage of population that speak language other than English at home	15%	22%
Unemployment rate (ages 16 and over)	5%	5%
Percentage of noninstitutionalized population with a disability	15%	13%
Percentage of population without health insurance	6%	9%
Percentage of population over age 65	19%	17%

Category	Oregon	United States
Percentage of households with zero vehicles available	7%	8%
Percentage of households without broadband	8%	10%

*A housing unit with more than one person per room is considered crowded. (U.S. Census Bureau, 2000)
Sources: U.S. Census Bureau American Community Survey 2023 5-Year Estimates

Race and Ethnicity

The CRE does not include race or ethnicity in its calculation. However, research has shown that communities of color are more vulnerable to hazards due to higher social vulnerability that can amplify the impacts of hazards. Table 2.3.3-3 shows race and ethnicity in Oregon and the United States based on the 2020 census. Oregon's white population (72%) is much higher than the United States (58%). All other racial groups are a smaller percentage in Oregon than in the United States, except Two or More Races (6 percent and 4 percent respectively). However, Oregon's Hispanic and Latino population makes up a considerable proportion of the state's population with 14%. Although other racial groups make up small portions of the population, they still need to be considered in mitigation actions. It is also important to note that although the census aims to reach the entire U.S. population, certain groups such as Hispanic or Latino populations, Black or African American populations, and American Indian and Alaska Native population living on reservations are historically undercounted by the census. (U.S. Census Bureau, 2023)

Table 2.3.3-3: Race and Ethnicity Data

Label	Oregon	United States
Hispanic Or Latino	14%	19%
Not Hispanic or Latino	86%	81%
White	72%	58%
Black or African American	2%	12%
American Indian and Alaska Native	1%	1%
Asian	5%	6%
Native Hawaiian and Other Pacific Islander	0%	0%
Some Other Race	1%	1%
Two or more races	6%	4%

Sources: U.S. Census Bureau 2020 Census

Housing

Housing tenure, type of housing, and whether a person is experiencing homelessness, all factors in their vulnerability to hazards. Renters are more vulnerable to natural hazards and the effects of natural disasters because they generally have less wealth than homeowners and tend to receive less government assistance after a natural disaster. (Hersher, 2024) People who live in mobile homes are also vulnerable because mobile homes are constructed less resiliently and are often made of lower quality materials than other housing types. They also often have lower quality infrastructure and are often located in more hazard prone locations. People experiencing homelessness, especially those that are unsheltered, are among the most vulnerable to natural disasters. (Curran-Groome, et. al., 2025)

Table 2.3.3-4 shows housing related demographic data in Oregon vs. the United States. Oregon has a higher percentage of renters, mobile home housing units, and people experiencing homelessness than the United States.

Table 2.3.3-4: Housing related demographic data

Category	Oregon	United States
Percentage of occupied housing units that are owner occupied	63%	65%
Percentage of occupied housing units that are renter occupied	37%	35%
Percentage of occupied housing units that are mobile homes or other type of housing*	7.6%	5.3%
People experiencing homelessness (Point in Time Count January 2023)**	20,142 (48/10,000)	653,104 (20/10,000)

*In table S2504 of American Community Survey Data, this category falls under "Units in Structure", other categories are 1 detached, 1 attached, 2 apartments, 3 or 4 apartments, 5 to 9 apartments, 10 or more apartment

**Point in time counts are based on data collected on the number of people experiencing homelessness for a single point in time – the last 10 days in January. 653,104 Americans experiencing homelessness equates to 20 out of every 10,000. 20,142 Oregonians experiencing homelessness equate to 48 out of every 10,000 people.

Sources: U.S. Census Bureau American Community Survey 2023 5-Year Estimates; United States Department of Housing and Urban Development *The 2023 Annual Homelessness Assessment Report to* Congress.

Tourist Population

Tourists are not counted in population statistics and are therefore considered separately in this analysis. According to Travel Oregon's 2023 Report, *The Economic Impact of Travel,* more than 29.9 million visitors stayed at least one night in Oregon in 2023. Table 2.3.3-5 shows the total number of person trips in 2023, or visitors that spent at least one night in a location. The table uses Travel Oregon's regional designations which are different from the hazard mitigation regions used in the rest of this NHMP. Visitor numbers were calculated through a combination of visitor surveys, visitor air travel, and lodging data. (Travel Oregon, 2024) In 2023, the Portland region of West Clackamas, Columbia, West Multnomah and Washington counties had the most visitors, with a total of 8,290,870. The Willamette Valley region followed the Portland region with a total of 7,137,950.

Table 2.3.3-5: Tourist data by Travel Oregon tourist region

Region	Counties	2023 Person-Trips to the Region
Central Coast	Douglas (minus coastal area), Lane (minus coastal area), Lincoln	2,260,770
Central Oregon	Crook, Deschutes, Jefferson, South Wasco	3,432,850
Eastern Oregon	Baker, Gilliam, Grant, Harney, Malheur, Morrow, Sherman, Umatilla, Union, Wallowa, Wheeler	2,124,600
Mt. Hood and Columbia River Gorge	East Clackamas, Hood River, East Multnomah, North Wasco	1,355,390
North Coast	Clatsop, Tillamook	1,980,830
Portland Region	West Clackamas, Columbia, West Multnomah, Washington	8,290,870
South Coast	Coos, Curry	1,682,710
Southern Oregon	East Douglas, Jackson, Josephine, Klamath, Lake	4,152,230
Willamette Valley	Benton, South Clackamas, East Lane, Linn, Marion, Polk, Yamhill	7,137,950

Sources: Travel Oregon. (2023). *The Economic Impact of Travel.*

Tourists are particularly vulnerable during natural hazard events because they are often unfamiliar with the hazards in the region and do not have the knowledge or materials needed to take care of themselves in a disaster. For example, a typical tourist unfamiliar with the region may have difficulty identifying or using evacuation routes or finding shelter in the event of an earthquake or wildfire. A typical tourist is less likely to have supplies that locals would likely have in a disaster. Tourists also usually do not have a local support network to fall back on.

2.3.4 Cultural Resources

Oregon recognizes the importance of protecting and preserving the natural, cultural, and historic resources found throughout the state. Oregon's history and future economic growth are tied to the deliberate efforts to preserve these resources. Oregon's recognized experts — Oregon Parks and Recreation Department, the State Historic Preservation Office, and the Oregon Heritage Commission — are essential partners in the identification, protection, and preservation of Natural, Cultural, and Historical Resources (NCHR) and their intersection with mitigation projects.

The State's success in preserving cultural resources through intentional planning and mitigation efforts, collaborative partnerships, and creative approaches is an ongoing process. Local, tribal, state, and national partners work collaboratively to increase the awareness of Natural, Cultural, and Historical Resources (NCHRs) and identify opportunities to protect them through existing site-specific plans and actions. OEM is

committed to requiring local jurisdictions to follow all applicable laws, rules, and regulations related to resource protection in mitigation projects.

NCHR-related information is available on the Oregon Parks and Recreation Department (OPRD) website. OPRD also encourages that NHCRs be considered in disaster planning. The information OPDR provides is designed to assist emergency managers, organizations, and agencies charged with protecting and preserving collections, sites, and artifacts to make informed decisions related to NCHR. OPRD promotes awareness, Best Management Practices, and dialog within the emergency management community and the professionals that maintain these important resources. (OPRD, 2025)

OEM curates and manages a GIS system called RAPTOR (Real-Time Assessment and Planning Tool for Oregon). RAPTOR is used by emergency managers before, during, and after disasters to stay informed of developing situations and maintain awareness of hazards or resources at risk. NCHR information in RAPTOR ensures emergency managers are aware of resources at risk and allows them to consider those resources when developing mitigation, response, and recovery actions. RAPTOR currently only includes the historic sites inventory from the State Historic Preservation Office. Other cultural resources, including tribal natural and cultural resource, are classified for their protection. Therefore, consultation directly with tribes' cultural resource departments is important when making mitigation decisions. Refer to the next section entitled *Tribal Natural and Cultural Resources* for more information about each of the Nine Federally Recognized Tribes' approaches to natural and cultural resources.

The 2025 State Hazard Risk Assessment (Chapter 3) uses an inventory of cultural organizations that are eligible for funding by the Oregon Cultural Trust as the data source for cultural resources. The analysis considers these locations as both assets that have the potential for exposure to natural hazard impacts as well as the potential to serve as venues to bring communities together and foster social cohesion. The risk assessment analysis used cultural related buildings from the Oregon Cultural Trust, an inventory of cultural organizations statewide. Refer to Chapter 3: Hazard Identification and Risk Assessment for further information.

2.3.5 Tribal Natural and Cultural Resources

Indigenous people often do not draw a hard line between natural resources and cultural resources because the relationship between humans and nature is treated in a more intertwined, less anthropocentric, and less commodified manner. (Naknanuk, 2022) As sovereign and separate government entities, each Tribe has its own approach to natural and cultural resource preservation, stewardship, and education. The sections below summarize each of the nine federally recognized Tribes' approaches to natural and cultural resources.

Burns Paiute Tribe

The Burns Paiute Tribe website states that financial resources to protect cultural resources and preserve their heritage are scarce. They were only recently able to re-establish and maintain a culture and heritage department. The department seeks and acquires resources to ensure that their tribal history, language, and traditional ways of life are preserved and sustained. They also perform federally mandated cultural resource management activities on and off the reservation. The Culture and Heritage Department's work focuses on gaining stronger ties and preserving the knowledge of elders. Programs include archaeology, The

Waditka Yaduan Language Preservation Project, Tribal Historic Preservation Office, Cultural Resource Management, and Research. (Burns Paiute, 2025)

Confederated Tribes of Coos, Lower Umpqua and Siuslaw Indians (CTCLUSI)

CTCLUSI's Natural Resources & Cultural Department has established programs to protect lands, waters, and cultural and natural resources. Programs include Air and Water programs (monitoring and investigating contamination to those resources with ongoing mitigation), Tribal Response Program (remediation of contaminated properties, response planning and actions to protect tribal resources), Restoration and Wetlands Program, Forest Management Program, Tribal Historic Preservation Program. Additional programs are also available to tribal and youth members including cultural stewardship, tobacco prevention, and language. (CTCLUSI, 2022)

Confederated Tribes of Grand Ronde

The mission of the Cultural Resources Department of the Confederated Tribes of the Grande Ronde is to "support a healthy community by facilitating dialogue, maintaining continuity, and providing protection of tribal lifeways for the benefit of future generations" (Confederated Tribes of Grand Ronde, 2025)

The Cultural Resources Department includes the Historic Preservation Office, Cultural Education, and the Chachalu Museum and Cultural Center. The Historic Preservation Office focuses their work on Archeology, Research, and the Cultural Protection Program. They coordinate with federal and state agencies on projects throughout ceded and ancestral homelands and advocate for the tribe's cultural resources. The Cultural Education program provides the tribal community with cultural classes and events that allow tribal members to gain a deeper understanding of cultural knowledge and identity. (Confederated Tribes of Grand Ronde, 2025)

Confederated Tribes of Siletz Indians

The Confederated Tribes of Siletz Indian's government includes a natural resources department with a mission to "protect, enhance, and provide for the wise use of all the Tribe's natural resources in a manner which will ensure that all generations to come will benefit from these resources. This philosophy applies to all lands to which the Tribe is historically tied, including its ancient, aboriginal, ancestral lands, its Coast Reservation, and its current and future land holdings." The Natural Resources department focuses their work on Tribal forestry, aquatics, wildlife, hunting and fishing, housing, and environmental protection. (Confederated Tribes of Siletz Indians, 2025)

The tribe organizes the Nesika Illahee Powwow every summer in Siletz Oregon with dancing, drumming, and singing and vendors representing indigenous American arts, crafts, and food. (Confederated Tribes of Siletz Indians, 2025) They also organize a language program that teaches Southwest Oregon/Northwest Californian Athabaskan language. Their Healthy Traditions Project provides education to members on the use of traditional foods. (Confederated Tribes of Siletz Indians, 2025)

Confederated Tribes of the Umatilla Indian Reservation (CTUIR)

CTUIR has established a program within their Department of Natural Resources called the Cultural Resources Protection Program. The program promotes the protection, preservation, and perpetuation of

CTUIR's culturally significant resources both on and off their reservation. However, all other CTUIR government departments are in part responsible for cultural resources.

CTUIR's comprehensive plan emphasizes cultural resources in three elements: Natural Resources, Cultural Heritage, and Treaty Rights. Specific focuses include protecting and preserving culturally significant places and resources including graves and sacred items of members and ancestors both on the reservation and in ceded lands and traditional use areas, protecting and restoring First Foods and exercising First Foods rights, and protecting, preserving and perpetuating culturally significant places and resources for current and future generations. (CTUIR, 2021)

Confederated Tribes of Warm Springs

The Confederated Tribes of the Warm Springs government includes a natural resources branch with a mission to "plan and execute a balanced direction for the protection, use, and enhancement to all tribal natural resources." Their work includes parks and outdoor recreation, conservation land programs, cultural resources, range and agriculture, forestry, fisheries, wildlife, water and soil, and GIS.

The cultural resources office is part of the Natural Resources Branch that works for the protection, preservation, and enhancement of cultural resources. They focus on cultural inventories on reservation. They also work off-reservation with federal, state, county, and city entities to protect and enhance tribal cultural resources. They act as the technical advisor for the tribe on the National Historic Preservation Act, the Native American Graves Protection and Repatriation Act, and the Archeological Resources Protection Act. (Confederated Tribes of Warm Springs, 2021)

Cow Creek Band of Umpqua Tribe of Indians

The Cultural Resources Department and the Natural Resources Department are separate departments of the tribal government. The cultural resources program focuses on helping Tribal members connect with traditional ways. Their focus is discovering, restoring, and preserving culture to share with members through cultural arts, events and the Takelma language. The natural resources department focuses on protection, preservation, and restoration of the flora, fauna, and earth and maintaining a connection to cultural sites and history. (Cow Creek Band of Umpqua Tribe of Indians, 2025)

Coquille Indian Tribe

The Coquille Indian Tribe have several programs that focus on natural and cultural resources. They emphasize Potlach, or the ancient practice of greeting, feeding, and bestowing gifts on guests in their work, events, and classes. Their cultural work includes a focus on artisanship, ancient foods, preserving knowledge of canoeing, traditional dances and ceremonies, and language revitalization. They have a Tribal Historic Preservation Office with archaeologists and historians who focus on preserving and interpreting cultural sites and resources. They also have a cooperative management agreement with the Oregon Department of fish and Wildlife in Coos, Curry, Douglas, Jackson, and Lane Counties for management of fish and wildlife. (Coquille Tribe, 2022)

Klamath Tribes

Natural and cultural resources fall under several departments and committees within the Klamath Tribes. The Natural Resources Department focuses on protecting, preserving, and enhancing natural resources. The department includes: The Game Management Program, Aquatic Ecologist and Research Biologist, Natural

Resource Specialist in timber, and GIS. The Klamath Tribes also have the Ambodat (meaning in, at, or near the water) Department that "implements programs to restore and enhance the aquatic resources upon which the tribal members depend for their livelihood." They also have a language department that focuses on keeping the Klamath language alive and educating tribal members.

The Klamath Tribes also have a Culture and Heritage committee that advise the tribal chairman and tribal council on identification, perseveration, and protection of the traditional culture and heritage of the tribes. (The Klamath Tribes, 2025)

2.4 Built Environment

2.4.1 Infrastructure

Understanding the strengths and weaknesses of infrastructure systems is key to understanding how natural hazards will affect Oregon. It is also key to mitigating for hazards and preparing infrastructure to withstand those hazards. The following sections are an overview of transportation, energy, telecommunications, and water and wastewater in Oregon.

2.4.1.1 Transportation

Roads

Natural hazards and emergency events disrupt automobile traffic, create gridlock, and shut down local transit systems, making evacuations and emergency operations difficult. Roads and transportation infrastructure are also community lifelines that need to be restored as quickly as possible after a natural disaster to allow for the movement of people and supplies. The following sections describe the major highways in each region.

Region 1: Oregon Coast

Most of the population bases in Region 1 are located along the region's major freeway, US-101. US-101, also called the Oregon Coast Highway, runs north-south along the entire Oregon coast. It is the only continuous passage west of the Coast Range for automobiles and trucks traveling along the coast. Routes through the Coast Range that connect to US-101 link coastal communities the interior of the state.

Region 2: North Willamette Valley/Portland Metro

The largest population centers in Region 2 are located along the region's major freeways: I-5, State Route 205, and I-84. I-5 runs north-south through region 2. It is the main passage for automobiles and trucks traveling through the west coast states. Route 205 is a loop route that serves Portland and Vancouver and provides access through the eastern side of the Portland metro region. I-84 runs east-west and is the main passage for automobiles and trucks traveling east along the Columbia River.

Region 3: Mid/Southern Willamette Valley

The highway system in the Region 3 centers on I-5 which runs north-south through the region. Several major east-west highways intersect it connecting the region to the I-5 corridor including Route 20, Route 22, and Route 58 which are all ODOT Lifeline Routes.

Region 4: Southwest Oregon

The cities of Ashland, Grants Pass, Medford, and Roseburg, the largest population centers in the region, are located along Interstate 5. I-5 runs north-south through the region and is the main passage for automobiles and trucks traveling along the West Coast. Route 109 and Route 140, which are both ODOT lifeline routes, connect to I-5 in this region.

Region 5: Mid-Columbia

The largest population bases in Region 5 are located along the region's major freeway, I-84. I-84 is the main east-west passage for automobiles and trucks traveling east along the Oregon and Washington border. Route 97 and Route 197, which are ODOT lifeline routes, run north south and connect to 1-84 along the Columbia River.

Region 6: Central Oregon

The largest population bases in the Central Oregon region are located along the region's major highways, including US-97, US-20, and US-26. All three routes are ODOT lifeline routes.

Region 7: Northeast Oregon

The largest population centers in Region 7 are located along the region's major freeway, I-84. I-84 runs northwest to southeast across the region. US-26, US-244, OR-245, and US-395 provide access west into Grant County. OR-82 provides access into Wallowa County. Additional north-south access is provided from Wallowa County to Washington via OR-3.

Region 8: Southeast Oregon

The largest population bases in the Southeast Oregon region are located along the region's major highways: I-84, US-20, US-26, and US-95. I-84 runs northwest to southeast. US-20, US-26, and US-95 provide access east and west into Idaho and central Oregon counties. US-395 provides access into Lake County.

Bridges

Oregon's rivers and varied topography have led to the construction of numerous bridges to maintain transportation connections across the state. Non-functional bridges disrupt local and freight traffic, emergency operations, and sever lifelines routes. These disruptions will have the potential to increase local economic losses if industries are unable to transport goods.

Many bridges across the state are part of the state and interstate highway system maintained by the Oregon Department of Transportation (ODOT). ODOT manages 2,773 bridges as of their 2023 Bridge Condition Report. ODOT's inventory does not include all bridges across the state. Cities and counties maintain some bridges. The bridge layer on ODOT's GIS tool, TransGIS, has a total of

10,343 bridge and culvert structures statewide which includes both ODOT owned structures and structures owned by other entities. (ODOT, 2024)

ODOT's 2023 Bridge Condition Report details the state of bridge conditions on state highways. ODOT assesses bridge conditions based on both ODOT data and the National Bridge Inventory. They summarize conditions using several measures, but most often use the National Bridge Inventory rating for bridge components, the deficient bridge classification, and structural condition rating. The structural condition rating rates bridges on a scale from very poor to very good. Only 44 bridges were in poor condition, or structurally deficient, in 2023. However, trends show that bridge conditions overall are slowly declining. (ODOT, 2023)

ODOT also tracks bridge key performance measures, a percentage of ODOT bridges not in distressed condition. The target percentage is 78 percent of bridges not distressed. In 2023, 77.9 percent of bridges were not in distressed condition. This rate is below the target but an improvement over the 2022 rating of 77.2%. ODOT has concerns that overall bridge ratings will continue to deteriorate as bridges across the state continue to age. ODOT has been unable to obtain enough funding to keep up with continued deterioration. The Department replaced three bridges in 2023 but would need to replace approximately 27 bridges annually to keep up with the 100-year design life of bridges. (ODOT, 2023)

ODOT operates a seismic retrofit program that prioritizes bridges for seismic retrofits based on the routes that would be most important in a seismic event. The program has five phases. Phase 1 routes provide a connection to the Redmond airport, east-west freight movement, and the north-south U.S. 97 corridor. Phase 2 routes connect the Willamette Valley with coastal communities and southern Oregon. Phase 3 adds redundancy and capacity to routes that were strengthened in phase 1 and 2. Phase 4 finalizes all proposed seismic lifeline corridors. Phase 5 is 12 full replacements of major bridges. of the program includes 709 bridges total. As of 2023, 35 of those bridge projects had been completed and 18 more had been funded. The program is facing significant challenges with the complexity of these projects as well as increased construction costs. (ODOT, 2023)

Railroads

Oregon's rail system is critical to the state's economy, energy, and food systems. Rail systems export lumber and wood products, pulp and paper, and other goods produced in Oregon and transport products from other states to and through Oregon (ODOT, 2020). Disruptions to the rail system can result in economic losses. The potential for harm from rail accidents can also have serious implications for local communities, particularly if they are carrying hazardous materials.

Region 1: Oregon Coast

Region 1 rail lines are short lines and freight routes, connecting the coast to larger rail lines and inland metropolitan areas. Curry County is the only coastal community without rail. The region's rail providers are the Portland & Western Railroad (PNWR), Port of Tillamook Bay Railroad (POTB), and the Coos Bay Rail Link (CBRL). The PNWR lines in Clatsop County connect Astoria to the Portland Metro Area. The POTB line connects Tillamook to inland railways operated by PNWR. Though there is no commuter rail line in the region, the Oregon Coast Scenic Railroad runs short scenic rail excursions along the coast near Tillamook.

Region 2: North Willamette Valley/Portland Metro

Region 2's major (Class I) freight rail providers are the Union Pacific (UP) and the Burlington Northern-Santa Fe (BNSF) railroads. The Port of Portland is a major marine gateway for rail freight. The region has six major rail yards and terminals operated by UP and BNSF, all located in Portland. Amtrak provides passenger rail service through the region. The Portland Westside Express Service provides commuter rail in Washington County. The Portland area is also serviced by a regional transit system (TriMet) that provides light rail service in the greater Portland Metropolitan area.

Region 3: Mid/Southern Willamette Valley

Region 3's railroads primarily run north-south. The Union Pacific Railroad is the major freight rail provider in the region. An Amtrak passenger train also runs on the UP line. It runs north to Spokane and south to Southern California where the tracks turn east and continue to Texas. Other freight railroads in the region include Central Oregon and Pacific, the Albany and Eastern, the Portland and Western, the Hampton Railway, the Willamette and Pacific, and the Willamette Valley Railway.

Region 4: Southwest Oregon

The region's rail providers are the Central Oregon & Pacific and the Rogue Valley Terminal Railroad. The Central Oregon & Pacific Line follows I-5 through the region, then runs west through Lane County and loops back into region 4 through Reedsport. The Rogue Valley Terminal Railroad is a short 12-mile spur off the Central Oregon & Pacific Line in Jackson County (ODOT, 2020). There is no passenger rail in the region.

Region 5: Mid-Columbia

The region's major freight rail providers are the Union Pacific (UP) and the Burlington Northern-Santa Fe (BNSF) railroads. UP operates two major rail yards in the region in The Dalles and Hinkle. Hinkle Yard serves as UP's system yard and locomotive service and repair yard for Oregon and the greater northwest area. (ODOT, 2020) Amtrak provides passenger rail service along the Columbia River Gorge and eastward via the Empire Builder line, on the Washington side of the river.

Region 6: Central Oregon

The region's major (Class I) freight rail providers are the Union Pacific and the Burlington Northern-Santa Fe railroads. BNSF and UP operate one major rail yard in Klamath Falls. The Klamath Falls Yard, which consists of two adjacent yards, is used for switching, storing rail cars, and locomotive repair. (ODOT, 2020) Amtrak provides passenger rail service from the Willamette Valley south through region 6 and southward to Los Angeles, California, with stops in Chemult and Klamath Falls.

Region 7: Northeast Oregon

The region's major (Class I) freight rail providers are the Union Pacific and the Burlington Northern-Santa Fe railroads. The Class I rail line follows the I-84 corridor. Another non-class I rail line provides access to Enterprise in Wallowa County. Grant County has no active rail lines. UP operates one rail yard in the region, in La Grande. (ODOT, 2020) Region 7 does not have passenger rail service.

Region 8: Southeast Oregon

The region's major freight rail providers are the Union Pacific and the Burlington Northern-Santa Fe railroads. The rail line follows the I-84 corridor. Another non-Class I rail line provides access to the City of Vale. Harney county has no active rail lines. UP operates two rail yards in Ontario and Nyssa. (ODOT, 2020) Region 8 does not have passenger rail service.

Airports

During and after natural disasters, public and private airports are important staging areas for emergency response activities. Public airport delays and closures will impact the ability for people to leave the region by air during and after a natural disaster. Businesses relying on air freight and the tourism industry may also be impacted by airport closures. The sections below detail major airports in each region and Table 2.4.1-1 gives a full count of the number of public and private airports and heliports in each region.

Region 1: Oregon Coast

Southwest Oregon Regional Airport in North Bend is the only commercial airport in the region and is the fifth busiest airport in Oregon. The airport is owned, operated and administered by Coos County Airport District. In 2023 about 50 passengers boarded planes at the Southwest Oregon Regional Airport each day. (FAA, 2024)

Region 2: North Willamette Valley/Portland Metro

Portland International Airport is the only primary commercial airport in the region and is the busiest airport in Oregon (FAA, 2024). The airport is owned, operated, and administered by the Port of Portland. In 2023, approximately 22,300 passengers boarded planes each day. (FAA, 2024) Approximately 71,000 flights flew out of Portland International Airport in 2023. (BTS, 2024) The Port of Portland also operates two relief airports, Portland-Hillsboro and Portland-Troutdale, which serve the region.

Region 3: Mid/Southern Willamette Valley

Eugene Airport is the largest public airport in the region and the second busiest airport in Oregon (FAA, 2024). The airport is owned, operated, and administered by the City of Eugene. In 2023 about 2,300 passengers boarded planes at the Eugene airport each day. (FAA, 2024)

Region 4: Southwest Oregon

Rogue Valley International-Medford Airport is the only commercial airport in the region and is the fourth busiest airport in Oregon. (FAA, 2024) The airport is owned, operated and administered by Jackson County. (FAA, 2025) In 2023, approximately 1,300 passengers boarded planes at Rogue Valley International-Medford Airport each day. (FAA, 2024)

Region 5: Mid-Columbia

The Eastern Oregon Regional Airport is the only commercial airport in the region and the seventh busiest airport in Oregon. (FAA, 2024) The airport is owned and operated by the city of Pendleton.

Three round trip flights between Portland and Pendleton leave the airport daily. (City of Pendleton, 2025).

Region 6: Central Oregon

The Redmond Regional Airport is the only commercial airport in the region and is the third busiest airport in Oregon. (FAA, 2024) The airport is owned and operated by the city of Redmond. (FAA, 2025) In 2023, about 1,500 passengers boarded planes at the airport daily. This airport has been identified to become a primary airport following a Cascadia Subduction Zone (CSZ) seismic event if Portland International Airport is incapacitated.

Region 7: Northeast Oregon

Northeast Oregon has no commercial airports and several general aviation public airports including Baker City and La Grande airports.

Region 8: Southeast Oregon

The Southeast Oregon region has no commercial airports and several general aviation public airports including the Burns and Ontario Municipal airports.

Table 2.4.1-2 - Public and Private Airports and Heliports by Region

	Number of Airports by FAA Designation				
	Public Airport	**Private Airport**	**Public Heliport**	**Private Heliport**	**Total**
Region 1	16	6	0	10	32
Region 2	11	32	1	22	66
Region 3	17	63	0	21	101
Region 4	10	29	0	11	50
Region 5	9	18	0	8	35
Region 6	17	40	0	11	68
Region 7	13	20	0	1	34
Region 8	6	17	0	1	24

Source: FAA Airport Data and Information Portal. (2025). *Published Data.* Airport Data and Information Portal

Ports

Oregon's ports have historically provided services for timber transport and for commercial and recreational fishing. Over the years, ports in Oregon have evolved to provide recreational, commercial, and economic services to Oregon residents and businesses by providing industrial land and infrastructure (river, rail, road, and air) and by promoting fresh seafood, fishing trips, and ecotourism. Oregon has 23 ports, with nine located in cities along the Columbia River and fourteen along the Pacific Coast. The ports along the Columbia River are a part of the Columbia-Snake port system that also includes ports in Washington and Idaho. Ports are special districts that function

similarly to a local government entity with an elected board of commissioners. (Oregon Legislature, 2010)

Region 1: Oregon Coast

Ports in the Oregon Coast Region are a major contributor to the local, regional, and national economies. In the North Coast, Ports include Astoria, Nehalem, and Garibaldi, and Tillamook Bay. The Port of Astoria is a deep-water port and includes facilities for cruise ships. In the Central Coast, ports include Newport, Toledo, Alsea, and Siuslaw. Newport and Siuslaw are active fishing ports that also provide an array of businesses catering to tourists. Port of Newport is a deep-water Port. In the South Coast, ports include Umpqua, Coos Bay, Bandon, Port Orford, Gold Beach, and Brookings-Harbor. The Port of Coos Bay is Oregon's largest coastal deep-draft harbor and supports cargo ships. (Oregon Legislature, 2010)

Region 2: North Willamette Valley/Portland Metro

Region 2 includes two ports: Port of Columbia County and Port of Portland. Port of Columbia County owns eight industrial properties that total 2,400 acres along 51 miles of the Columbia River. (Port of Columbia, 2025) Port of Portland is responsible for overseeing the Portland International Airport and other aviation and marine activities in the Portland Metro area. The Port of Portland includes three marine terminals, five industrial parks, and three airports (Port of Portland, 2025).

Region 5: Mid-Columbia

Region 5 includes three ports: Port of Cascade Locks, Port of The Dalles, and Port of Hood River. The port district of Port of Cascade Locks is approximately 347 square miles. The port's holdings include industrial land, a marine park, and the Bridge of the Gods. (Port of Cascade Locks, 2024) The Port of Hood River covers about half of Hood River County, extending south from the Columbia River through the Hood River Valley. It provides five types of facilities and services in the region: bridge, marina, airport, recreation, and property development. (Port of Hood River, 2025). Port of The Dalles district is approximately 664 square miles and covers the northern third of Wasco County. It includes industrial land and The Dalles Marina (Port of The Dalles, 2025).

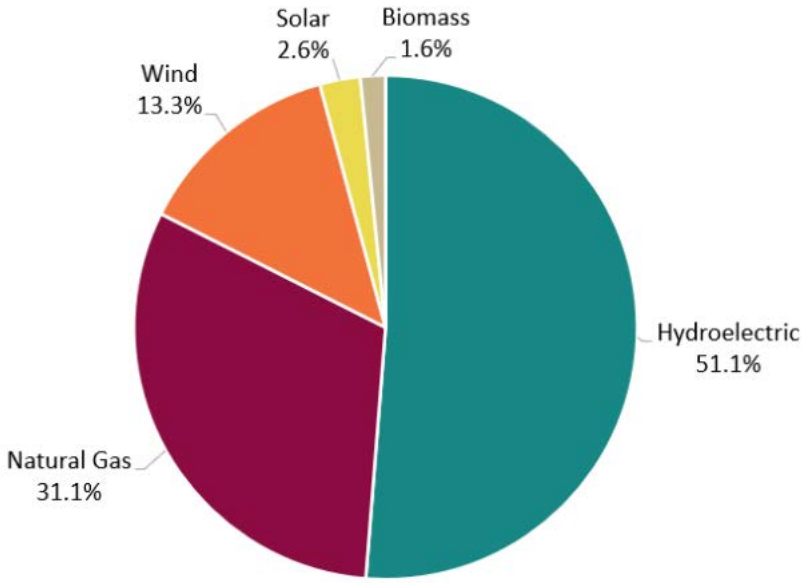
2.4.1.2 Energy

Safe and reliable energy systems are community lifelines in a natural disaster that need to be restored as soon as possible following a natural disaster. Energy systems are also vulnerable to hazards depending on the mode of production, transmission, and end use. Natural disasters can add stress to energy infrastructure that may lead to system damage or disruption in service. Energy systems in Oregon mainly break down into three categories: electricity, transportation fuel, and direct-use fuels. In 2022, 32 percent of energy used in Oregon was electricity. Thirty-one percent of energy use in 2022 was direct-use fuels which includes fuel oil and natural gas used for heat and other purposes like gas stoves. Thirty-seven percent of energy consumption was transportation fuels, almost all of which is imported from outside of the state. The following sections give further details on the energy produced and used in Oregon. (ODOE, 2024)

Electricity

Oregon's electricity is produced using a diverse array of resources. Figure 2.4.1-1 shows that in 2022 hydropower was used to generate more than half of the state's electricity (51%). Hydropower is followed by natural gas (31%), and wind (13%). Approximately 69 percent of electricity generated in Oregon is from non-greenhouse gas emitting resources. Energy produced in Oregon is both used in Oregon and sold to utilities in other states. In 2022, 37 percent of the state's hydropower and 45 percent of its wind generation were exported. (ODOE, 2024)

Figure 2.4.1-1 - Sources used to generate electricity produced in Oregon



Note: Based on data from 2022

Source: Oregon Department of Energy, 2024.

Oregon's eight natural hazards mitigation planning regions are served by three investor-owned electric utilities and 38 customer-owned or publicly owned electric utilities. (ODOE, 2021) All regions have electricity-generating facilities. (U.S. Department of Homeland Security, 2023) The following sections describe each region's electric system. Table 2.4.1-2 lists electric power-generating facilities by region.

Region 1: Oregon Coast

Region 1 has only two power plants, both of which are powered by biomass. (U.S. Department of Homeland Security, 2023) The Bonneville Power Administration (BPA) is the area's wholesale electricity distributor. Pacific Power and Light (Pacific Power) is the largest investor-owned utility company serving the region. The Blachly-Lane Electric Cooperative, Coos-Curry Electric Cooperative, and Western Oregon Electric Cooperative serve portions of the region. The Bandon Municipal Utility District serves an area around the City of Bandon in Coos County. In addition, the Tillamook People's Utility District, Central Lincoln People's Utility District, and Consumers Power Inc. serve portions of the region. (ODOE, 2021)

Region 2: North Willamette Valley/Portland Metro

Portland General Electric (PGE) is the largest investor-owned utility in the region, serving large areas of Clackamas, Multnomah, and Washington Counties. Pacific Power and Light (Pacific Power) is another investor-owned utility company serving a small portion of Multnomah County. The Western Oregon Electric Cooperative, Inc. provides electricity for portions of the region. Three municipal utility districts also support portions of the region: City of Cascade Locks, City of Forest Grove, and City of Canby. In addition, the Clatskanie People's Utility District and the Columbia River People's Utility District serve portions of the region. (ODOE, 2021)

The Bonneville Dam is the Bonneville Power Administration's major dam in the region, located on the Columbia River. Other dams in the region are located on Willamette, Clackamas, and Sandy Rivers.

Region 3: Mid/Southern Willamette Valley

The Bonneville Power Administration is Region 3's wholesale electricity distributor. Pacific Power and Light (Pacific Power) is the largest investor-owned utility company in the region, serving primarily Linn, Polk, and Marion Counties. Portland General Electric serves Marion and Yamhill Counties. The Blachly-Lane Electric Cooperative, Lane County Electric Cooperative, and Western Oregon Electric Cooperative each serve a portion of region 3. Four municipal utility districts serve the region: Eugene Water and Electric Board, Monmouth Power and Light Department, McMinnville Water and Light, and Springfield Utility Board. In addition, the Central Lincoln People's Utility District, Consumer's Power, Inc., Emerald People's Utility District, and Salem serve portions of the region. (ODOE, 2021)

The Detroit, Carmen-Smith, and Lookout Point dams generate the most power in the region. BPA's dams in region 3 are: Big Cliff and Detroit Dams on the North Santiam River, Foster and Green Peter Dams on the South Santiam River, Cougar Dam on the McKenzie River, and Dexter, Lookout Point, and Hills Creek Dams on the Middle Fork of the Willamette River.

Region 4: Southwest Oregon

The Bonneville Power Administration is Region 4's wholesale electricity distributor. Most of the region is served by Pacific Power and Light. The Coos-Curry Electric Cooperative and the Douglas Electric Cooperative serve portions of Douglas and Josephine Counties. The Umpqua Indian Utility Cooperative serves the Cow Creek Band of Umpqua Tribe of Indians, including the Seven Feathers Casino Resort in Douglas County. (ODOE, 2021)

Hydropower dams are primarily located on the Applegate, Rogue, and Umpqua Rivers.

Region 5: Mid-Columbia

The Bonneville Power Administration is Region 5's wholesale electricity distributor. Pacific Power and Light is the primary investor-owned utility company serving portions of Gilliam, Hood River, Morrow, Sherman, and Umatilla Counties. The region's electric cooperatives are the Hood River Electric Cooperative, Wasco Electric Cooperative, Columbia Basin Cooperative, Umatilla Cooperative, Columbia Power Cooperative, and Central Electric Cooperative. Two utility districts

serve the region: City of Cascade Locks and Milton-Freewater. In addition, the Northern Wasco People's Utility District serves portions of the region. (ODOE, 2021)

The major BPA dams in the region are located on the Columbia River in communities of The Dalles, John Day, and McNary.

Region 6: Central Oregon

The Bonneville Power Administration is Region 6's wholesale electricity distributor. Pacific Power and Light is the primary investor-owned utility company serving portions of Crook, Deschutes, Jefferson, Klamath, and Lake Counties. The region's electric cooperatives are: Central Electric Cooperative, Columbia Basin Cooperative, Columbia Power Cooperative, Harney Electric Cooperative, Midstate Electric Cooperative, Surprise Valley Electric Cooperative, and Wasco Electric Cooperative. (ODOE, 2021)

The major BPA dams in the region are the Pelton and Round Butte Dams on the Deschutes River.

Region 7: Northeast Oregon

The Bonneville Power Administration is Region 7's wholesale electricity distributor. Pacific Power and Light is the primary investor-owned utility company serving Wallowa County. Idaho Power Company serves portions of Baker County. The region's electric cooperatives are Oregon Trail Electric Cooperative, Central Electric Cooperative, Columbia Power Cooperative, and the Umatilla Electric Cooperative. The Oregon Trail Electric Cooperative serves the major population centers in the region. (ODOE, 2021)

Major dams in the region are the Brownlee, Oxbow, and Hells Canyon Dams on the Snake River.

Region 8: Southeast Oregon

The Bonneville Power Administration is the area's wholesale electricity distributor. Idaho Power is the primary investor-owned utility company serving Harney and Malheur Counties. The region's electric cooperatives include the Harney Electric Cooperative, and the Oregon Trail Electric Cooperative. (ODOE, 2021)

Table 2.4.1-4: Electric power plants by region and fuel source -only operational plants included

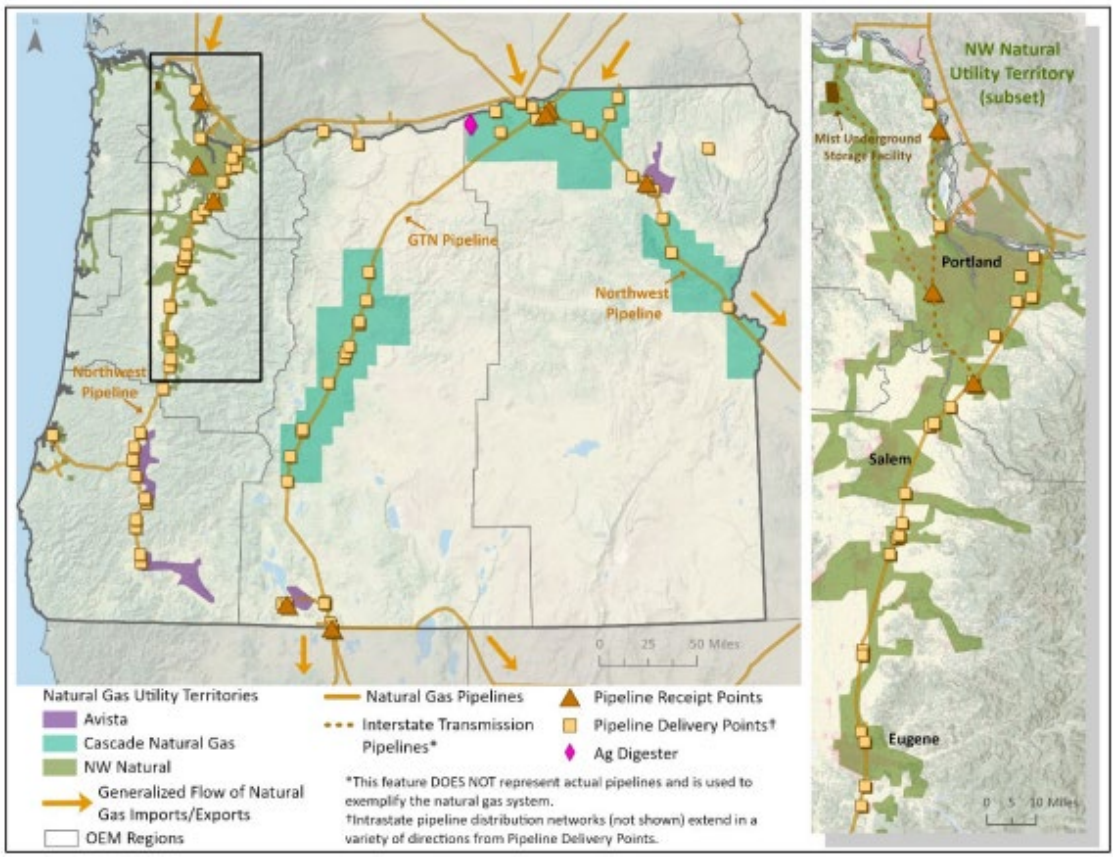
	Hydro-electric	Fossil Fuel	Wind	Biomass	Solar	Geothermal	Total Power Plants
Region 1	0	0	0	2	0	0	2
Region 2	9	3	0	1	6	0	19
Region 3	13	2	0	7	11	0	33
Region 4	16	0	0	4	1	0	21
Region 5	5	5	35	3	2	0	50
Region 6	12	2	0	0	16	0	30
Region 7	3	0	6	0	1	0	10
Region 8	2	0	0	0	5	1	8

Source: U.S. Department of Homeland Security Geospatial Management Office – Homeland Infrastructure Foundation Level Database Authoritative Feature Class for Power Plants. Updated September 21, 2023. https://hifld-geoplatform.hub.arcgis.com/datasets/geoplatform::power-plants-2/about

Natural Gas

Liquefied natural gas (LNG) is transported into Oregon via pipelines. No natural gas is produced in Oregon. Natural gas is used both as a direct use fuel source, and as fuel for producing electricity at power plants. As noted below, LNG pipelines run through some hazard mitigation regions. The Mist Underground Natural Gas Storage Facility is also located in Columbia County, in Region 2. LNG pipelines and natural gas storage facilities are vulnerable to earthquakes and can cause danger to human life, safety, and environmental impacts in the case of a release. Figure 2.4.1-2 shows existing LNG pipelines and natural gas utility territories in Oregon.

Figure 2.4.1-2 - Liquefied Natural Gas Pipelines and Infrastructure in Oregon



Source: Oregon Department of Energy. (2024). Energy Security Plan. https://www.oregon.gov/energy/safety-resiliency/Documents/2024-Oregon-Energy-Security-Plan.pdf

Oregon is served by three natural gas utilities: NW Natural, Cascade Natural Gas, and Avista. They do not serve the entirety of the state. NW Natural is mainly concentrated in the northwestern portion of the state, in Regions 1, 2, and 3 and small portions of Regions 4 and 5. Cascade Natural

Gas mainly serves portions of central Oregon, portions of Malheur and Baker Counties, and portions of Umatilla and Morrow County Avista serves small areas around Roseburg, Medford, Klamath Falls, and La Grande. For a detailed map of utilities, refer to Oregon Department of Energy's "Find Your Utility" tool (ODOE Find Your Utility).

Liquid Fuels

Liquid fuels generally refer to fossil fuels and alternative fuels like ethanol and biodiesel that are mainly but not exclusively used to power transportation. Most liquid fuels used in Oregon are produced outside of the state. Fuel is transported into the state via truck, barge, rail, and pipeline. Over 90 percent of liquid fuels in Oregon come from refineries in Washington. The remaining 10 percent come from refineries in Salt Lake City and the San Francisco Bay Area.

Most fuels used in Oregon are transported into the state via the Olympic Pipeline which generally follows I-5 south from the Canadian Border to the Portland fuel terminals at the Critical Energy Infrastructure Hub (refer to the section titled Critical Energy Infrastructure Hub for more information about where the fuel terminals are located). Smaller portions of fuel are also delivered to the state via truck from Washington, Idaho and Nevada. Maritime vessels also supplement the flow of fuel to the Portland fuel terminals. (ODOE, 2024)

From the Portland Fuel Terminals, the Kinder Morgan Pipeline transports diesel fuel to the Eugene terminal, the main terminal for central and southwest Oregon. Pipelines also carry jet fuel to Portland International Airports. Barges are used to deliver fuels from the Portland terminals up the Columbia River to terminals in Umatilla County. After fuels are transported to other terminals, they are dispersed to smaller storage facilities, retailers (like gas stations), and end users across the state via truck. (ODOE, 2024)

Critical Energy Infrastructure Hub

Oregon's critical energy infrastructure hub (CEI Hub) is in Region 2, in north Portland. It is located along a six-mile stretch of the Willamette River between Sauvie Island to the north and the Fremont Bridge along US-30 to the South. The following energy sector facilities are located at the CEI Hub:

- All of Oregon's major liquid fuel port terminals
- Liquid fuel transmission pipelines and transfer stations
- Natural gas transmission pipelines
- Liquefied natural gas storage facility
- High-voltage electrical substations and transmission lines
- Electrical substations for local distribution

In 2013, DOGAMI conducted a study of the CEI Hub's earthquake risk. (Wang, Bartlett, & Miles, 2013) The study determined that most facilities at the site are constructed on soils susceptible to liquefaction and that the various energy sector facilities have significant seismic risks. An additional study by ECONorthwest for Multnomah County Office of Sustainability and Portland Bureau of Emergency Management in 2022 came to similar conclusions and inventoried the magnitude and extent of a potential fossil fuel release from the CEI Hub. Impacts would likely include loss of life and injuries, effects on navigation and river-related commercial activity, short- and long-term environmental effects, short- and long-term air quality impacts, and impacts on cultural resources.

In 2019, the Multnomah County Board of Commissioners adopted a resolution against the expansion of fossil fuel transportation and storage infrastructure in the county and that supports efforts to require the industry to bear the full cost of damages. (ECONorthwest, 2022)

2.4.1.3 Telecommunications

Telecommunications infrastructure includes television, telephone, broadband internet, radio, and ham radio. These systems are key for maintaining communications capabilities during natural disaster events and other emergency situations to keep citizens safe and informed. Additionally, responders depend on telecommunications infrastructure to be routed to sites where they are needed.

OEM coordinates the Oregon Emergency Response System (OERS) that manages state resources in response to natural and technological emergencies involving multi-jurisdictional cooperation between all levels of government and the private sector. It was established in 1972 to improve communication and coordination between government agencies. (OEM, 2025)

Television

Television serves as a major provider for local, regional, and national news and weather information and can play a vital role in emergency communications. The local primary stations identified as emergency messengers are identified in the Oregon State Emergency Alert System Plan which is required by the Federal Communication Commission (SECC, 2022).

Telephone and Broadband

Landline telephone, mobile wireless telephone, and broadband providers serve each of the eight natural hazards mitigation planning regions. Broadband technology is provided in all regions via cable, digital subscriber line (DSL), fiber, fixed wireless, and/or mobile wireless. However, there are still gaps in internet access across the state. Certain populations are more likely to disproportionately lack access to broadband internet including:

- Households with annual income at or below 150 percent of the federal poverty level
- Older adults (60+)
- Veterans
- Individuals with disabilities
- Individuals with a language barrier
- Individuals who are members of racial or ethnic minority groups
- Residents of rural areas (American Immigration Council, 2022)

Landline telephones are not very common throughout the state. Residents in rural areas rely more heavily on landlines due to less consistent cellular reception outside of major transportation corridors. Wireless providers sometimes offer free emergency mobile phones to those impacted by disasters, which can aid communication when landlines and broadband service are unavailable.

Radio

Radio is readily available to those who live within each of the eight natural hazards mitigation planning regions and can be accessed through car radios, emergency radios, and home sound systems. Radio is a major communication tool for weather and emergency messages. Radio transmitters for each region are identified in the Oregon State Emergency Alert System Plan (SECC, 2022)

Ham Radio

Amateur radio, or ham radio, is a service provided by licensed amateur radio operators. Ham radio is an alternate means of communicating when normal systems are down or at capacity. Emergency communication is a priority for the Amateur Radio Relay League (ARRL), the national association for amateur radio operators. Each region is served by Amateur Radio Emergency Service (ARES) districts. Radio Amateur Civil Emergency Services (RACES) is a special phase of amateur radio recognized by FEMA that provides radio communications for civil preparedness purposes including natural disasters. The Oregon Section of the American Relay Radio League has more information on their ARES webpage.

2.4.1.4 Water and Wastewater

Drinking water, stormwater, and wastewater systems are all vulnerable to natural hazards and those vulnerabilities can have repercussions on human health, ecosystems, and industry. They are all key lifelines that will need to be restored as quickly as possible in the event of a natural disaster.

Drinking Water

In most of Oregon, municipal drinking water supplies are obtained primarily from a combination of surface water and groundwater sources. Of the 935 total community water systems in Oregon, approximately 150 systems use surface water as their primary source and 665 use groundwater. However, of the 138 systems across the state that serve populations of over 10,000 people, 72 have surface water as their primary source and only 12 have groundwater as their primary source. (OPH, 2025) Because of high levels of turbidity in streams during heavy rain events, many communities are investing in new well fields. Earthquakes pose a major threat to water supply because of the risk of dam failure at reservoirs.

Rural residents draw water from surface water, groundwater wells, or springs. Areas with sedimentary and volcanic soils may be subject to high levels of arsenic, hydrogen sulfide, and fecal coliform bacteria, which can impact the safety of groundwater sources. In areas where no new live-flow water rights are available, farmers and ranchers are using above-ground storage to supply water for crop irrigation during dry seasons. At times, urban water districts with surplus water have sold water to rural areas.

Surface sources for drinking water are vulnerable to pollution caused by non-point sources and point sources. Pollution is a major threat to surface water quality, and may include stormwater runoff from roadways, agricultural operations, timber harvest, erosion and sedimentation. DEQ,

ODA, and ODF have programs in place to address water quality concerns caused by land management practices. However, many water bodies continue to not meet water quality standards and pesticide benchmarks. In general, ODA's water quality rules and Confined Animal Feeding Operations (CAFO) program do provide some protection. However, the CAFO program is designed to provide water quality protection for up to a certain design storm, not for a major flood or other natural hazard event. Landslides, flood events, earthquakes and resulting liquefaction can cause increased erosion and sedimentation in waterways.

Underground water supplies and aging or outdated infrastructure such as reservoirs, treatment facilities, and pump stations can be severed or damaged during a seismic event. Rigid materials such as cast iron may snap under the pressure of liquefaction. More flexible materials such as polyvinyl chloride (PVC) and ductile iron may pull apart at joints under the same stresses. These types of infrastructure damage could result in a loss of water pressure in municipal water supply systems, thus limiting access to potable water. This can lead to unsanitary conditions that may threaten human health and limit fire suppression.

Region 1: Oregon Coast

In Region 1 municipal drinking water is mainly supplied by surface water. Each county's water is drawn from several major waterways, including the Youngs, Nehalem, Wilson, Nestucca, Siletz, Yaquina, Alsea, Siuslaw, Umpqua, Coos, Coquille, and Rogue Rivers. Limited access to water due to low summer flows has become a major concern in the region. New water rights cannot be purchased in region 1. Conservation approaches now allow landowners to share or sell a portion of their water rights to downstream users.

Region 2: North Willamette Valley/Portland Metro

In Region 2 municipal drinking water mainly comes from surface water with supplementary groundwater when needed. The Bull Run watershed is the primary drinking source for the City of Portland. For many communities in region 2, the Willamette River is both a source of potable water and a discharge location for wastewater treatment facilities. The Portland Water Bureau has water wholesale contracts with 19 other water providers in the Portland area that serve about 351,000 people. Wholesale contracts are with cities, water districts, and private water companies. (PWB, 2025) Cities that draw water from the Willamette River face water rights disputes and issues related to water quality.

Region 3: Mid/Southern Willamette Valley

Most of Region 3's municipal drinking water supply is from surface water sources with supplementary ground water sources. For many communities in region 3, the Willamette River is both a source of potable water and a discharge location for clean wastewater treatment plant effluent. Cities that draw water from the Willamette River face water rights disputes and issues related to water quality.

Region 4: Southwest Oregon

Most of Region 4's municipal drinking water supply is obtained from surface water. In Jackson and Josephine Counties, the Rogue River provides municipal water supplies to most cities. The City of

Cave Junction, however, uses water from the Illinois River. In Douglas County, most cities source their water from the Umpqua River and its tributaries.

Region 5: Mid-Columbia

The drinking water supply in Region 5 is drawn from a combination of surface, well, and spring sources. In the eastern and western portions of the region, surface water sources are often supplemented by groundwater. The region's central counties use groundwater as a primary source, supplemented with springs where they are available. In this part of the region groundwater shortages are increasing. Water quality in the region's municipal supply is good. Water quality could be threatened as older or damaged well infrastructure may not filter coliform and other bacteria as effectively as newer infrastructure.

Region 6: Central Oregon

In Region 6 municipal drinking water supply is from both surface and ground sources. In Crook, Deschutes, Jefferson, and Klamath Counties, rural areas use surface water sources. In the upper basin of Klamath County, rural drinking water is drawn from springs. The lower basin draws water from Klamath Lake for drinking water and irrigation. In rural areas of Lake County, drinking water is primarily drawn from wells. The region's cities primarily draw drinking water from wells except Bend, which draws water from Bridge Creek, a spring-fed waterway. A small portion of the City of Lakeview's drinking water is drawn from springs.

Region 7: Northeast Oregon

In Region 7 municipal drinking water supply is from both surface and ground sources. In Wallowa and Grant Counties, most municipal drinking water is from wells and supplemented by surface water. In Grant County, cities draw drinking water equally from a combination of surface and ground sources. Baker City draws its water from mountain springs. Other cities in Baker County depend primarily on groundwater wells for municipal drinking water. Rural residents also obtain water primarily from both surface sources and groundwater wells.

Region 8: Southeast Oregon

In Region 8, most municipal drinking water is from groundwater wells. The City of Ontario primarily draws drinking water from the Snake River. The City of Nyssa also uses the Snake River as a secondary water source. The City of Vale primarily uses the Malheur River as a primary source and groundwater wells as a backup. Rural areas in Malheur County draw drinking water from the Owyhee River, Beulah Reservoir, and Billy Creek. In Harney County, rural drinking water is drawn primarily from groundwater wells. Irrigation water is generally from surface sources and distributed through established irrigation districts in Malheur County. In Harney County, irrigation water is drawn from a combination of groundwater wells and surface sources including the Silvies, Donner und Blitzen River, and smaller tributary creeks. Water shortages have become common in region 8. Low levels of snowpack can lead to severe shortages in a region that is already subject to annual shortages. Low precipitation levels can lead to low levels of groundwater recharge, which could impact both agricultural and municipal supplies. Additionally, no new water rights are available for surface water, although groundwater rights are still available in Malheur County.

Stormwater

Stormwater runoff is precipitation that flows over land or impervious surfaces rather than infiltrating where it lands. Stormwater runoff can pick up pollutants, such as sediments and chemicals, and wash them into water bodies, causing non-point source pollution. In urbanized areas, where larger portions of the land surface are impervious due to development, a lack of treatment for non-point source pollution can lead to adverse impacts to surface water quality. If the downstream water body is used for drinking water, this can affect drinking water quality. Non-point source pollution can also lead to environmental issues, such as increases in surface water temperatures or increased concentrations of nutrients that can adversely affect habitat health. Furthermore, large volumes of fast-moving stormwater entering surface waterways can cause erosion issues and impact the integrity of roads and other infrastructure. (EPA, 2025)

Sewer infrastructure is also vulnerable to more intense storms and increased runoff from impervious areas. Leaves, trash, and other debris can clog stormwater systems. In urban areas with combined sewers, where stormwater runoff, sewage, and industrial wastewater are all transported in one pipe, large amounts of stormwater runoff into the storm sewer can lead to combined sewer overflows (CSOs). Combined sewer overflows happen when the amount of runoff exceeds the capacity of the sewer system and untreated stormwater and wastewater flow directly into nearby waterbodies. CSOs present a heightened health threat as sewage can be discharged directly into surface water bodies instead of being treated at wastewater treatment plants. (EPA, 2024) Underground stormwater and wastewater pipes are also vulnerable to damage by seismic events.

Requirements for stormwater mitigation vary by region due to differences in precipitation and amounts of development. Low impact development (LID), or stormwater infrastructure that uses or mimics natural processes to infiltrate, evaporate, or use stormwater, can alleviate or lighten the burden to a jurisdiction's storm sewer system. Low impact development aims to manage stormwater runoff as close to the source as possible and avoid discharging it into storm sewer systems. Where stormwater does need to enter storm sewers, LID can decrease volume, flow rate, and temperature of the stormwater. (EPA, 2024) The City of Portland has been recognized as a national innovator in stormwater management and code because of its progressive LID stormwater mitigation strategies in the City's building code. However, most jurisdictions do not require LID strategies in their building codes. Requiring decentralized LID stormwater management strategies could help reduce the burden of new development on storm sewer systems and increase a community's resilience to flooding and seismic events, among other hazards.

Wastewater

Wastewater is water that has been generated from residential, commercial, industrial, mining, or agricultural operations that require advanced treatment. (EPA, 2025) Wastewater collection and treatment systems generally fall into two categories: decentralized systems and centralized systems. Decentralized systems treat sewage close to where wastewater is generated rather than transporting it to a centralized wastewater treatment location. Decentralized systems are most commonly individual septic systems or small community cluster systems. Decentralized systems are used more often in small communities and rural areas where distance, terrain, or cost prevent the

construction of centralized systems. Almost 25 percent of households in the United States are on a decentralized wastewater system. (EPA, 2024) Decentralized wastewater systems in Oregon are governed by OAR 340-071 *Onsite Wastewater Treatment Systems.* The state's onsite wastewater management program is implemented by the Oregon Department of Environmental Quality (DEQ). Septic system permits have been required in Oregon since 1972. DEQ maintains records for Baker, Coos, Jackson, Union, and Wallowa counties. All other counties maintain septic permits at a county level. Contacts for each county can be found on the DEQ website: Oregon DEQ - Onsite Septic Staff and County Agent Contact Information

Centralized systems are municipal sewer systems that transport wastewater via pipes to a central wastewater treatment facility. After wastewater is treated, it is discharged to surface water our groundwater. Most urbanized areas use centralized sewer systems. Across the United States about 75 percent of households are connected to centralized sewer systems. (EPA, 2024) Centralized wastewater systems in Oregon are governed by OAR 860-037 *Wastewater Service Regulation for Joint Water/Wastewater Utilities.* Under the Clean Water Act, every wastewater treatment plant is required to maintain a National Pollutant Discharge Elimination System (NPDES) permit. Oregon DEQ issues NPDES permits, except those on tribal lands which are issued by EPA. Of the nine federally recognized tribes' land, only the Confederated Tribes of Warm Springs Reservation Wastewater Treatment Plant holds an EPA NPDES permit (EPA, 2024). Statewide, there is a total of 49 major wastewater treatment plants and 117 minor treatment plants. Plants are heavily concentrated in regions 1, 2, 3, and 4 and along the Columbia River where population density is higher. (U.S. Department of Homeland Security, 2025)

2.5 Economy

The impact of natural hazards on economic conditions depends on many variables. The vulnerability of businesses' labor, capital, suppliers, and customers are all relevant factors. (Zhang , Lindell, & Prater, 2009) Some industries, such as manufacturing and construction, rebound quickly and even thrive following a disaster. Others, like wholesale and retail, rebound more slowly or never recover (Zhang , Lindell, & Prater, 2009). 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 employment sectors, workforce participants, financial and natural resources, and critical infrastructure are interconnected and interdependent.

2.5.1 Employment and Unemployment

Natural disasters do not impact all labor market participants equally. Unemployed and underemployed populations are disproportionately affected by disaster events. Research shows that employment outcomes can be especially bad for people physically displaced by a disaster (Karoly & Zissimopoulos, 2010). Moreover, those who are unemployed and many who are employed in low-wage positions lack access to employee benefit plans that provide income and healthcare supports (Flanagan B. E., Gregory , Hallisey, Heitgerd, & Lewis, 2011). Income deprivation and inaccessible healthcare, ruinous in the best of times, are felt more severely following a disaster. It is important to understand existing labor force characteristics and existing market trends to build a resilient workforce and mitigate the scope and intensity of disruptions and economic pain. Table 2.5.1-1 shows the total civilian labor force in each region, which includes people who are employed and unemployed in each county in each region. Table 2.5.1-1 shows the seasonally adjusted unemployment rate in each county and region.

Table 2.5.1-1: Civilian Labor Force, 2024

	Total Civilian Labor Force	Employed Workers	Unemployed
Oregon	2,190,716	2,100,284	90,432
Region 1			
Clatsop	20,078	19,264	814
Coos	26,735	25,455	1,280
Curry	8,888	8,427	461
Lincoln	21,419	20,398	1,021
Tillamook	12,281	11,804	477
Region 2			
Clackamas	227,136	218,507	8,629
Columbia	25,165	23,977	1,188
Multnomah	469,142	450,297	18,845
Washington	335,961	323,656	12,305
Region 3			
Benton	50,772	49,069	1,703
Lane	185,674	177,912	7,762
Linn	61,804	59,019	2,785
Marion	174,621	167,527	7,094
Polk	43,849	42,097	1,752
Yamhill	56,611	54,485	2,126
Region 4			
Douglas	47,706	45,308	2,398
Jackson	107,225	102,214	5,011
Josephine	35,995	33,992	2,003
Region 5			
Gilliam	943	898	45
Hood River	14,185	13,727	458
Morrow	6,123	5,894	229
Sherman	987	952	35
Umatilla	38,705	37,104	1,601
Wasco	13,600	13,050	550
Region 6			
Crook	11,416	10,789	627
Deschutes	106,779	102,529	4,250
Jefferson	10,459	9,972	487
Klamath	30,322	28,663	1,659
Lake	3,567	3,397	170
Wheeler	833	808	25
Region 7			
Baker	7,115	6,822	293

	Total Civilian Labor Force	Employed Workers	Unemployed
Grant	3,126	2,938	188
Union	12,153	11,588	565
Wallowa	3,630	3,472	158
Region 8			
Harney	3,598	3,445	153
Malheur	13,319	12,825	494

Source: Oregon Employment Department, 2025

Table 2.5.1-2: Annual seasonally adjusted unemployment rate (%)

	2019	2020	2021	2022	2023
United States	3.7	8.1	5.3	3.6	3.6
Oregon	3.7	7.6	5.2	3.9	3.7
Region 1					
Clatsop County	3.7	9.5	5.9	4.0	3.7
Coos County	4.8	8.6	6.2	5.0	4.5
Curry County	5.1	8.7	6.6	5.1	4.6
Lincoln County	4.3	10.8	6.7	4.9	4.2
Tillamook County	3.8	8.0	5.4	4.2	3.8
Region 2					
Columbia County	4.4	7.9	5.7	4.5	4.4
Clackamas County	3.4	7.2	4.8	3.6	3.4
Multnomah County	3.2	8.6	5.4	3.7	3.6
Washington County	3.1	6.5	4.4	3.3	3.2
Region 3					
Benton County	3.0	5.6	3.9	3.3	3.0
Lane County	4.0	7.9	5.5	4.3	4.0
Linn County	4.3	7.7	5.6	4.4	4.1
Marion County	3.9	7.0	5.1	4.0	3.7
Polk County	4.0	6.5	4.8	4.0	3.8
Yamhill County	3.4	6.8	4.7	3.6	3.5
Region 4					
Douglas County	4.8	7.8	5.8	4.9	4.7
Jackson County	4.3	7.8	5.4	4.4	4.3
Josephine County	4.9	7.9	6.2	5.3	5.1
Region 5					
Gilliam County	3.6	6.2	4.8	3.7	4.2
Hood River County	3.1	6.3	4.5	3.4	3.0
Morrow County	4.1	5.2	4.6	3.9	3.4
Sherman County	3.5	6.2	4.3	3.1	3.8

	2019	2020	2021	2022	2023
Umatilla County	4.8	6.8	5.2	4.3	4.1
Wasco County	4.1	7.1	5.2	4.1	4.0
Region 6					
Crook County	5.1	8.8	6.6	5.1	5.5
Deschutes County	3.9	7.9	5.3	3.9	3.7
Jefferson County	5	8.3	6.4	5.2	4.6
Klamath County	6.1	8.7	6.7	5.7	5.2
Lake County	5.4	5.7	5.5	5.1	5
Wheeler County	4.2	4.5	3.3	3.2	2.8
Region 7					
Baker County	4.6	7.2	5.1	4.5	4.3
Grant County	6.8	8.4	6.6	5.8	5
Union County	4.8	7.9	5.6	4.5	3.9
Wallowa County	5.7	7.2	5.4	5.1	4.4
Region 8					
Harney County	5.3	6	5.1	4.6	4.2
Malheur County	4.1	5.3	4.4	4.1	3.7

2.5.2 Supersectors

The North American Industry Classification System (NAICS) is a framework used by the United States, Canada, and Mexico to collect, analyze, and publish data about the North American economy. The classification system groups economic units with similar production processes according to a six-digit hierarchical structure that designates the sector, subsector, industry group, NAICS industry, and national industry (Office of Management and Budget , 2020). The U.S. Bureau of Labor Statistics through its Quarterly Census of Employment and Wages program adds to the NAICS hierarchy by grouping NAICS sectors into supersectors. (U.S. Bureau of Labor Statistics, 2019) This section describes regional economic activity through these supersectors.

Identifying supersectors with many business establishments and targeting mitigation strategies to support them can help the region's resilience. A business establishment is an "economic unit… that produces goods or provides services. It is typically at a single physical location and engaged in one, or predominantly one, type of economic activity" (U.S. Bureau of Labor Statistics, 2019). Individual business establishments are also likely to be impacted by natural hazards, with small businesses experiencing a disproportionate amount of risk.

Each supersector faces distinct vulnerabilities to natural hazards. Identifying a region's dominant supersectors and the underlying industries enables communities to target mitigation activities toward those industries' specific sensitivities. Each of the primary private employment supersectors represented across the state has sensitivity to natural hazards, as follows:

- **Trade, Transportation, and Utilities:** Retail Trade is the largest employment subsector within the Trade, Transportation, and Utilities sector. Retail Trade is vulnerable to disruptions in the disposable income of residents and to disruptions in the transportation system. Residents'

discretionary spending diminishes after natural disasters as spending priorities tend to focus on essential items.

- **Leisure and Hospitality:** This sector primarily serves regional residents with disposable income and tourists. Following a natural disaster, residents may have less disposable income. Tourists may choose not to visit a region with unstable infrastructure.

- **Education and Health Services:** The industries in these sectors play important roles in emergency response in the event of a disaster.

- **Manufacturing:** This sector is highly dependent upon transportation networks to access supplies and send finished products to outside markets. For these reasons, the manufacturing sector may be susceptible to disruptions in transportation infrastructure. However, manufacturers are frequently less dependent on local markets for sales, which may contribute to the economic resilience of this sector.

- **Professional and Business Services:** This sector is composed of professional service providing industries including scientific and technical professionals, management professionals and administrative and support services (e.g., engineering, law, headquarters, temp help, etc.). In general, this sector has low vulnerability to natural disasters. Vulnerability is increased if suppliers are affected or physical infrastructure such as buildings, roads, telecommunications, or water systems is damaged. Mitigation efforts for this sector should include preparing business continuity and recovery plans.

- **Natural Resources and Mining:** The primary industries within this sector regionally are largely crop and animal production. These industries tend to fluctuate seasonally and are vulnerable to a variety of natural hazards (winter storms, floods, etc.). In addition to the loss of farm production, wages could be lost due to natural disasters. These industries are also dependent upon transportation systems that are vulnerable to disasters.

The following sections detail the five major supersectors in each region, as well as business establishment size and employment by sector.

Region 1: Oregon Coast

In 2024, the five major supersectors by share of employment in Region 1 were:

1. Leisure and Hospitality
2. Trade, Transportation and Utilities
3. Local Government
4. Education and Health Services
5. Manufacturing

Retail businesses are concentrated in the larger cities of the region and disruption of the transportation system could sever the connectivity between people living throughout the region and these retail hubs. The importance of Health and Social Assistance industries is underscored in Region 1 because of the significant share of older adults and individuals with a disability. Health care is a relatively stable revenue sector regionally with an abundant distribution of businesses primarily serving a local population. More than half of all business establishments in Region 1 have fewer than five employees.

Table 2.5.2-1 - Business establishment size by county, 2022 (Region 1)

County	Total Business Establishments	Fewer than 5	5-9	10-19	20-49	50-99	100-249	250-499	500-999	1000 or more
Clatsop	1,604	900	321	220	119	29	11	N	N	N
Coos	1,618	878	325	228	137	30	12	5	N	N
Curry	702	424	145	79	46	3	N	3	N	N
Lincoln	1,632	934	351	197	117	20	9	3	N	N
Tillamook	763	437	168	91	48	12	4	N	N	N
Total by Size	6,319	3,573	1,310	815	467	94	36	11	0	0

Source: Bureau of Labor Statistics, County Business Patterns 2022

Table 2.5.2-2: 2024 Covered Employment by Sector, Region 1

	Region 1		Clatsop County		Coos County		Curry County		Lincoln County		Tillamook County	
Industry	Total Employment	%	Employment	%	Employment	%	Employment	%	Employment	%	Employment	%
Total all ownerships	78,289	100%	19,816	100%	23,008	100%	6,588	100%	18,881	100%	9,996	100%
Total private coverage	64,116	82%	17,524	88%	17,699	77%	5,436	83%	15,258	81%	8,199	82%
Natural resources and mining	2,108	3%	187	1%	769	3%	214	3%	265	1%	673	7%
Construction	3,885	5%	1,115	6%	1,124	5%	375	6%	830	4%	441	4%
Manufacturing	6,870	9%	2,071	10%	1,507	7%	644	10%	940	5%	1,708	17%
Trade, transportation and utilities	13,697	18%	3,576	18%	4,149	18%	1,221	19%	3,230	17%	1,521	15%
Information	455	1%	131	1%	136	1%	43	1%	95	1%	50	1%
Financial activities	2,533	3%	527	3%	750	3%	238	4%	824	4%	194	2%
Professional and business services	5,343	7%	1,135	6%	2,207	10%	349	5%	1,269	7%	383	4%
Education and health services	10,187	13%	2,715	14%	3,267	14%	802	12%	2,226	12%	1,177	12%
Leisure and hospitality	16,780	21%	5,446	27%	3,196	14%	1,344	20%	5,127	27%	1,667	17%
Other services	2,196	3%	608	3%	582	3%	190	3%	435	2%	381	4%
Unclassified	41	0%	12	0%	12	0%	(c)	(c)	17	0%	(c)	(c)
Total all government	14,172	18%	2,292	12%	5,309	23%	1,152	17%	3,623	19%	1,796	18%
Total federal government	1,066	1%	178	1%	329	1%	113	2%	326	2%	120	1%
Total state government	1,760	2%	381	2%	461	2%	162	2%	365	2%	391	4%
Total local government	11,347	14%	1,733	9%	4,519	20%	877	13%	2,932	16%	1,286	13%

Note: (c) = confidential information not provided by the Oregon Employment Department to prevent identifying specific businesses.

Source: Oregon Employment Department. (2025). Quarterly Census of Employment and Wages. Retrieved from Qualityinfo.org

Region 2: North Willamette Valley/Portland Metro

In 2024, the five major supersectors by share of employment in region 2 were:

1. Trade, Transportation and Utilities
2. Professional and Business Services
3. Education and Health Services
4. Manufacturing
5. Leisure and Hospitality

Retail businesses are concentrated in the larger cities of the region and are most numerous in the Portland Metro area. The importance of the healthcare and social assistance sector is underscored in region 2 because the region serves as a hub for health care.

More than half of all business establishments in region 2 have fewer than 5 employees. Region 2 also includes 46 employers with workforces exceeding 1,000 employees, representing a concentration of employment in certain sectors in Washington County in particular.

Table 2.5.2-3: Business establishment size by county, 2022 (Region 2)

County	Total Business Establishments	Fewer than 5	5-9	10-19	20-49	50-99	100-249	250-499	500-999	1000 or more
Clackamas	12,830	7,413	2,287	1,541	1,074	305	150	39	17	4
Columbia	1,011	566	221	122	76	17	7	N	N	N
Multnomah	27,434	14,786	4,960	3,668	2,551	811	464	129	42	23
Washington	16,302	8,710	3,010	2,102	1,542	517	304	72	26	19
Total by Size	57,577	31,475	10,478	7,433	5,243	1,650	925	240	85	46

Source: Bureau of Labor Statistics, County Business Patterns 2022

Table 2.5.2-4: 2024 Covered employment by sector, Region 2

	Region 2		Clackamas County		Columbia County		Multnomah County		Washington County	
Industry	Total Employment	%	Employment	%	Employment	%	Employment	%	Employment	%
Total all ownerships	991,205	100%	173,967	100%	11,713	100%	496,871	100%	308,654	100%
Total private coverage	878,804	89%	159,034	91%	10,039	86%	423,565	85%	286,166	93%
Natural resources and mining	11,645	1%	5,157	3%	442	4%	1,998	0%	4,048	1%
Construction	61,342	6%	14,791	9%	697	6%	26,342	5%	19,512	6%
Manufacturing	101,220	10%	17,662	10%	1,483	13%	29,717	6%	52,358	17%
Trade, transportation and utilities	182,103	18%	33,595	19%	2,316	20%	92,200	19%	53,992	17%
Information	20,983	2%	2,626	2%	63	1%	11,309	2%	6,985	2%
Financial activities	46,555	5%	7,669	4%	397	3%	24,482	5%	14,007	5%
Professional and business services	161,211	16%	24,704	14%	1,039	9%	81,626	16%	53,842	17%
Education and health services	155,102	16%	28,328	16%	1,654	14%	82,642	17%	42,478	14%
Leisure and hospitality	100,254	10%	17,450	10%	1,465	13%	53,293	11%	28,046	9%
Other services	37,336	4%	6,842	4%	468	4%	19,410	4%	10,616	3%
Unclassified	1,057	0%	211	0%	16	0%	546	0%	284	0%
Total all government	112,401	11%	14,933	9%	1,674	14%	73,306	15%	22,488	7%
Total federal government	14,678	1%	1,269	1%	77	1%	12,343	2%	989	0%
Total state government	10,056	1%	1,695	1%	222	2%	5,343	1%	2,796	1%
Total local government	87,670	9%	11,969	7%	1,376	12%	55,621	11%	18,704	6%

Note: (c) = confidential information not provided by the Oregon Employment Department to prevent identifying specific businesses.

Source: Oregon Employment Department. (2025). Quarterly Census of Employment and Wages. Retrieved from Qualityinfo.org

Region 3: Mid/Southern Willamette Valley

In 2024 the five major supersectors by share of employment in Region 3 were:

1. Education and Health Services
2. Trade, Transportation and Utilities
3. Local Government
4. Leisure and Hospitality
5. Manufacturing

Health care is a relatively stable revenue sector regionally with an abundant distribution of businesses primarily serving a local population. Retail businesses are concentrated in the larger cities of the region. The timber manufacturing industry is particularly vulnerable to droughts, landslides, and wildfires.

More than half of all business establishments in region 3 have fewer than 5 employees. Region 3 also includes employers with workforces exceeding 1,000 employees, representing a concentration of employment in certain sectors.

Table 2.5.2-5: Business establishment size by county, 2022 (Region 3)

County	Total Business Establishments	Fewer than 5	5-9	10-19	20-49	50-99	100-249	250-499	500-999	1000 or more
Benton	2,202	1,174	436	319	192	55	20	3	N	N
Lake	191	113	46	24	5	N	N	N	N	N
Linn	2,805	1,468	573	396	257	52	41	10	6	N
Marion	9,073	4,769	1,817	1,263	851	236	93	33	8	3
Polk	1,598	927	304	207	119	19	18	3	N	N
Yamhill	2,763	1,583	545	316	232	49	29	5	3	N
Total by Size	18,632	10,034	3,721	2,525	1,656	411	201	54	17	3

Source: Bureau of Labor Statistics, County Business Patterns 2022

Table 2.5.2-6: 2024 Covered employment by sector, Region 3

			Benton County		Lane County		Linn County		Marion County		Polk county		Yamhill County	
Industry	Total Employment	%	Employment	%	Employment	%	Employment	%	Employment	%	Employment	%	Employment	%
Total all ownerships	476,677	100%	37,441	100%	156,133	100%	48,624	100%	172,970	100%	22,564	100%	38,945	100%
Total private coverage	393,886	83%	28,435	76%	132,118	85%	42,883	88%	137,214	79%	17,868	79%	35,368	91%
Natural resources and mining	29,339	6%	1,169	3%	2,859	2%	2,997	6%	15,536	9%	2,737	12%	4,041	10%
Construction	27,992	6%	1,301	3%	7,563	5%	3,320	7%	12,309	7%	1,312	6%	2,187	6%
Manufacturing	44,372	9%	2,534	7%	14,353	9%	8,358	17%	10,618	6%	1,683	7%	6,826	18%
Trade, transportation and utilities	77,650	16%	4,528	12%	28,425	18%	10,256	21%	26,955	16%	2,542	11%	4,944	13%
Information	4,688	1%	662	2%	1,820	1%	289	1%	1,524	1%	112	1%	281	1%
Financial activities	16,774	4%	1,152	3%	7,035	5%	1,168	2%	5,795	3%	514	2%	1,110	3%
Professional and business services	43,770	9%	4,297	11%	17,418	11%	3,503	7%	14,893	9%	1,332	6%	2,327	6%
Education and health services	87,541	18%	7,108	19%	29,731	19%	7,603	16%	30,151	17%	4,505	20%	8,443	22%
Leisure and hospitality	46,291	10%	4,162	11%	17,548	11%	3,930	8%	14,305	8%	2,381	11%	3,965	10%
Other services	15,029	3%	1,479	4%	5,223	3%	1,411	3%	5,006	3%	712	3%	1,198	3%
Unclassified	441	0%	44	0%	144	0%	47	0%	121	0%	37	0%	48	0%
Total all government	82,793	17%	9,006	24%	24,016	15%	5,742	12%	35,756	21%	4,696	21%	3,577	9%
Total federal government	4,984	1%	540	1%	2,051	1%	395	1%	1,467	1%	89	0%	442	1%
Total state government	26,624	6%	342	1%	2,026	1%	683	1%	23,018	13%	290	1%	265	1%
Total local government	51,184	11%	8,124	22%	19,939	13%	4,664	10%	11,271	7%	4,316	19%	2,870	7%

			Benton County		Lane County		Linn County		Marion County		Polk county		Yamhill County	
Industry	Total Employment	%	Employment	%	Employment	%	Employment	%	Employment	%	Employment	%	Employment	%

Note: (c) = confidential information not provided by the Oregon Employment Department to prevent identifying specific businesses.
Source: Oregon Employment Department. (2025). Quarterly Census of Employment and Wages. Retrieved from Qualityinfo.org

Region 4: Southwest Oregon

In 2024, the five major supersectors by share of employment in Region 4 were:

1. Education and Health Services
2. Trade, Transportation and Utilities
3. Leisure and Hospitality
4. Manufacturing
5. Local Government

The importance of Health and Social Assistance industries is underscored in region 4 because of the significant share of older adults and individuals with a disability.

More than half of all business establishments in Region 4 have fewer than 5 employees.

Table 2.5.2-7: Business establishment size by county, 2022 (Region 4)

County	Total Business Establishments	Fewer than 5	5-9	10-19	20-49	50-99	100-249	250-499	500-999	1000 or more
Douglas	2,717	1,520	527	341	221	68	27	9	N	N
Jackson	6,554	3,605	1,281	856	552	159	83	13	N	3
Josephine	2,157	1,171	444	293	174	46	24	N	3	N
Total by Size	11,428	6,296	2,252	1,490	947	273	134	22	3	3

Source: Bureau of Labor Statistics, County Business Patterns 2022

Table 2.5.2-8: 2024 Covered employment by sector, Region 4

	Region 4		Douglas County		Jackson County		Josephine County	
Industry	Total Employment	Percent	Employment	Percent	Employment	Percent	Employment	Percent
Total all ownerships	160,558	100%	38,143	100%	91,056	100%	31,359	100%
Total private coverage	140,660	88%	31,380	82%	80,884	89%	28,396	91%
Natural resources and mining	7,303	5%	1,741	5%	4,669	5%	893	3%
Construction	8,379	5%	1,766	5%	5,453	6%	1,160	4%
Manufacturing	14,157	9%	4,584	12%	6,786	7%	2,787	9%
Trade, transportation and utilities	31,279	19%	6,955	18%	19,140	21%	5,184	17%
Information	1,420	1%	336	1%	855	1%	229	1%
Financial activities	5,346	3%	1,023	3%	2,889	3%	1,434	5%
Professional and business services	12,470	8%	2,942	8%	7,810	9%	1,718	5%
Education and health services	36,733	23%	6,834	18%	19,507	21%	10,392	33%
Leisure and hospitality	18,294	11%	3,886	10%	10,844	12%	3,564	11%
Other services	5,139	3%	1,279	3%	2,855	3%	1,005	3%
Unclassified	140	0%	35	0%	76	0%	29	0%
Total all government	19,898	12%	6,763	18%	10,172	11%	2,963	9%
Total federal government	3,851	2%	1,508	4%	2,014	2%	329	1%
Total state government	2,584	2%	707	2%	1,298	1%	579	2%
Total local government	13,463	8%	4,549	12%	6,859	8%	2,055	7%

Note: (c) = confidential information not provided by the Oregon Employment Department to prevent identifying specific businesses.

Source: Oregon Employment Department. (2025). Quarterly Census of Employment and Wages. Retrieved from Qualityinfo.org

Region 5: Mid-Columbia

In 2024, the five major supersectors by share of employment in Region 5 were:

1. Trade, Transportation and Utilities
2. Natural Resources and Mining
3. Education and Health Services
4. Local Government
5. Leisure and Hospitality

While smaller in overall employment figures, growth in the Information sector via increasing rates of data center development is driving economic growth in some counties in region 5. Because there are few employers in this sector, but employment is proportionally significant, employment data is confidential.

More than half of all business establishments in Region 5 have fewer than 5 employees.

Table 2.5.2-9: Business establishment size by county, 2022 (Region 5)

County	Total Business Establishments	Fewer than 5	5-9	10-19	20-49	50-99	100-249	250-499	500-999	1000 or more
Gilliam	67	39	16	6	3	3	N	N	N	N
Hood River	1,049	591	211	138	78	20	7	N	N	N
Morrow	215	121	43	21	17	5	5	N	N	N
Sherman	55	31	13	5	5	N	N	N	N	N
Umatilla	1,587	796	362	214	146	37	19	6	5	N
Wasco	720	401	138	101	57	14	7	N	N	N
Total by Size	3,693	1,979	783	485	306	79	38	6	5	0

Source: Bureau of Labor Statistics, County Business Patterns 2022

Table 2.5.2-10: 2024 Covered employment by sector, Region 5

	Region 5		Gilliam County		Hood River County		Morrow County		Sherman County		Umatilla County		Wasco County	
Industry	Total Employment	%	Employment	%	Employment	%	Employment	%	Employment	%	Employment	%	Employment	%
Total all ownerships	69,840	100%	1,007	100%	14,483	100%	7,208	100%	995	100%	33,619	100%	12,528	100%
Total private coverage	58,161	83%	746	74%	13,331	92%	6,278	87%	685	69%	26,553	79%	10,568	84%
Natural resources and mining	11,733	17%	54	5%	3,157	22%	1,530	21%	37	4%	4,445	13%	2,510	20%
Construction	2,950	4%	(c)	(c)	537	4%	338	5%	67	7%	1,579	5%	429	3%
Manufacturing	6,407	9%	19	2%	1,785	12%	1,578	22%	(c)	(c)	2,549	8%	476	4%
Trade, transportation and utilities	12,074	17%	112	11%	1,945	13%	838	12%	367	37%	6,803	20%	2,009	16%
Information	(c)	(c)	(c)	(c)	104	1%	(c)	(c)	(c)	(c)	(c)	(c)	269	2%
Financial activities	1,250	2%	10	1%	258	2%	50	1%	(c)	(c)	717	2%	215	2%
Professional and business services	3,513	5%	208	21%	954	7%	399	6%	18	2%	1,369	4%	565	5%
Education and health services	9,094	13%	74	7%	1,986	14%	330	5%	23	2%	4,448	13%	2,233	18%
Leisure and hospitality	7,175	10%	38	4%	2,273	16%	239	3%	94	9%	3,058	9%	1,473	12%
Other services	1,607	2%	41	4%	321	2%	74	1%	22	2%	775	2%	374	3%
Unclassified	(c)	(c)	(c)	(c)	12	0%	(c)	(c)	(c)	(c)	(c)	(c)	15	0%
Total all government	11,680	17%	261	26%	1,152	8%	930	13%	311	31%	7,066	21%	1,960	16%
Total federal government	1,276	2%	14	1%	165	1%	67	1%	156	16%	558	2%	316	3%
Total state government	2,130	3%	19	2%	118	1%	48	1%	23	2%	1,614	5%	308	2%
Total local government	8,273	12%	228	23%	868	6%	815	11%	132	13%	4,894	15%	1,336	11%

Note: (c) = confidential information not provided by the Oregon Employment Department to prevent identifying specific businesses.
Source: Oregon Employment Department. (2025). Quarterly Census of Employment and Wages. Retrieved from Qualityinfo.org

Region 6: Central Oregon

In 2024, the five major supersectors, by share of employment in region 6 were:

1. Trade, Transportation, and Utilities
2. Education and Health Services
3. Leisure and Hospitality
4. Professional and Business Services
5. Local Government

More than half of all business establishments in Region 6 have fewer than 5 employees.

Table 2.5.2-11: Business establishment size by county, 2022 (Region 6)

County	Total Business Establishments	Fewer than 5	5-9	10-19	20-49	50-99	100-249	250-499	500-999	1000 or more
Crook	634	390	118	68	45	4	5	3	N	N
Deschutes	8,456	5,235	1,396	978	629	141	57	16	3	N
Jefferson	451	272	100	39	33	N	5	N	N	N
Klamath	1,549	840	338	187	134	30	13	5	N	N
Lake	191	113	46	24	5	N	N	N	N	N
Wheeler	29	20	3	5	N	N	N	N	N	N
Total by Size	11,310	6,870	2,001	1,301	846	175	80	24	3	0

Source: Bureau of Labor Statistics, County Business Patterns 2022

Table 2.5.2-12: 2024 Covered employment by sector, Region 6

	Region 6		Crook County		Deschutes County		Jefferson County		Klamath County		Lake County		Wheeler County	
Industry	Total Employment	%	Employment	%	Employment	%	Employment	%	Employment	%	Employment	%	Employment	%
Total all ownerships	135,924	100%	7,617	100%	94,288	100%	6,949	100 %	24,083	100 %	2,627	100 %	360	100 %
Total private coverage	118,118	87%	6,373	84%	85,576	91%	4,901	71%	19,469	81%	1,583	60%	216	60%
Natural resources and mining	2,983	2%	(c)	(c)	982	1%	361	5%	1,175	5%	440	17%	25	7%
Construction	10,310	8%	836	11%	7,905	8%	160	2%	1,321	5%	79	3%	9	3%
Manufacturing	10,166	7%	696	9%	6,497	7%	1,175	17%	1,595	7%	203	8%	(c)	(c)
Trade, transportation and utilities	23,788	18%	1,253	16%	16,724	18%	946	14%	4,500	19%	333	13%	32	9%
Information	(c)	(c)	(c)	(c)	1,662	2%	43	1%	118	0%	20	1%	(c)	(c)
Financial activities	4,531	3%	197	3%	3,527	4%	98	1%	671	3%	38	1%	(c)	(c)
Professional and business services	13,843	10%	607	8%	11,255	12%	254	4%	1,637	7%	87	3%	3	1%
Education and health services	23,664	17%	826	11%	17,088	18%	888	13%	4,685	19%	113	4%	64	18%
Leisure and hospitality	20,919	15%	909	12%	16,248	17%	763	11%	2,790	12%	165	6%	44	12%
Other services	5,081	4%	305	4%	3,518	4%	209	3%	944	4%	98	4%	7	2%
Unclassified	(c)	(c)	(c)	(c)	169	0%	(c)	(c)	32	0%	(c)	(c)	144	40%
Total all government	17,668	13%	1,244	16%	8,712	9%	2,048	29%	4,615	19%	1,044	40%	5	1%
Total federal government	2,716	2%	377	5%	1,129	1%	96	1%	841	3%	235	9%	38	11%
Total state government	2,583	2%	135	2%	1,152	1%	373	5%	619	3%	203	8%	101	28%
Total local government	12,610	9%	732	10%	6,431	7%	1,578	23%	3,155	13%	606	23%	108	30%

Note: (c) = confidential information not provided by the Oregon Employment Department to prevent identifying specific businesses.

Source: Oregon Employment Department. (2025). Quarterly Census of Employment and Wages. Retrieved from Qualityinfo.org

Region 7: Northeast Oregon

In 2024, the five major supersectors by share of employment in region 7 were:

1. Trade, Transportation and Utilities
2. Education and Health Services
3. Local Government
4. Leisure and Hospitality
5. Manufacturing

More than half of all business establishments in region 7 have fewer than 5 employees.

Table 2.5.2-13: Business establishment size by county, 2022 (Region 7)

County	Total Business Establishments	Fewer than 5	5-9	10-19	20-49	50-99	100-249	250-499	500-999	1000 or more
Baker	524	316	104	60	28	9	6	N	N	N
Grant	212	140	37	23	8	3	N	N	N	N
Union	736	391	160	114	52	10	4	5	N	N
Wallowa	367	261	58	30	14	3	N	N	N	N
Total by Size	1,839	1,108	359	227	102	25	10	5	0	0

Source: Bureau of Labor Statistics, County Business Patterns 2022

Table 2.5.2-14: 2024 Covered employment by sector, Region 7

	Region 7		Baker County		Grant County		Union County		Wallowa County	
Industry	Total Employment	Percent	Employment	Percent	Employment	Percent	Employment	Percent	Employment	Percent
Total all ownerships	21,573	100%	5,595	100%	2,541	100%	10,378	100%	3,059	100%
Total private coverage	16,792	78%	4,471	80%	1,548	61%	8,472	82%	2,301	75%
Natural resources and mining	1,149	5%	185	3%	288	11%	499	5%	177	6%
Construction	1,188	6%	247	4%	101	4%	633	6%	207	7%
Manufacturing	2,041	9%	574	10%	95	4%	1,203	12%	169	6%
Trade, transportation and utilities	3,939	18%	1,202	21%	322	13%	1,921	19%	494	16.%
Information	204	1%	56	1%	52	2%	67	1%	29	1%
Financial activities	612	3%	115	2%	62	2%	329	3%	106	3%
Professional and business services	1,255	6%	332	6%	135	5%	616	6%	172	6%
Education and health services	3,457	16%	1,034	18%	197	8%	1,840	18%	386	13%
Leisure and hospitality	2,206	10%	526	9%	212	8%	1,046	10%	422	14%
Other services	711	3%	197	4%	77	3%	304	3%	133	4%
Unclassified	(c)	(c)	(c)	(c)	(c)	(c)	15	0%	(c)	(c)
Total all government	4,782	22%	1,124	20%	993	39%	1,906	18%	759	25%
Total federal government	972	5%	243	4%	299	12%	302	3%	128	4%
Total state government	981	5%	239	4%	158	6%	452	4%	132	4%
Total local government	2,828	13%	641	11%	536	21%	1,152	11%	499	16%

Note: (c) = confidential information not provided by the Oregon Employment Department to prevent identifying specific businesses.

Source: Oregon Employment Department. (2025). Quarterly Census of Employment and Wages. Retrieved from Qualityinfo.org

Region 8: Southeast Oregon

In 2024, the five major supersectors by share of employment in Region 8 were:

1. Trade, Transportation and Utilities
2. Education and Health Services
3. Natural Resources and Mining
4. Local Government
5. Leisure and Hospitality

More than half of all business establishments in Region 8 have fewer than 5 employees.

Table 2.5.2-15: Business establishment size by county, 2022 (Region 8)

County	Total Business Establishments	Fewer than 5	5-9	10-19	20-49	50-99	100-249	250-499	500-999	1000 or more
Harney	216	130	44	24	15	N	N	N	N	N
Malheur	731	372	156	103	77	17	N	3	N	N
Total by Size	947	502	200	127	92	17	0	3	0	0

Source: Bureau of Labor Statistics, County Business Patterns 2022

Table 2.5.2-16: 2024 Covered employment by sector, Region 8

		Region 8	Harney County		Malheur County	
Industry	Total Employment	Percent	Employment	Percent	Employment	Percent
Total all ownerships	15,885	100%	2,576	100%	13,309	100%
Total private coverage	11,730	74%	1,559	61%	10,171	76%
Natural resources and mining	1,733	11%	238	9%	1,495	11%
Construction	412	3%	114	4%	298	2%
Manufacturing	(c)	(c)	(c)	(c)	1,104	8%
Trade, transportation and utilities	3,580	23%	417	16%	3,163	24%
Information	(c)	(c)	(c)	(c)	81	1%
Financial activities	291	2%	51	2%	240	2%
Professional and business services	499	3%	94	4%	405	3%
Education and health services	2,105	13%	243	9%	1,862	14%
Leisure and hospitality	1,576	10%	309	12%	1,267	10%
Other services	321	2%	75	3%	246	2%
Unclassified	(c)	(c)	(c)	(c)	10	0%
Total all government	4,155	26%	1,017	39%	3,138	24%
Total federal government	472	3%	258	10%	214	2%
Total state government	1,545	10%	140	5%	1,405	11%
Total local government	2,138	13%	619	24%	1,519	11%

Note: (c) = confidential information not provided by the Oregon Employment Department to prevent identifying specific businesses.
Source: Oregon Employment Department. (2025). Quarterly Census of Employment and Wages. Retrieved from Qualityinfo.org

2.5.3 Agricultural Economy

Agriculture is an important component of Oregon's economy and represents a significant portion of developed land use and export trade value produced in Oregon. Market sales of agricultural products in Oregon, including crops, livestock, and nursery production represented $6.7 billion in income to Oregon farms and ranches in 2022. Thirteen percent of Oregon's gross domestic product comes from agriculture. Agriculture is directly and indirectly responsible for over 686,000 jobs, or 20.3 percent of jobs statewide. This translates to approximately $29 billion in wages and $12 billion in taxes. Agriculture produces almost $3 billion in traded-sector exports. (DLCD, 2023) Approximately 15 percent of sales in Oregon's economy are linked to agriculture, food, and fiber industries. (OSU, 2021)

More extreme temperature and precipitation can prevent crops from growing. Extreme events, especially floods and droughts, can harm crops and reduce yields. (USGCRP, 2014) Drought could become a challenge in areas where rising summer temperatures cause soils to become drier. Although increased irrigation might be possible in some places, in other places water supplies may also be reduced, leaving less water available for irrigation when more is needed. Oregon's small farms are particularly vulnerable to natural hazards exacerbated by climate change. The following sections include tables showing the total number of farms in each county within a region and their market sales of agricultural products.

Table 2.5.3-1: Agricultural product market values by county, 2022

	Total Farms	Market Sales Value of Agricultural Products ($1,000)
Oregon	35,547	6,771,166
Region 1		
Clatsop	211	9,355
Coos	543	66,948
Curry	169	19,531
Lincoln	299	6,995
Tillamook	241	160,694
Region 2		
Clackamas	4,156	510,305
Columbia	723	64,858
Multnomah	680	95,892
Washington	1,793	326,039
Region 3		
Benton	995	122,806
Lane	2,375	137,593
Linn	2,138	342,098
Marion	2,477	874,627
Polk	1,158	249,678
Yamhill	2,000	418,319
Region 4		

	Total Farms	Market Sales Value of Agricultural Products ($1,000)
Douglas	1,811	89,758
Jackson	2,396	105,350
Josephine	605	38,410
Region 5		
Gilliam	155	42,682
Hood River	497	134,605
Morrow	341	866,052
Sherman	173	54,820
Umatilla	1,616	525,616
Wasco	458	137,967
Region 6		
Crook	609	53,399
Deschutes	1,572	39,986
Jefferson	348	62,653
Klamath	828	170,284
Lake	353	175,700
Wheeler	153	9,549
Region 7		
Baker	676	101,338
Grant	374	29,563
Union	806	74,790
Wallowa	480	42,943
Region 8		
Harney	477	99,336
Malheur	861	510,625

Source: U.S. Department of Agriculture, 2022 Census of Agriculture

2.5.4 Economic Trends and Issues

A strong and diverse economic base increases the ability of individuals, families, and communities to absorb impacts of a disaster and recover more quickly. Therefore, the current and anticipated financial conditions of a community are strong determinants of community resilience. Supporting the growth of dominant industries and employment sectors, as well as emerging sectors identified in this analysis, can help regions become more resilient to economic downturns that often follow a hazard event (Stahl et al., 2000).

Region 1: Oregon Coast

The economic analysis of the region shows the following situations increase Oregon Coastal communities' level of vulnerability to natural hazard events:

- Unemployment rates are higher than the state average in Curry, Coos, and Lincoln and Tillamook Counties.
- The region's most competitive industries employ a small share of the overall population.
- The regional economy is heavily dependent on tourism and seasonal employment.
- The regional economy is lacking opportunities for highly skilled employees, limiting the income potential of coastal residents.
- Many of the region's most concentrated industries are natural resource-based or depend on natural resource industries. These sectors are especially vulnerable to the impacts of climate change.

Region 2: North Willamette Valley/Portland Metro

The economic analysis of the region shows the economy in Region 2 has experienced strong growth in recent years and has a diversity of high paying, traded industries. The following situations increase Region 2's level of vulnerability to natural hazard events:

- Although Region 2 represents the largest share of the state's employment and advanced manufacturing industries, it is also responsible for 15 percent of the state's overall agricultural production by dollar value.
- Unemployment in Columbia County is consistently higher than its regional peers and higher than the statewide average.
- The Portland metro area is the economic hub for the state. Any disruptions caused by a natural hazard could ripple throughout the other regions.

Region 3: Mid/Southern Willamette Valley

The economic analysis of the region shows the following situations increase Region 3's level of vulnerability to natural hazard events:

- Unemployment in Linn and Lane Counties is consistently higher than its regional counterparts and higher than the statewide average.
- Many of the region's most concentrated industries are natural resource-based or depend on natural resource industries. These sectors are especially vulnerable to the impacts of climate change.
- 11,000 farms, especially small and medium-sized farms in Region 3, are vulnerable to drought and extreme heat.
- The Forestry and Logging subsector, an area of competitive advantage for the region, has been consistently shedding jobs for over a decade.

Region 4: Southwest Oregon

The economic analysis of the region shows the following situations increase the region's level of vulnerability to natural hazard events:

- Unemployment in all three regional counties is consistently higher than the statewide average.

- Within the region, unemployment in Douglas and Josephine Counties is regularly higher than unemployment rates in Jackson County.
- The region is dependent on tourism which might increasingly be impacted by annually occurring disasters like wildfire and drought.
- Many of the region's most concentrated industries, including agriculture, are natural resource-based or depend on natural resource industries. These sectors are especially vulnerable to the impacts of climate change.
- The regional economy has fewer opportunities for highly skilled employees, limiting the income potential of residents in Region 4.

Region 5: Mid-Columbia

The economic analysis of the region shows the following situations increase the regional communities' level of vulnerability to natural hazard events:

- Unemployment in Gilliam County is increasing relative to the statewide average.
- A growing share of local governments in Umatilla and Morrow Counties are increasingly dependent on the construction and operation of data centers to provide tax revenue.
- Region 5 is a significant agricultural production region of Oregon, responsible for over $1.7 billion in market sales in 2022.
- Many of the region's most concentrated industries are natural resource-based or depend on natural resource industries. These sectors are especially vulnerable to the impacts of climate change.
- The region lost employment in many of its manufacturing subsectors from 2010-2024.
- The region lacks a diversity of traded sector industries.

Region 6: Central Oregon

The economic analysis of the region shows the following situations increase the region's level of vulnerability to natural hazard events:

- Many of the region's most concentrated industries are natural resource-based or depend on natural resource industries. These sectors are especially vulnerable to the impacts of climate change.
- Two of the region's most competitive subsectors, Wood Product Manufacturing and Forestry and logging, experienced declining employment from 2010-2024.
- Except for Deschutes and Wheeler Counties, unemployment rates across the region are higher than in the statewide.

Region 7: Northeast Oregon

The economic analysis of the region shows the following situations increase the region's level of vulnerability to natural hazard events:

- The region generally lacks a diversity of traded sector industries. Many of the region's most concentrated industries are natural resource-based or depend on natural resource industries. These sectors are especially vulnerable to the impacts of climate change.

- Unemployment rates across the region are consistently higher than statewide.
- The regional economy has fewer opportunities for highly skilled employees, limiting the income potential of regional residents.

Region 8: Southeast Oregon

The economic analysis of the region shows the following situations increase the region's level of vulnerability to natural hazard events:

- The region generally lacks a diversity of traded sector industries. Many of the region's most concentrated industries are natural resource-based or depend on natural resource industries. These sectors are especially vulnerable to the impacts of climate change.
- Unemployment rates in Harney County are higher than statewide.
- The regional economy has few opportunities for highly skilled employees, limiting the income potential of regional residents.

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Chapter 3 Hazard Identification and Risk Assessment

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What is a Natural Hazards Risk Assessment?

A natural hazards risk assessment provides the factual foundation for establishing broad mitigation goals and identifying promising places to look for specific mitigation projects that could reduce risks of natural hazards to people, property, and the natural environment.

A risk assessment provides actionable information to natural hazard mitigation planners and funders to reduce risks of harm from natural hazards. A risk assessment does not, however, provide sufficient detail to evaluate potential projects at specific locations, and does not substitute for benefit-cost analyses to determine whether specific projects are eligible for grants.

How is this natural hazards risk assessment unique?

One of the key assumptions of this risk assessment is that social and economic settings significantly contribute to the potential for harm.

This 2025 Oregon Natural Hazards Mitigation Plan uses two complementary tools to assess risk from different perspectives:

- National Risk Index
- Oregon Natural Hazards Risk Assessment

3.1 National Risk Index

The Federal Emergency Management Agency (FEMA) created the National Risk Index (NRI) in collaboration with various stakeholders and partners in academia; local, state and federal government; and private industry. It is a dataset and online tool to help illustrate the United States communities most at risk for 18 natural hazards. The Risk Index leverages available source data for natural hazard and community risk factors to develop a baseline risk measurement for each United States county and Census tract. For comprehensive details about the Risk Index, see the National Risk Index Technical Documentation.

3.1.1 Strengths

The NRI includes an estimate of expected annual loss in dollars for each census tract for each hazard. It includes social vulnerability data to recognize that the same physical event will have different impacts on people based on their characteristics and conditions. It also incorporates a community resilience index because the impact of a disaster on an individual can be reduced or magnified based on the support or lack of support from a resilient community.

3.1.2 Weaknesses

The NRI focuses on monetary values. It shows higher risk in areas with more expensive buildings and insured agricultural crops. Death and injury are counted as value-of-a-life losses to people, not disruption or monetary losses to individuals. The NRI is based on historic and current conditions. It does not account for future conditions that may be different from previous conditions. Thus, it does not meet the requirements of 44 CFR § 201.4(c)(2)(i) which require that an NHMP include, "information on previous occurrences of hazard events, as well as the probability of future hazard events."

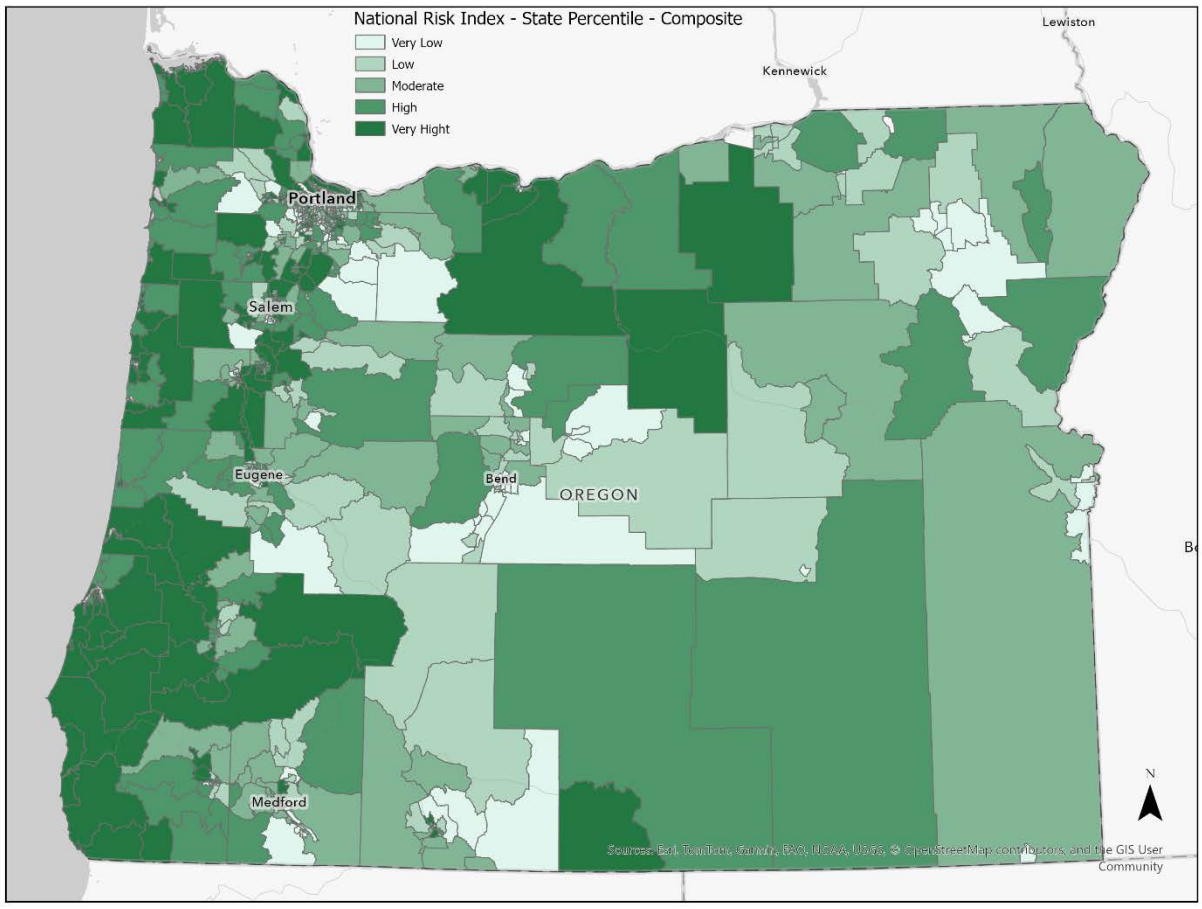
3.1.3 Risk Maps

The Federal Emergency Management Agency, National Risk Index (NRI), maps natural hazard risk for 18 natural hazards, 11 of which occur in Oregon. DLCD downloaded the Oregon data to produce maps showing the all-hazards composite risk, and risk for each hazard. The all-hazards composite risk map is shown in Figure 3.1.3-1.

Jenks Natural Breaks were used to categorize percentiles from very low to very high. The NRI evaluates more hazards than does the Oregon Natural Hazards Risk Assessment. NRI hazards evaluated for Oregon are: avalanche, **coastal flooding**, cold wave, **drought**, **earthquake**, hail, **heat wave,** ice storm, **landslide**, lightning, **riverine flooding**, strong wind, tornado, **tsunami, volcanic activity, wildfire**, and **winter storm**. Natural hazards in bold are evaluated in the Oregon Natural Hazards Risk Assessment.

Hazard specific maps are in section 3.3, following the description of each hazard.

Figure 3.1.3-1: National Risk Index: All-hazards by State Percentile



3.2 Oregon Natural Hazards Risk Assessment

The Oregon Department of Land Conservation and Development and the Oregon Department of Geology and Mineral Industries produced the Oregon Natural Hazards Risk Assessment (ONHRA) using data at the census tract scale. Oregon has 993 inhabited census tracts.

The ONHRA uses a statistical model to assess risk from nine natural hazards:

- Flood
- Coastal hazards
- Tsunami
- Drought
- Extreme heat
- Landslide
- Volcano
- Wildfire
- Earthquake

The ONHRA includes narrative descriptions without modeled results for three natural hazards:

- Windstorms
- Winter storms
- High hazard potential dams

Hazard mitigation risk assessments typically focus on areas and communities most at risk of harm from natural hazard events. These impacts can be viewed in a utilitarian lens— mitigating impacts to the greatest number of people and highest value properties. The ONHRA uses percentage of assets exposed to natural hazard events in a census tract rather than counts or asset values. This approach highlights where harm may be experienced more acutely. Many of the census tracts and cities highlighted by the ONHRA have low populations. These are areas that state mitigation planners often overlook even though there may be cost-effective mitigation projects in these areas (GAO 2025; Reilly et al. 2023).

This risk assessment pairs well with other assessment approaches, such as FEMA's National Risk Index (NRI). The Oregon risk assessment complements the NRI with its holistic view of hazard vulnerability. The Oregon risk assessment does not determine grant funding distribution; it merely highlights areas and people that may be good candidates for mitigation opportunities, as these communities may be missed by broader assessments focused primarily focused on dollar losses, such as the NRI. This risk assessment offers a holistic view of statewide risk to natural hazard impacts. This tool is also useful for local planning work such as outreach, creative mitigation project planning, and identifying areas for additional mitigation consideration. The ONHRA identifies mitigation focus areas in which information about state-owned or leased buildings, critical facilities, and lifelines located in these areas. The document provides brief descriptions of demographic changes in the mitigation focus areas.

3.2.1 Literature Review

Land use planning problems have multiple and often conflicting desired outcomes. Comprised of 19 statewide land use planning goals, Oregon's land use planning system is aimed at comprehensive planning for balanced land use outcomes, including hazard mitigation. The Oregon natural hazard risk assessment upgrade aims to achieve these same goals: holistic planning to mitigate risks of natural hazards to people and property. Within climate change adaptation and disaster preparedness, response, and recovery literature, integration between natural hazard mitigation and comprehensive community planning is a well-established goal (Pearce 2003).

This section provides details of the literature that the Oregon Department of Land Conservation and Development staff drew upon to inform the development of its upgraded natural hazard risk assessment tool. First, terms and definitions are provided, then a discussion of the social context of resilience. Then, an overview of multi-criteria decision method (MCDM) tools and their applications is provided. Next, a discussion of the Preference Ranking METHod for Enrichment Evaluations (PROMETHEE) method and use in risk assessment and planning, and how climate change is considered and evaluated in the natural hazard risk assessment. Finally, supporting literature and rationale for each included indicator is included. Technical application information is detailed in methods.

3.2.1.1 Defining Resilience

Hazard mitigation planning aims to enhance the capacity of a community to anticipate, respond, adapt and recover from natural hazard events. Mitigation planning helps communities adequately prepare for, and prevent or mitigate, the impacts of hazard events; such planning supports community *resilience*. A resilient community can absorb disturbances, such as hazard events, without significant structural or functional changes. Resilience is effectively synonymous with social ecological systems (SES) theory and definitions (Gunderson and Holling 2002). The resilience paradigm, as with any conceptual model, comes with attendant biases and shortfalls. Scholars have pointed out that traditional resilience thinking has several strong biases: the simplification that people's knowledge, values, and livelihoods primarily concern the environment; the homogenization of social complexities and assumption that people's experiences and expectations of what it means to be 'resilient' are the same; and the social value attached to the term 'resilience' (Fabinyi et al. 2014). As academics have succinctly asked, mitigation planners concerned with community resilience must ask, "resilience to what? Resilience for whom?" (Cote & Nightingale 2012; Cutter 2016). DLCD brings experience as planners into conversation with the resilience and mitigation literature. This iterates in a few ways. First, DLCD brings a planning-oriented approach to understandings of resilience. Resilience is not converse vulnerability, and there are multiple ways of knowing and understanding resilient systems and environments. In this assessment, resilience is a system attribute and potential outcome, if mitigation to address vulnerabilities and thus risk is successful. Next, this assessment methodology follows traditional conceptualizations of hazard vulnerability. Vulnerability is a function of exposure, sensitivity, and capacity to adapt to hazards (Adger 2006). Risk is a product of probability of hazard occurrence and the vulnerability of a certain area or group. Thus, risk is informed by vulnerabilities. In this way, the natural hazard risk assessment considers vulnerabilities, but is not entirely driven by vulnerability. Probability of hazard occurrence is an equally

important driver in identifying particularly risky areas, and thus, strong candidate for mitigation investments.

Alarming rates of environmental and climate change have inspired policymakers and scholars to rethink the link between natural hazard mitigation and climate change adaptation actions. Mitigation typically aims to anticipate and prevent harm or loss resulting from natural hazard events, whereas adaptation responds and reorganizes to better cope with harm from natural hazards. For many communities across the state, it is not possible to mitigate every potential harm resulting from hazard events. Adaptation becomes a necessary process. This risk assessment acknowledges several nuances to the mitigation and adaptation link. Actions that may benefit one community may cause unintentional or unforeseen harm to another. Additionally, the burden of adapting or mitigating may fall on more vulnerable communities, creating or reinforcing disparate burdens on these communities. Finally, the benefits of mitigating or adapting may not be evenly spread. However, effective mitigation and adaptation practices clarify definitions, goals, and encourage the consideration of a broad range of expertise and knowledge. This assessment attempts to address these concerns by reframing potential adaptation actions towards a "whole community" framework.

3.2.1.2 Multi-Criteria Decision Analysis (MCDA) Tools

To achieve those goals, this analysis implements Multi-Criteria Decision Analysis (MCDA) to enhance risk assessment capabilities within Oregon's comprehensive land use planning system. MCDA tools have a rich history of practitioner and research applications in a variety of problem-solving settings. Multi-criteria decision analysis (MCDA) methods are widely used decision-making tools that are used to choose between multiple alternatives that have a mix of, often conflicting, criteria or desired outcomes and cannot be easily compared. There are several types of MCDA, which range from distance-based methods, pairwise comparison-based methods, utility-based methods, and outranking methods.

Distance based methods use linear algebra to identify the ideal alternative based on the shortest distance to the ideal solution and the farthest distance to the negative solution. This method uses an algorithm (Dijkstra's algorithm) to solve a shortest path problem and distance (Euclidian, city block, great circle, n-dimensional) and arrive at the most satisfactory answer for a given set of criteria. The most applied methods include Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS), (Hwang & Yoon 1981). TOPSIS has frequently been used in disaster management for flooding and transportation assessments, and for seismic vulnerability assessments.

Pairwise comparison- based methods such as analytical hierarchy and analytical network processes (Saaty 2005) and Best-Worst Method (Rezaei 2015; Rudd & Fleishman 2014) prioritize options by comparing them in pairs and groups. Similarly, utility-based methods evaluate and prioritize options by assigning relative importance to different criteria. These methods rely on multi-attribute utility theory.

The best-known methods in this class are Step-wise Weight Assessment Ratio Analysis (SWARA), Weighted Aggregated Sum Product Assessment (WASPAS), and Complex Proportional Assessment (COPRAS). Agarwal et al. (2020) evaluated humanitarian supply chain management issues using a hybrid between SWARA and WASPAS. Rahman (2020) developed models to identify the optimal spatial distribution of emergency evacuation centers to improve flood emergency management in Bangladesh.

Interaction based methods interpret the effects that criteria in the decision-making hierarchy have on Laboratory (DEMATEL) (Gabus & Fontela 1972). DEMATEL has been a popular decision-making method in disaster management (Sen et al. 2021; van de Lindt et al. 2020; Yang et al. 2018).

Finally, preference-based methods consider the superiority of one alternative over the other, given a set of criteria and relative weighting. Methods at the forefront include Elimination Et Choice Translating Reality (ELECTRE) (Roy 1990), and Preference Ranking Organization METHod for Enrichment Evaluations (PROMETHEE) (Brans & Mareschal 2005). Such outranking methods are well suited to disaster risk evaluation and hazard-mitigation planning for their relative ease of interpretation, methodological simplicity, and consideration of user inputs and preferences (Sun et al. 2020; Nassereddine et al. 2019; Caroleo et al. 2018). In sum, preference ranking is the quantification of opinion, expressed through indicator choice and variable weighting.

3.2.2 Outranking Method

The ONHRA uses an outranking method called Preference Ranking METHod for Enrichment Evaluations (PROMETHEE) (Brans and Mareschal 2005). Outranking refers to the process of determining a binary relation between a set of alternatives, given preferences of the decision-maker, evaluations of the alternatives, and the nature of the problem. This method follows a procedure that considers the superiority, or preference, of one alternative over all others given a set of criteria. Pairwise comparison matrices compute the amplitude of deviation between every possible pair of alternatives, resulting in a ranked set of alternatives based on a given set of indicator criteria. PROMETHEE is at the forefront of environmental suitability analyses (Sotiropoulou & Vavatsikos 2021), multi-hazard risk assessments (Soldati et al. 2022), and collective policy action identification (Palmisano et al. 2022). In this analysis, PROMETHEE compares risk between geographies instead of evaluating alternatives in a decision-making process. This identifies mitigation focus areas, but does not make decisions about specific mitigation actions.

The combination of geographic information systems (GIS) technology with MCDA methods is an effective tool to identify, characterize, and evaluate natural hazard risk. Many international studies have successfully combined GIS and MCDA applied to natural hazards risk rankings, including high n- criteria studies (Kappes & Papathoma-Kohle et al. 2012; Kappes & Keiler et al. 2012; Soldati et al. 2022; Zschau 2017). For example, Palmisano, Sardaro, and La Sala included 43 indicators organized into seven thematic dimensions to identify collective policy actions through PROMETHEE (Palmisano et al. 2022). Similarly, the Oregon Natural Hazard Risk Assessment (ONHRA) includes 88 total indicators, with an average of 26 indicators per hazard, to characterize multi-hazard vulnerabilities and identify potential mitigation focus areas across the state. These indicators similarly range across seven categories: people, public health, the built environment, cultural resources, economy, governance, and hazard characteristics

3.2.2.1 Best Practices

Planning for and implementing equitable hazard mitigation strategies is a well-established goal and is reflected with state-of-the-art hazard mitigation literature and research (Bradshaw 2014; Goldsmith 2022; McKittrick 2006; Woods 1998). Environmental disasters underscore and worsen existing inequities across communities, often revealing overlapping preexisting vulnerabilities (Ribot 2014). These

vulnerabilities disproportionately burden marginalized and under-resourced communities. In this analysis, equity is considered across indicator themes. The Oregon Natural Hazard Risk Assessment is based on an understanding of vulnerability to natural hazards drawn from best practice literature, the DLCD strategic plan, and FEMA definitions of equitable natural hazard mitigation planning. The ONHRA identifies focus areas for mitigation actions. Specific mitigation actions may be highly local, and nuanced analysis of mitigation potential is critical to effective mitigation. For example, a mitigation action that works well in one community may not suit another. A mitigation action that is well suited to a coastal community may not be suitable for a community in the mid-Willamette Valley. Mitigation actions that benefit a part of a community may harm or create new vulnerabilities for another, resulting in what Cutter (2014) describes as 'relational vulnerability'. Thus, the ONHRA shows the drivers of vulnerability to discover mitigation actions best suited to unique communities across Oregon.

3.2.3 Hazard Scenarios

The ONHRA uses data from the Oregon Department of Geology and Mineral Industries (DOGAMI), Federal Emergency Management Agency (FEMA) National Flood Hazard Program and National Risk Index, Oregon Department of Forestry (ODF), United States Geological Survey (USGS), United States Department of Agriculture (USDA), and United States Forest Service (USFS). For example, riverine and coastal flood hazards use data from FEMA's National Flood Hazard Program. Landslide susceptibility uses statewide landslide mapping from DOGAMI. See the Appendix in Chapter 9 for full descriptions of hazard datasets.

3.2.4 Vulnerability Indicators

The ONHRA uses vulnerability indicators in six thematic categories:

- People
- Built Environment
- Economic Environment
- Cultural Resources
- Governance
- Public Health
- Hazard Scenarios

These categories correspond to FEMA guidance describing what needs to be evaluated in natural hazard mitigation plans. The ONHRA goes beyond this minimum to better meet the needs of Oregonians.

The Oregon Natural Hazard Risk Assessment incorporates over 88 indicators in these seven categories. First, hazard scenarios were identified, and vulnerability indicators selected from each domain. The risk assessment upgrade team met with 250 interested parties, experts, and stakeholders over the course of several dozen brainstorming and selection meetings. To compile a list of potential indicators. These indicators are attributes that characterize a source of resilience or vulnerability to hazards or a combination of hazards.

To select indicators for use in the model DLCD assessed several different factors: suitable indicators focus on answering a specific question, have publicly available baseline data, and are practical, easy to measure, and interpretable (Beasley & Wright 2001). Research supporting inclusion of an indicator in the risk assessment model is peer-reviewed and well documented in its rationale, methodology, and analysis. Additionally, ideal indicator data has low variance, is available at the appropriate geographic scale, and is correlated with what the indicator measures. See the Appendix in Chapter 9 for a complete data dictionary.

3.2.4.1 People

Hazard vulnerability indicators concerning people and social demographics include race, age, housing status, disabilities, and social economic statuses. These indicators are included as a single measure in the risk assessment and are represented within the Community Resilience Estimate (CRE) from the U.S. Census. See the Appendix in Chapter 9 for a complete description of the CRE.

Housing indicators include houseless populations, people living alone, rent burden, and housing tenure. Basic shelter and housing, and the quality and affordability of such shelter and housing, plays a crucial and multifaceted role in hazard mitigation efforts (Cutter et al. 2003).

Disabilities can create a range of differential vulnerabilities to natural hazards (Morrow 1999; Hemingway & Priestley 2014). The social model of disability frames human vulnerability to natural hazards as socially reproduced, as coined by Morrow (1999). In this risk assessment, disabilities are represented within the CRE measure. These characteristics include hearing, vision, cognition, ambulatory, self-care, or independent living difficulty. This definition also includes institutionalized populations.

3.2.4.2 Built Environment

The vulnerability of the built environment and infrastructure is used in ONHRA with vulnerability indicators including buildings in the Special Flood Hazard Areas, critical facilities, building exposure to natural hazards, roads in the special flood hazard zone, roads in landslide susceptibility areas, roads in wildfire hazard zones, bridges in special flood hazard zone, bridges in landslide susceptibility areas, bridges in earthquake hazard zones, tree canopy coverage, repetitive loss and severe repetitive loss properties. In addition to this hazard-exposed infrastructure, we included two building types that are vulnerable to harm or causing harm from any hazard – mobile homes and older homes.

3.2.4.3 Cultural Resources

Cultural institutions, historic sites, and other assets can be both exposed to natural hazard impacts, and can bring communities together to increase social cohesion. The ONHRA includes the number of cultural related and historic buildings in the census tract using an inventory from the Oregon Cultural Trust. Religious institutions can also increase social cohesion and community connection. The ONHRA includes the percentage of members to a religious group. This measure is the percentage of the census tract population that belongs to any religious group. This data is maintained by the US Religion Census, a private organization that collects information about participation in religious organizations. The ONHRA

uses the 2020 Religion Census for estimated adherents including members, their children, and estimated numbers of participants who are not members.

3.2.4.4 Economy

Income and poverty are significant contributing factors to vulnerability (Kasperson & Kasperson 2001). The ONHRA uses outdoor jobs, natural resource jobs, and annualized losses from the National Risk Index to people, agriculture, and buildings due to hazards as economic vulnerability indicators. Natural resource jobs and outdoor jobs are more likely to be interrupted by natural hazards, and thus areas with more of these jobs are more likely to suffer economic decline after a natural disaster.

3.2.4.5 Governance

Measuring social cohesion and community adaptive capacity is difficult and therefore requires quantitative and qualitative measurements. Brown and Westaway (2011) note an evolution in understanding of natural hazard resilience and adaptive capacity away from solely quantifiable and objective measures towards a relational aspect of these concepts. Additionally, Agrawal (2008) argues that institutions structure vulnerability. Therefore, the ONHRA includes indicators related to government planning, government preparedness, and civic engagement. Such indicators include mitigation projects undertaken and funded by FEMA, the Community Rating System (CRS) score for the community, and the city and county tax rates obtained from the Oregon Department of Revenue.

3.2.4.6 Public Health

The ONHRA includes distances to hospitals and estimated number of hospital beds as public health vulnerability indicators.

3.2.5 Indicator Key

Some of the indicators measure vulnerability, thus a higher number indicates a **higher** vulnerability. These indicators have a gold background.
Other indicators measure resilience; thus a higher number indicates a **lower** vulnerability**.** These indicators have a blue-green background.

3.2.5.1 General

These socio-economic indicators were used for all evaluated hazards.

Indicator Name	Description	Data Source	Justification
EP_MINRTY	Percentage of non-white population	2020 Census	The State of Oregon and the Department of Land Conservation and Development have a “lead with race” policy. The CRE (a social vulnerability indicator) does not include race.
Housing Tenure	Percent of owned homes	2020 Census	Tenure definition from US Census: A unit is owner occupied if the owner or co-owner lives in the unit, even if it is mortgaged or not fully paid for. Owners have more control over mitigation projects and opportunities.
EP_MOBILE	Percentage of residential building stock that are mobile homes	2020 Census; **ACS Table(s)**: B25024, B25032	Mobile homes are more likely than site-built homes to be damaged by natural hazard events. Manufactured home parks are often located in hazard zones
Median_Yrblt	Median year built of general building stock based on HAZUS default data.	Hazus (org. 2020 Census)	Older homes likely are built with less stringent buildings codes. Maintenance status may make them more prone to damage due to natural hazard events.
HospitalDistMile	Distance from tract centroid to nearest hospital.	DOGAMI generated	Distance to the nearest hospital indicates degree of access to medical services in the face of and after a natural hazard event.
NatResrcJobs	Percentage of natural resource jobs.	2020 Census	People employed in natural resource jobs may work outdoors and may face reductions in work hours or access to raw materials during and after a natural hazards event. Short term employment gains may be experienced from rebuilding, but these are short-lived.

Indicator Name	Description	Data Source	Justification
PRED3_PE	Percentage of individuals with three plus components of social vulnerability from the Community Resilience Estimate (CRE)	2023 CRE Estimate	Metric for how socially vulnerable people are to the impacts of disasters.
Hosp_Beds	Estimated number of hospital beds based on square footage of hospital building (1500ft^2 per bed)	DOGAMI generated	Indicates the ability of local medical system to address emergencies during and after an event.
Pct_Adherents	Percentage of members to a religious group	2020 US Religion Census	Indicates community cohesion or access to local assistance.
Mitigation	Number of migitation projects (grouped by zip code and evenly distributed to overlaying tracts)	FEMA: Hazard Mitigation Assistance Projects - v4 | FEMA.gov	Measures degree of mitigation attention that has been paid to the area.
Watch	Average rating from survey of neighborliness: Will watch neighbor's house	OHA	Indicates propensity to assist neighbors during and after an event.
CountyTax	County tax rate	Oregon Dept. of Revenue	Indicates capacity of local government to plan, respond to, and mitigate.
CityTax	City tax rate	Oregon Dept. of Revenue	Indicates capacity of local government to plan, respond to, and mitigate.
Cultural	Number of cultural-related institutions	Oregon Cultural Trust	Indicates community cohesion by participation in cultural activities
Favors	Average rating from survey of neighborliness: Willing to do favors for neighbor	OHA	Indicates propensity to assist neighbors during and after an event.
Advice	Average rating from survey of neighborliness: Seeks advice from neighbor	OHA	Indicates propensity to assist neighbors during and after an event.
Parties	Average rating from survey of neighborliness: Attended parties that occur in neighborhood	OHA	Indicates propensity to assist neighbors during and after an event.
Visits	Average rating from survey of neighborliness: Has visited neighbor's house	OHA	Indicates propensity to assist neighbors during and after an event.

3.2.5.2 Hazard Specific Indicators

Indicator Name	Description	Data Source	Justification
Coastal Hazards			
CFL_pct_CF	Percentage of critical facilities (2020 State NHMP data) buildings exposed to coastal flooding based on NFIP flood zones.	DOGAMI generated	Indicates the degree of disruption to critical facilities during a flood event and its aftermath.
Hist_count	Number of historic buildings.	OPRD/Historic Preservation	Indicates cultural significance in the area
Port	Presence of marine port infrastructure	DOGAMI generated	Damage to ports disrupts commerce, jobs, and local economy. May be costly to repair
Bridge_Scour_pct	Percentage of bridges that are scoured from a 100-year flood.	ODOT	A high proportion of damaged bridges in an area indicates reduced ability to find detours.
CRS_Rate	Community Rating System (NFIP program for reduced insurance premiums) score for communities within census tracts (1 – 10 scores with 1 being the best score).	FEMA	Communities that participate in the Community Rating System tend to be better prepared for flood events and to adopt policies to avoid building in flood hazard zones.
ImpervSurf_Pct	Percentage of impervious surface.	Justice40	Areas with a high percentage of impervious surface tend to have flood and drainage problems, leading to the potential for damage.
FIRM_Diff	Number of years difference between median year built and first Flood Insurance Rate Map date.	FEMA/2020 Census	Older flood maps tend to misrepresent areas subject to flood; newer maps are more reliable indicators of flood hazard.
FL_Haz_Area	Area of tract in 100-year flood hazard.	FEMA	Census tracts with large flood hazard zones are more likely to suffer harm.
RepeatLoss	Number of Repetitive loss structures	FEMA	Indicates historic repetitive losses and opportunity for mitigation.
Drought			

Indicator Name	Description	Data Source	Justification
Drght_NRI_rate	Expected annual loss (EAL) rate for drought from the FEMA NATIONAL RISK INDEX.	National Risk Index	EAL rates are designed to reflect the average expected annual percentage loss for the building value, population, and agriculture value within a community
Drght_Events	Number of drought events from the FEMA NATIONAL RISK INDEX.	National Risk Index	
Drght_AL_AG	Expected annual loss (EAL) rate for agriculture from FEMA NATIONAL RISK INDEX.	National Risk Index	EAL rates are designed to reflect the average expected annual percentage loss for the building value, population, and agriculture value within a community
Over90th	Mean number of days that are above the historic 90th percentile temp	OCCRI	
Over90F	Mean number of days above 90 degrees Fahrenheit	OCCRI	
Over90th	Mean number of days that are above the historic 90th percentile temp	OCCRI	
Over90F	Mean number of days above 90 degrees Fahrenheit	OCCRI	
Earthquake			
LQ_pct_bld	Percentage of STATEWIDE BUILDING FOOOTPRINTS FOR OREGON buildings exposed to Moderate to Very High liquefaction zones based on data compiled in the Oregon Seismic Hazard Dataset (OSHD).	DOGAMI generated	Indicates the degree of disruption within the census tract because of liquefaction and its aftermath.
LQ_pct_CF	Percentage of critical facilities (2020 State NHMP data) buildings exposed to Moderate to Very High liquefaction zones based on data compiled in the Oregon Seismic Hazard Dataset (OSHD).	DOGAMI generated	Indicates the degree of disruption to critical facilities as a result liquefaction.

Indicator Name	Description	Data Source	Justification
EQCSZ_pct_CF	Percentage of critical facilities (2020 State NHMP data) buildings that are red or yellow-tagged buildings based on CSZ Deterministic Hazus scenario analysis.	DOGAMI generated	Indicates the degree of disruption to critical facilities because of earthquake.
EQ25_pct_CF	Percentage of critical facilities (2020 State NHMP data) buildings that are red or yellow-tagged buildings based on 2500 Probabilistic Hazus scenario analysis.	DOGAMI generated	Indicates the degree of disruption to critical facilities because of earthquake.
Hist_count	Number of historic buildings.	OPRD/Historic Preservation	Indicates cultural significance in the area
Hwy_LQ_pct	Miles of major roadway exposed to Moderate to Very High liquefaction zones based on data compiled in the Oregon Seismic Hazard Dataset (OSHD)	ODOT/DOGAMI generated	Damaged roads disrupt transportation and access to services.
Erqk_NRI_rate	Expected annual loss (EAL) rate for earthquake from FEMA NATIONAL RISK INDEX.	National Risk Index	FEMA designed EAL rates to reflect the average expected annual percentage loss for the building value, population, and agriculture value within a community.
LQ_Haz_Area	Area of tract in high or very high liquefaction hazard.	DOGAMI generated	Indicates a potential disruption.
Bridges_LIQ	Number of bridges that are within high or very high liquefaction hazard.	ODOT/DOGAMI generated	Bridges provide critical transportation links and can take time to repair leading to disruptions.
PGA_2500	Average shaking in tract from 2500-year probabilistic earthquake.	DOGAMI generated	
Extreme Heat			
Heat_Events	Number of heat events.	National Risk Index	
Heat_ALAG	Expected annual loss (EAL) rates to agriculture from heat.	National Risk Index	FEMA designed EAL rates to reflect the average expected annual percentage loss for the building value, population, and

Indicator Name	Description	Data Source	Justification
			agriculture value within a community
Heat_ALPOP	Expected annual loss rate to population from heat.	National Risk Index	FEMA designed EAL rates to reflect the average expected annual percentage loss for the building value, population, and agriculture value within a community
OutdoorJobs	Percentage of jobs that occur outside.	ACS 2021	People who work outdoors are exposed to natural hazards and their consequences.
TreeCan_avg	Tree canopy density	USDA	Indicates potential for shade or cooling.
Flood			
Bridge_Scour	Number of bridges that are at risk from scour during a 100-year flood.	Oregon Dept. of Transportation	Bridges provide key transportation links that can be difficult to go around if damaged during a flood. Often require extended repair times.
CRS_Rate	Community Rating System (NFIP program for reduced insurance premiums) score for communities within census tracts (1 – 10 scores with 1 being the best score).	FEMA	Communities that participate in the Community Rating System tend to be better prepared for flood events and to adopt policies to avoid building in flood hazard zones.
FL_pct_bld	Percentage of Statewide Building Footprint for Oregon buildings exposed to flooding based on NFIP flood zones.	DOGAMI generated	Indicates the degree of disruption within the census tract because of flood and its aftermath.
FL_pct_CF	Percentage of critical facilities (2020 State NHMP data) buildings exposed to flooding based on NFIP flood zones.	DOGAMI generated	Indicates the degree of disruption to critical facilities during a flood event and its aftermath.
ImpervSurf_Pct	Percentage of impervious surface.	Justice40	Areas with a high percentage of impervious surface tend to have flood and drainage problems, leading to the potential for damage.

Indicator Name	Description	Data Source	Justification
Hwy_FL_pct	Miles of major roadways miles based on ODOT data that are exposed to flood hazard from NFIP data.	ODOT/DOGAMI generated	Flooded roads disrupt transportation and access to services.
Bridge_Scour_pct	Percentage of bridges that are scoured from a 100-year flood.	ODOT	A high proportion of damaged bridges in an area indicates reduced ability to find detours.
FIRM_Diff	Number of years difference between median year built and first Flood Insurance Rate Map date.	FEMA/2020 Census	Older flood maps tend to misrepresent areas subject to flood; newer maps are more reliable indicators of flood hazard.
FL_Haz_Area	Area of tract in 100-year flood hazard.	FEMA	Census tracts with large flood hazard zones are more likely to suffer harm.
RepeatLoss	Number of Repetitive loss structures	FEMA	Indicates historic repetitive losses and opportunity for mitigation.
Hist_count	Number of historic buildings.	OPRD/Historic Preservation	Indicates cultural significance in the area
CFL_pct_bld	Percentage of STATEWIDE BUILDING FOOOTPRINTS FOR OREGON buildings exposed to coastal flooding based on NFIP flood zones.	DOGAMI generated	Indicates the degree of disruption within the census tract because of flood and its aftermath.
Hwy_FL_pct	Miles of major roadways that are exposed to flood hazard from NFIP data based on ODOT data.	ODOT/DOGAMI generated	Flooded roads disrupt transportation and access to services.
Landslide			
LSS_pct_bld	Percentage of STATEWIDE BUILDING FOOOTPRINTS FOR OREGON buildings exposed to existing landslide deposit SLIDO.	DOGAMI generated	Indicates the degree of disruption within the census tract as a result of landslide.
LSS_pct_CF	Percentage of critical facilities (2020 State NHMP data) buildings exposed to existing landslide deposit SLIDO.	DOGAMI generated	Indicates the degree of disruption to critical facilities during a landslide event and its aftermath.

Indicator Name	Description	Data Source	Justification
Hwy_LSS_pct	Miles of major roadways based on ODOT data that are exposed to existing landslide deposits based on SLIDO.	ODOT/DOGAMI generated	Damaged roads disrupt transportation and access to services.
Hist_count	Number of historic buildings.	OPRD/Historic Preservation	Indicates cultural significance in the area
LSS_Haz_Area	Area of tract in high or very high landslide hazard.	DOGAMI generated	Indicates the degree of potential disruption and harm to people or property.
Tsunami			
TSU_pct_bld	Percentage of STATEWIDE BUILDING FOOOTPRINTS FOR OREGON buildings exposed to any sized (SM-XXL) CSZ tsunami.	DOGAMI generated	Indicates the degree of disruption within the census tract as a result of tsunami.
TSU_pct_CF	Percentage of critical facilities (2020 State NHMP data) buildings exposed to any sized (SM-XXL) CSZ tsunami.	DOGAMI generated	Indicates the degree of disruption to critical facilities because of tsunami.
Port	Presence of marine port infrastructure	DOGAMI generated	Damage to ports disrupts commerce, jobs, and local economy. May be costly to repair
Bridges_TSU	Number of bridges that are within a tsunami inundation zone.	ODOT/DOGAMI generated	Bridges provide critical transportation links, particularly on the coast where detour routes are few and far between.
Hist_count	Number of historic buildings.	OPRD/Historic Preservation	Indicates cultural significance in the area
Volcano			
LAH_pct_bld	Percentage of STATEWIDE BUILDING FOOOTPRINTS FOR OREGON buildings exposed to volcanic lahar hazard of any size based on USGS and DOGAMI lahar zones for Cascade volcanoes.	DOGAMI generated	Indicates the degree of disruption within the census tract, including harm to people and property.
LAH_pct_CF	Percentage of critical facilities (2020 State NHMP data) buildings exposed to volcanic lahar hazard of any size based on USGS and	DOGAMI generated	Indicates the degree of disruption to critical facilities

Indicator Name	Description	Data Source	Justification
	DOGAMI lahar zones for Cascade volcanoes.		during a volcanic event and its aftermath.
Hist_count	Number of historic buildings.	OPRD/Historic Preservation	Indicates cultural significance in the area
Wildfire			
WF_pct_bld	Percentage of STATEWIDE BUILDING FOOOTPRINTS FOR OREGON buildings exposed to Medium and High Burn Probability based on PNW Quantitative database.	Oregon Dept. of Forestry/DOGAMI	Indicates the degree of disruption within the census tract, including harm to people and property.
WF_pct_CF	Percentage of critical facilities (2020 State NHMP data) buildings exposed to Medium and High Burn Probability based on PNW Quantitative database.	Oregon Dept. of Forestry/DOGAMI	Indicates the degree of disruption to critical facilities during a flood event and its aftermath.
BurnProb	Burn probability from the QPNW	QPNW	
Hwy_WF_pct	Percentage of highway miles within High Burn Probability Zones		
Hist_count	Number of historic buildings.	OPRD/Historic Preservation	Indicates cultural significance in the area
Over 90th	Mean number of days that are above the historic 90th percentile temp	OCCRI	
Over90F	Mean number of days above 90 degrees Fahrenheit	OCCRI	

3.2.6 Methods

This section describes the method that the Oregon Department of Land Conservation and Development used to create the Oregon Natural Hazards Risk Assessment (ONHRA). This upgraded tool can be used for future state, tribal, and local plans.

The description starts with an overview of the previous risk assessment method, the quantitative methods used for the ONHRA, and community engagement. Next is a detailed method for how the models were used in 2025 in hazard risk analysis work at DLCD. The final section describes limitations of the approach and planned future improvements to the risk assessment.

3.2.6.1 Quantitative Natural Hazard Vulnerability Analysis Using Multi-Criteria Decision Analysis

The natural hazard risk assessment used in the 2020 Oregon NHMPO relied on subject matter experts' opinions to develop risk and vulnerability scores for each hazard. This assessment approach had several shortcomings. The results were subjective, making it impossible to compare hazards. This approach did not adequately account for social vulnerabilities. Finally, the previous approach focused primarily on assets and people that were directly exposed to hazards. The upgraded natural hazard risk assessment identifies places particularly at risk to the effects of natural hazards by balancing a set of indicators against all census tract geographies in Oregon. Broad groups of experts met to choose vulnerability indicators in six thematic categories. Each indicator is supported by best practice literature. Finally, the upgraded assessment method can handle indicator complexity.

Multi-Criteria Decision Analysis (MCDA) methods are decision aids well suited to identify focus areas for hazard mitigation. The ONHRA uses Preference Ranking Organization Method for Enrichment Evaluation II (PROMETHEE II), which is used for complete ranking and selection of a finite set of the best compromise alternatives (Behzadian et al. 2010; Brans & Mareschel 2005).

The PROMETHEE II method uses preference functions to calculate at least one indicator value within each domain for each hazard. Results were then mapped and analyzed to identify risk drivers for the census tracts with the highest hazard ranking. See Appendix in Chapter 9 for more information.

PROMETHEE II is intended to provide a complete ranking of a finite set of feasible alternatives and is preferred by a majority of researchers and practitioners (Behzadian et al. 2010). This outranking method is based on pair-wise comparison of alternatives along each recognized criterion. Alternatives are evaluated according to selected criteria. Thus, the decision maker, or end-user, must weigh the criteria appropriately (Macharis et al. 2004).

3.2.6.2 Weighting

The PROMETHEE model allows weighting of indicators by assigning fractional weighs to each indicator such that the total of all weights equals 1. Weighting is used to emphasize one criterion over another in the ranking.

The ONHRA uses two types of indicators: hazard specific and vulnerability. The vulnerability indicators are labeled "General" on the hazard maps and tables because they apply to all hazards. Together they have 65 percent of the total indicator weight. The hazard-specific indicators varied by hazard and have 35 percent of the total indicator weight.

Within the General category, the indicators are equally weighed, except for a group of indicators that are highly correlated and were therefore treated as a combined indicator. This group included Watch, Favors, Advice, Parties, and Visits. Those five indicators are highly correlated. As a result, they were considered one indicator for weighting purposes and then equally weighted among themselves. When the five indicators are combined into one, there are 14 General indicators. Sixty-five percent divided by 14 equals 0.046. Then dividing 0.046 by 5 equals 0.009. So, the General indicators are all assigned weights of 0.046, except for Watch, Favors, Advice, Parties, and Visits, which are assigned weights of 0.009.

The collection of indicators specific to each hazard were weighted equally among themselves. For example, the Flood hazard has eleven hazard-specific indicators. Thirty-five percent divided by 11 equals 0.0318, rounded to 0.032 as shown on the flood hazard map.

The table to the right of each map shows the weights used for that hazard Weights for the General category are the same across hazards.

3.2.6.3 Process

DOGAMI programmed the multi-criteria process using Python. The multi-criteria component is relatively simple, but processing the data can be complicated, including ingesting, checking, de-coupling, and re-building.

The process is three individual Python functions:

1. Perform the multi-criteria process and write results at the census tract, county, and city levels.
2. Create maps based on the results.
3. Create tables summarizing the results.

There are two pieces of input data needed to run this analysis. First, a spreadsheet that specifies which indicators are used for each hazard. This sheet defines the weight and type for each indicator. Second, a geographic information system (GIS) with a polygon feature class containing the outline of all census tracts within Oregon. This feature class contains the following attributes: Census tract ID, county name, and values for each indicator.

The multi-criteria method used by DOGAMI in this analysis is **PROMETHEE_II**, from the *pymcdm* Python package version 1.2.1: https://pypi.org/project/pymcdm/. The preference function used in this case by **PROMETHEE_II** is “usual.”

The multi-criteria method uses three inputs:

1. An un-labeled array of indicator columns and value for each census tract in rows.
2. A list of weight values for each indicator. The list must correspond correctly to the indicator array.
3. A list of types for each indicator showing whether high values are good (1) or bad (-1). The list must correspond correctly to the indicator array.

The output of the method is an un-labeled array (in-memory) with each indicator in columns and the preference rank for each census tract in rows.

This assessment performs three Python functions.

Python Function 1: Run a Multi-Criteria Analysis.

First, identify applicable indicators for the hazard using the spreadsheet. Convert the information in the census tracts to an un-labeled array representing each indicator associated with the hazard for each census tract. Construct a list of weights and types associated with the hazard (from the spreadsheet). Run the multi-criteria analyses based on the inputs listed above. For each hazard, write the analysis

result to a new census tracts polygon feature class, containing: PROMETHEE score for each census tract, PROMETHEE rank for each census tract, and the indicators used for the hazard (all others are removed).

The census tract results are used to summarize by county. For each hazard:

1. Using the existing County column in the census tract results, calculate the average PROMETHEE preference score for each county based on the associated census tracts.
2. Calculate the rank based on the newly calculated county level scores.
3. Save the county result to a new feature class containing the PROMETHEE score and rank for each county.

The census tract results are also used to summarize by city. For each hazard:

1. Create a geospatial intersection of city boundaries and the census tract PROMETHEE results.
2. For each city, calculate the mean PROMETHEE preference score for each county based on the associated census tracts.
3. Calculate the rank based on the newly calculated city level scores.
4. Convert the polygon result to a point feature class to better represent the cities cartographically.

Python function 2: Create Result Maps.

This tool generates maps based on the multi-criteria results produced in Function 1.

Python function 3: Create Result Tables.

This tool generates spreadsheets of the multi-criteria results produced in Function 1.

3.2.6.4 Limitations and Planned Future Improvements

The upgraded risk assessment has several limitations that could be addressed in future iterations of the tool. First, while the risk assessment is conceptually rooted in resilience scholarship and best practice, not all the expert advisors agreed on all the indicators to use in the first run of the model. Verifying the validity of indicators, and model results, is a crucial aspect of maintaining a relevant risk assessment tool and this work will be pursued in the future. Additionally, indicators included in the assessment may not be comprehensive. Indicators were selected based on peer reviewed evidence and stakeholder support, and their data availability. Additionally, as this method is a quantification of expert opinion, weighting choices have a subjective influence on the results. As further research continues, new indicators or representative data may be applicable and incorporated into the risk assessment. The ONHRA does not address compounding and cascading hazards.

Finally, this risk assessment is limited in its purpose: identifying communities and geographic areas that are most in need of further investigation for mitigation investment. It is not a diagnostic tool. It cannot evaluate the benefits and costs of a for a specific proposed project to mitigate natural hazards.

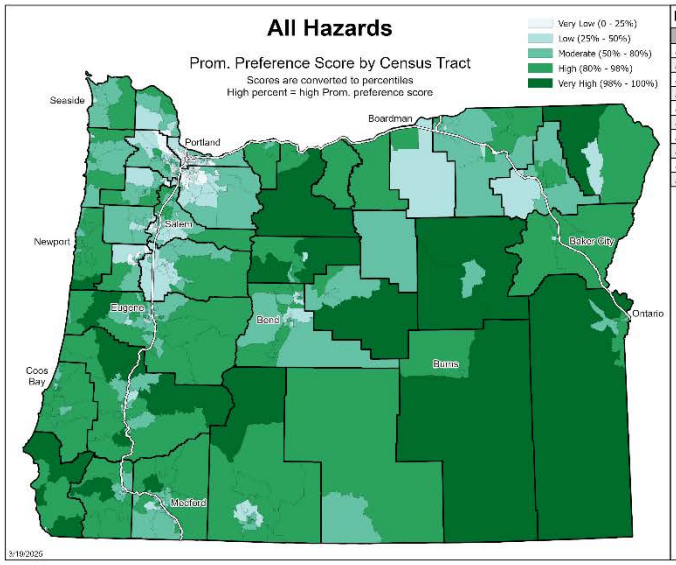
A second iterative phase will continue development of the risk assessment model. In this next phase, a public facing tool will be developed and available as an option for tribes, counties, cities, and other local governments to use in their own risk assessments.

3.2.7 Risk Maps

The ONHRA maps show the risk ranking for each census tract across Oregon. One map shows ranking using both hazard-specific indicators and socio-economic vulnerability indicators. The second map shows census tracts ranked using only hazard indicators, without using socioeconomic vulnerability indicators. This section includes maps using all-hazards composite risk rankings. The hazard-specific maps are in section 3.3, following the description of each hazard. Chapter 9 includes a key to all indicators used in the model and has examples of the information available from the risk assessment model.

Figure 3.2.7-1 shows census tracts ranked using hazard and socioeconomic vulnerability indicators. Figure 3.2.7-2 shows census tracts ranked using only hazard indicators, without using socioeconomic vulnerability indicators. Cities are included for locational reference only and do not show risk by city.

Figure 3.2.7-1 All Hazards Results of Oregon Risk Assessment using PROMETHEE Ranking with Socioeconomic Indicators included

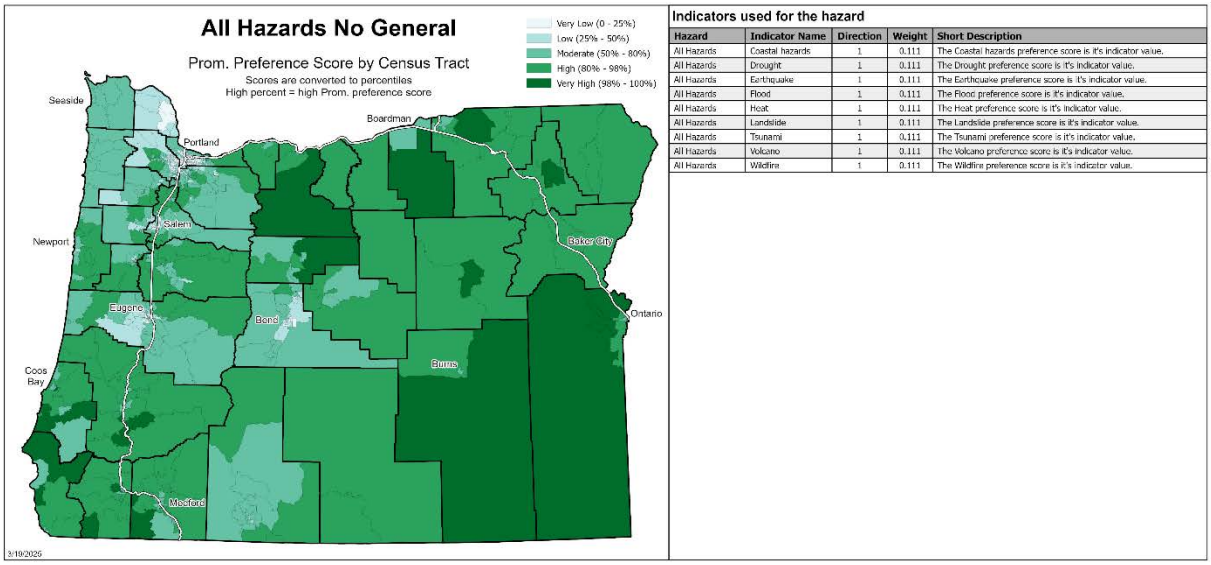


Indicators used for the hazard

Hazard	Indicator Name	Direction	Weight	Short Description
All Hazards	General	1	0.65	The General preference score is it's indicator value.
All Hazards	Coastal hazards	1	0.039	The Coastal hazards preference score is it's indicator value.
All Hazards	Drought	1	0.039	The Drought preference score is it's indicator value.
All Hazards	Earthquake	1	0.039	The Earthquake preference score is it's indicator value.
All Hazards	Flood	1	0.039	The Flood preference score is it's indicator value.
All Hazards	Heat	1	0.039	The Heat preference score is it's indicator value.
All Hazards	Landslide	1	0.039	The Landslide preference score is it's indicator value.
All Hazards	Tsunami	1	0.039	The Tsunami preference score is it's indicator value.
All Hazards	Volcano	1	0.039	The Volcano preference score is it's indicator value.
All Hazards	Wildfire	1	0.039	The Wildfire preference score is it's indicator value.

Map combines the rankings for all hazards into a composite ranking.

Figure 3.2.7-2 All Hazards Results of Oregon Risk Assessment using PROMETHEE Ranking without Socioeconomic Indicators Included



Indicators used for the hazard

Hazard	Indicator Name	Direction	Weight	Short Description
All Hazards	Coastal hazards	1	0.111	The Coastal hazards preference score is it's indicator value.
All Hazards	Drought	1	0.111	The Drought preference score is it's indicator value.
All Hazards	Earthquake	1	0.111	The Earthquake preference score is it's indicator value.
All Hazards	Flood	1	0.111	The Flood preference score is it's indicator value.
All Hazards	Heat	1	0.111	The Heat preference score is it's indicator value.
All Hazards	Landslide	1	0.111	The Landslide preference score is it's indicator value.
All Hazards	Tsunami	1	0.111	The Tsunami preference score is it's indicator value.
All Hazards	Volcano	1	0.111	The Volcano preference score is it's indicator value.
All Hazards	Wildfire	1	0.111	The Wildfire preference score is it's indicator value.

Map combines the rankings for all hazards into a composite ranking

DLCD contracted with the Oregon Climate Research Institute to produce data by census tract for future meteorological conditions that influence natural hazards. DLCD used the future conditions data to produce maps. For some hazards, the data relate directly to the natural hazard, for example drought. For other hazards, the map shows a condition that indirectly influences the natural hazard. For example, heavy precipitation influences floods and landslides, but a 10 percent increase in heavy precipitation would not automatically result in a 10 percent increase in flooding or landslides. Days over 90°F can indicate the possibility of extreme heat events. An increase in days with temperatures above the local 90th percentile can contribute to local heat stress. The wind section includes a map showing change from present conditions, but the ONHRA is not yet able to produce risk rankings for windstorms.

3.3 Hazard Identification

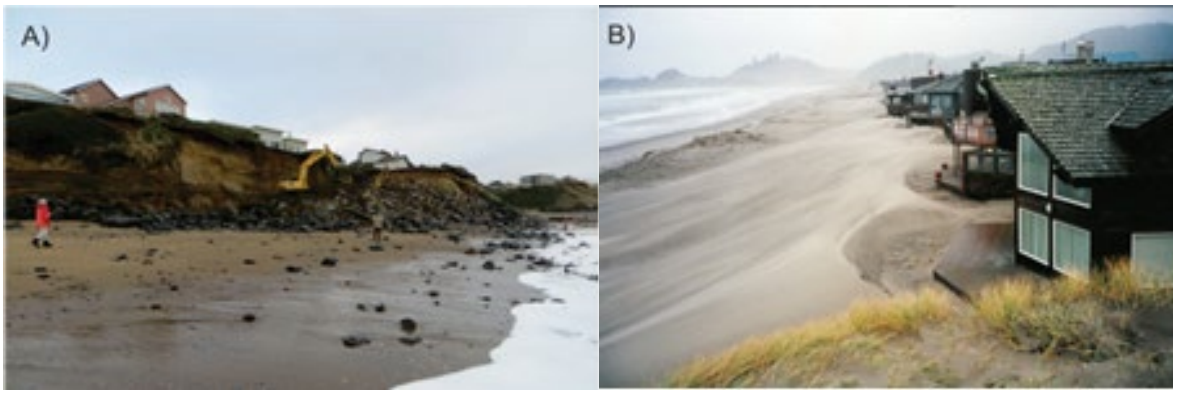
3.3.1 Coastal Hazards

Figure 3.3.1-1: Erosion at the Capes Condominiums, Oceanside, Oregon

Source: DOGAMI Notes: The Capes, a multi-million-dollar condominium complex constructed on an old Holocene dune field adjacent to Oceanside. Due to erosion of the sand at the toe of the bluff during the 1997-98 El Nino winter, the bluff face began to fail threatening several of the homes built nearest the bluff edge.

The Pacific Northwest (PNW) coast of Oregon is, without a doubt, one of the most dynamic coastal landscapes in North America, evident by its long sandy beaches, extensive dune systems, sheer coastal cliffs, dramatic headlands and vistas, and ultimately the power of the Pacific Ocean that serves to erode and change the shape of the coast. It is these qualities along with its various natural resources that have drawn people to live along its narrow shores. However, coastal communities are increasingly under threat from a variety of natural hazards that all come together along the coastal strip. These include wave-induced coastal erosion (both short and long term), wave runup and overtopping (wave-induced flood hazards), inundation of homes by wind-blown sand, coastal landslides, earthquakes, and potentially catastrophic tsunamis generated by the Cascadia Subduction Zone (CSZ). Over time, these hazards are gradually being compounded, in part due to the degree of development that has evolved along the Oregon coast in recent decades. A particular concern is that the local geology and geomorphology of the region have restricted development to low-lying areas, chiefly along dunes, barrier spits, or along coastal bluffs present along the open coast that are subject to varying rates of erosion, and to low-lying areas adjacent to the numerous estuaries that make up the coast. All these sites are highly susceptible to increased impacts as erosion processes and flood hazards intensify, driven by rising sea level and increased storminess, especially when combined with shoreline armoring such as riprap.

Figure 3.3.1-2: A) Emergency riprap being placed in front of a home at Gleneden Beach following a bluff failure (February 2013). B) Homes being inundated with excess sand during strong wind event in November 2021



Source: DOGAMI

There are many dangers inherent in living on the coast. Beaches and coastal bluffs are some of the most dynamic landforms, responding to a myriad of variables. Both landforms are constantly changing (at varying time scales) as they respond to changes in the ocean processes (waves, nearshore currents, and tides) that affect the beach and toe of the bluff as well as those sub-aerial processes (rainfall, sun, wind) that directly affect coastal bluffs. While coastal bluffs gradually erode over the long-term, they can also respond very rapidly, at times sliding away (in a matter of minutes to a few hours) so that homes and sections of highways are damaged or destroyed (Figure 3.3.1-2A). Beaches are especially dynamic features, as wave action constantly shifts sand around This is especially noticeable in major storms, with the shoreline retreating rapidly, periodically destroying homes built too close to the sea. At other times, large quantities of sand migrate back onto beaches, burying homes built atop coastal dunes (Figure 3.3.1-2B). There is no location on the Oregon coast that is immune to coastal hazards. Without question, the most important natural variables that influence changes to the shape and width of the beach and ultimately its stability are the beach sand budget (balance of sand entering and leaving the system) and the processes (waves, currents, tides, and wind) that drive these changes. Human influences associated with jetty construction, dredging practices, coastal engineering, and the introduction of non-native dune grasses during settlement have all affected the shape and configuration of the beach, including the volume of sand on a number of Oregon's beaches, ultimately influencing the stability or instability of these beaches. These developments restrict the natural movement of sand and the ability of estuaries to migrate inland, causing the phenomenon known as 'coastal squeeze.' Coastal squeeze occurs when coastal habitats, like beaches and wetlands, are confined between human-made structures and rising sea levels, preventing them from naturally shifting or adapting to environmental changes. This not only undermines the natural resilience of coastal ecosystems but also increases the vulnerability of coastal communities to flooding, erosion, and storm surges.

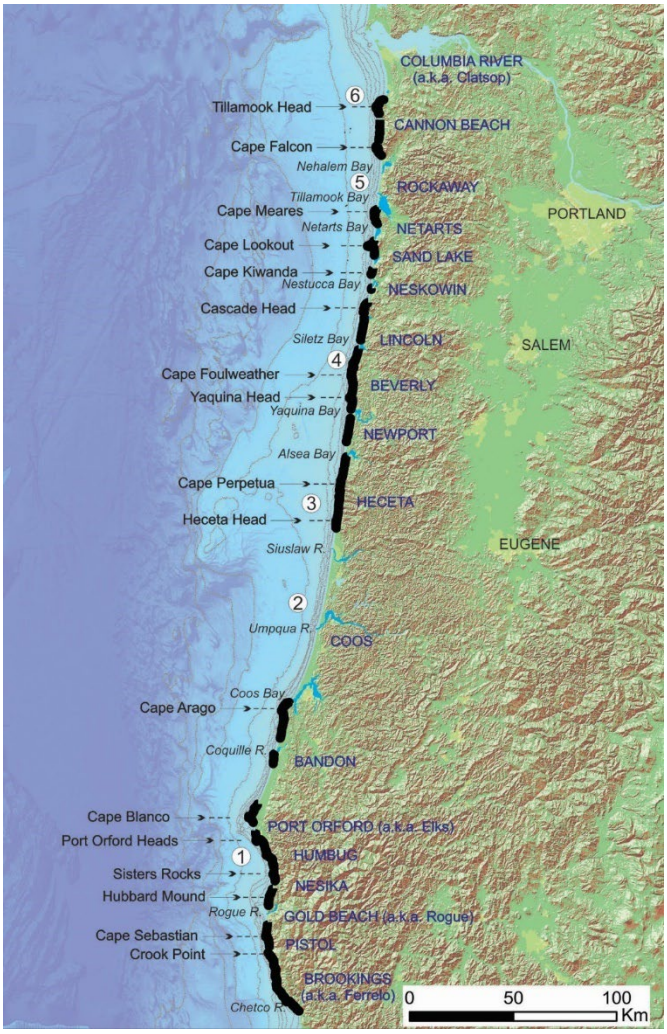
3.3.1.1 Analysis and Characterization

Geology and Geomorphology

The Oregon coast extends 366 miles from the Columbia River to the California border. The present coastline is the result of geologic processes that include a rise in sea level as Ice Age glaciers melted. The coastal geomorphology of this landscape reflects a myriad of geomorphic features (Figure 3.3.1-3.) that range from plunging cliffs (in Regions 1, 4, and 5), rocky shorelines and shore platforms (Regions 1, 3, 5, and 6), wide and narrow sandy beaches backed by both dunes (Regions 2, 5, and 6) and cliffs (Regions 3 and 4), gravel and cobble beaches backed by cliffs (Regions 1, 5, and 6), barrier spits (Regions 2, 4, and 5), and estuaries (Regions 1–6). Cliff or bluff-backed shorelines make up the bulk of the coast accounting for 58 percent of the coastline, the remainder being dune-backed beaches. Geomorphically, the coast can be broken up into a series of "pocket beach" littoral cells (Figure 3.3.1-3) that reflect resistant headlands (chiefly basalt) interspersed with short to long stretches of beaches backed by both less resistant cliffs or dunes (e.g., Lincoln and Tillamook Counties [Regions 3 and 5 in Figure 3.3.1-3; also see Figure 3.3.1-4.]). The headlands effectively prevent the exchange of sand between adjacent littoral cells. Some beaches form barrier spits, creating estuaries or bays behind them (e.g., Netarts, Nestucca, and Siletz spits). About 75.6 percent of the coastline consists of beaches composed of sand or gravel backed by either dunes or bluffs, while the remaining 24.4 percent of the coast is composed of a mixture of rocky cliffs (including headlands) and shores. The Coos Cell is the largest of the 18 littoral cells on the Oregon coast, which extends from Cape Arago in the south to Heceta Head in the north, some 62.6 miles long.

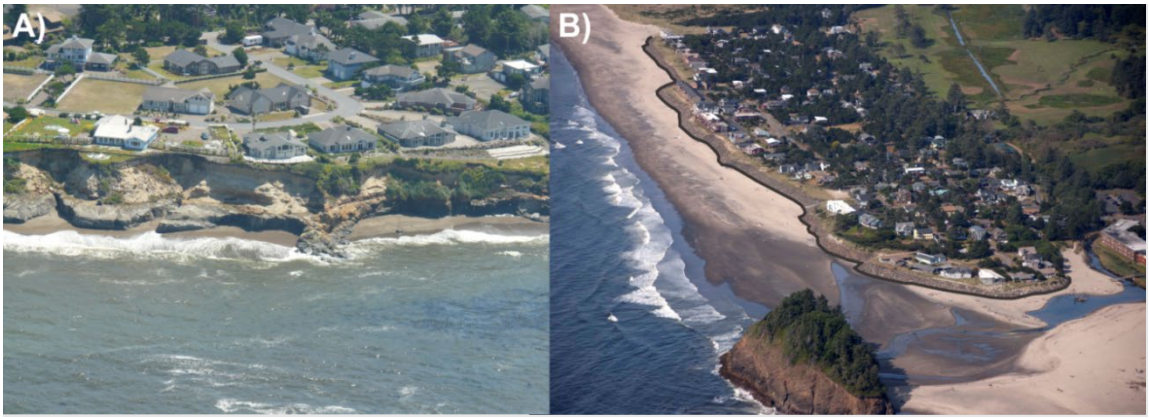
Bold black lines denote the locations of cliffs and rocky shores. Faint grey lines denote faulting. Blue text denotes littoral cells. Numbers indicate regional coastal geomorphic features: plunging cliffs (1, 4, and 5); rocky shorelines and shore platforms (1, 3, 5, and 6); wide and narrow sandy beaches backed by dunes (2, 5, and 6) and cliffs (3 and 4); gravel and cobble beaches backed by cliffs (1, 5, and 6); barrier spits (2 and 5); and estuaries (1–6).

Figure 3.3.1-3: Oregon's coastal geomorphology and littoral cells



Source: DOGAMI

Figure 3.3.1-4 (A) Houses Line the Cliff at Fogarty Creek in Lincoln County. (B) Extensive Erosion along the Dune-Backed Beaches in Neskowin Have Resulted in the Construction of Massive Riprap



Note the proximity of the eroding cliff edge to homes.
Source: L. Stimely, DOGAMI

Interspersed among the littoral cells are 21 estuaries that range in size from small, such as the Winchuck estuary (0.5 km2) adjacent to the Oregon/California border, to large, such as the Columbia River (380 km2), which separates the states of Oregon and Washington. The estuaries are all ecologically important to many fish and wildlife species and in many cases are the sites of important recreational and commercial enterprise. Additionally, estuaries play a crucial role in carbon sequestration, acting as natural carbon sinks that help mitigate climate change. When unaltered, undeveloped estuaries also provide valuable localized protection against storms and flooding, buffering coastal communities from extreme weather events and rising sea levels. In general, Oregon estuaries can be divided into two broad groups based on physiographic differences between estuaries located on the north and south coast. On the northern Oregon coast, the prevalence of pocket beach littoral cells and weaker rock formations in the coast range has resulted in more rapid erosion of the region's rock formations. This produces ample material at the coast, and coupled with alongshore sediment transport, has aided the formation of barrier spits across drowned river valleys and hence the formation of estuaries landward of the spits. In contrast, sediment loads on the southern Oregon coast are comparatively lower due to the presence of more resistant rock formations. Furthermore, the region is generally much steeper, which essentially limits the landward extent of the tide in drowned rivers and, hence, ultimately the size of the estuaries.

Unlike much of the U.S. coast, population pressure on the Oregon coast is relatively low and is largely confined to small coastal towns separated by large tracts of coast with little to no development. The bulk of these developments are concentrated on the central to northern Oregon coast in Lincoln, Tillamook, and Clatsop Counties. On the cliffed shores of the central Oregon coast, between Newport and Lincoln City, homes are perched precariously close to the edge of the cliffs (Figure 3.3.1-4A). In some areas, the erosion has become acute, requiring various forms of coastal engineering (commonly riprap) as an attempt to mitigate the problem **(**Figure 3.3.1-4B), and in a

few cases the landward relocation of the homes. In other areas, critical infrastructure such as US Highway101 tracks close to the coast, and in a few areas, erosion of the cliffs has resulted in expensive remediation (e.g., adjacent to Nesika Beach in Curry County). Although the processes driving coastal erosion on bluff-backed shores are entirely a function of the delicate balance between the assailing forces (waves, tides, and currents) and properties of the rock (rock type, bedding, strength, etc.), increasing development pressure, weak land-use regulations, a lack of quantitative information, and ignorance of the physical processes have contributed to the need for remediation in many coastal areas.

Elsewhere, significant development is typically located along the most seaward dune (foredune) system (Figure 3.3.1-4B), as developers seek to capitalize on ocean views and proximity to the beach. However, major storms, especially those associated with El Niño events in the late 1990s, have resulted in extensive erosion, with many communities (e.g., Neskowin and Rockaway Beach in Tillamook County) having to resort to major coastal engineering to safeguard individual properties. The magnitude and extent of these erosion events have now left entire communities entirely dependent on the integrity of these structures.

Sand Budget

The beach sand budget is the rate at which sand is brought into the coastal system versus the rate at which sand leaves the system. A negative balance means that more sand is leaving than is arriving and results in erosion of that segment of shoreline. A positive balance means that more sand is arriving than is leaving, enabling that segment of shoreline to gain sand and accrete and potentially advance seaward. Along the Oregon coast, potential sources of sand include rivers, bluffs, dunes, and the inner shelf. Potential sand sinks include bays (estuaries), dunes, dredging around the mouths of estuaries, and mining of sand.

Attention is often focused on the effects of beach and dune erosion. Yet, there are segments of Oregon's coast where periodically the concern is excess sand build-up, as has occurred in places like Pacific City, Manzanita, Bayshore Spit, Nedonna, and Cannon Beach. This excess accumulation of sand can impact the structural integrity of and access to ocean-fronting homes, requiring the sand to be removed through remedial sand grading.

Classifying Coastal Hazards

Natural hazards that affect coastal regions can be divided into two general classes, *chronic* and *catastrophic*.

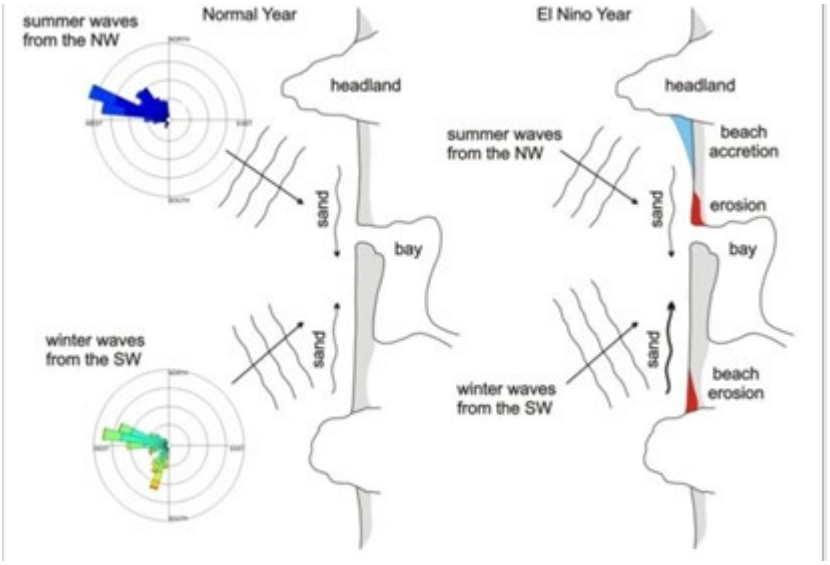
Chronic hazards such as beach, dune, and bluff erosion; landslides; slumps; and flooding of low-lying lands during major storms usually cause gradual and cumulative damage. However, storms that produce large winter waves, heavy rainfall, and/or high winds may result in very rapid, episodic erosion or other damage that can affect properties and infrastructure over a matter of hours. The regional, oceanic, and climatic environments that result in intense winter storms determine the severity of chronic hazards along the Oregon coast. Chronic hazards are typically local in nature, and threats to human life and property that arise from them are generally less severe than those associated with catastrophic hazards. However, the wide distribution and frequent occurrence of chronic hazards make them a more immediate concern.

Catastrophic hazards are regional in scale and scope. Cascadia Subduction Zone earthquakes, and the ground shaking, subsidence, landsliding, liquefaction, and tsunamis that accompany them are catastrophic hazards. Tsunamis generated from distant earthquakes can also cause substantial damage in some coastal areas. The processes associated with earthquakes, tsunamis, floods, and landslides are discussed later in this chapter.

Causes of Coastal Hazards

Chronic coastal hazards include periodic high rates of beach and dune erosion and sand inundation; "Hotspot erosion" due to the occurrence of El Niños and from rip current embayments; intermittent coastal flooding as a result of El Niños, storm surges and high ocean waves; and the enduring recession of coastal bluffs due to long-term changes in mean sea level, variations in the magnitude and frequency of storm systems, and climate change. Other important hazards include mass wasting of sea cliffs such as slumping and landslides, which may be due to wave attack and geologic instability.

Figure 3.3.1-5:Patterns of Sediment Transport During "Normal" and El Nino Years



Source: Komar (1986)

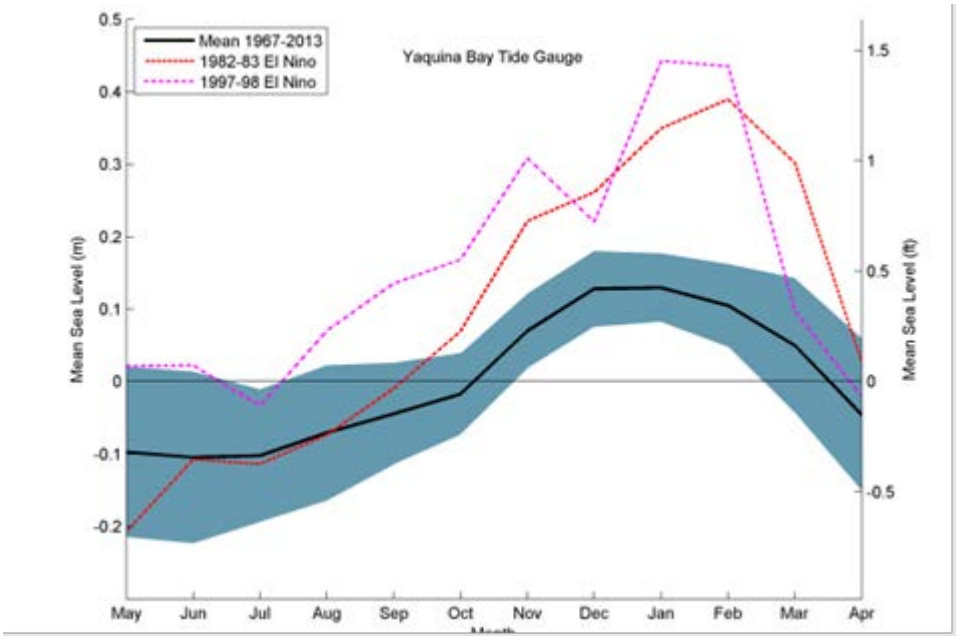
Most of these hazards are the product of the annual barrage of rain, wind, and waves that batter the Oregon coast, causing ever-increasing property damage and losses. A number of these hazards may be further exacerbated by climate cycles such as the El Niño Southern Oscillation, or longer-term climate cycles associated with the Pacific Decadal Oscillation. Other hazards, such as subduction zone earthquakes and resulting tsunamis, can have catastrophic impacts on coastal communities' residents and infrastructure, and in many areas these impacts will persist for many decades following the event due to adjustments in the coastal morphodynamics following subsidence or uplift of the coast. All these processes can interact in complex ways, increasing the risk from natural hazards in coastal areas.

Waves

Along dune- and bluff-backed shorelines, waves are the major factor affecting the shape and composition of beaches. Waves transport sand onshore (toward the beach), offshore (seaward to form nearshore bars etc.), and along the beach (longshore transport). Short-term beach and shoreline variability (i.e., storm related changes) is directly dependent on the size of the waves that break along the coast, along with high ocean water levels, and cell circulation patterns associated with rip currents. In contrast, long-term shoreline change is dependent on the balance of the beach sediment budget, changes in sea level over time, and storm and wave climate patterns.

The Oregon coast is exposed to one of the most extreme ocean wave climates in the world, due to its long fetches (area over which the wind can blow to create waves) and the strength of the extratropical storms that develop and track across the North Pacific. These storms exhibit a pronounced seasonal cycle producing the highest waves (mean = 12.8 ft) in the winter, with winter storms commonly generating deep-water wave heights greater than 33 ft, with the largest storms in the region having generated waves in the range of 45 to 50 ft. In contrast, summer months are dominated by considerably smaller waves (mean = 5.3 ft), enabling beaches to rebuild and gain sand eroded during the preceding winter. When large waves are superimposed on high tides, they can reach much higher elevations at the back of the beach, contributing to significantly higher rates of coastal erosion and flood hazards. It is the combined effect of these processes that leads to the erosion of coastal dunes and bluffs, causing them to retreat landward.

Figure 3.3.1-6:Average Monthly Tides for the Yaquina Bay Tide Gage. Expressed as an Average for the Period 1967–2013, and as Monthly Averages for the 1982-83 and 1997-98 El Niños



Source: Jonathan Allan, DOGAMI
Shaded region= ±1 standard deviation providing a measure of normal ranges.

Winds and waves tend to arrive from the southwest during the winter and from the northwest during the summer. Net sand transport tends to be offshore and to the north in winter and onshore

and to the south during the summer (Figure 3.3.1-5). El Niño events can exaggerate the characteristic seasonal pattern of erosion and accretion and may result in an additional 60–80 feet of "hotspot" dune erosion along the southern ends of Oregon's littoral cells, particularly those beaches that are backed by dunes, and on the north side of estuary inlets, rivers and creeks.

Ocean Water Levels

The elevation of the sea is controlled in part by the astronomical tide. High ocean water levels at the shoreline may be the product of combinations of high tides, storm surges, strong onshore-directed winds, El Niños, and wave runup. As can be seen in Figure 3.3.1-6, the Oregon coast experiences a seasonal cycle in its measured tides, with the tides tending to be highest in the winter and lowest in the summer. This seasonal variation is entirely a function of ocean upwelling during the summer months, which brings cold dense water to the surface; due to the Coriolis effect and ocean currents, this water is directed landward where it piles up along the coast depressing sea level. In the winter, this process breaks down resulting in a warming of the ocean, which raises the mean sea level. The typical seasonal variability in water levels is about 0.8 ft, increasing to as much as 2 ft during an El Niño (Figure 3.3.1-6), essentially raising the mean shoreline elevation, enabling waves to break closer to dunes or along the base of coastal bluffs.

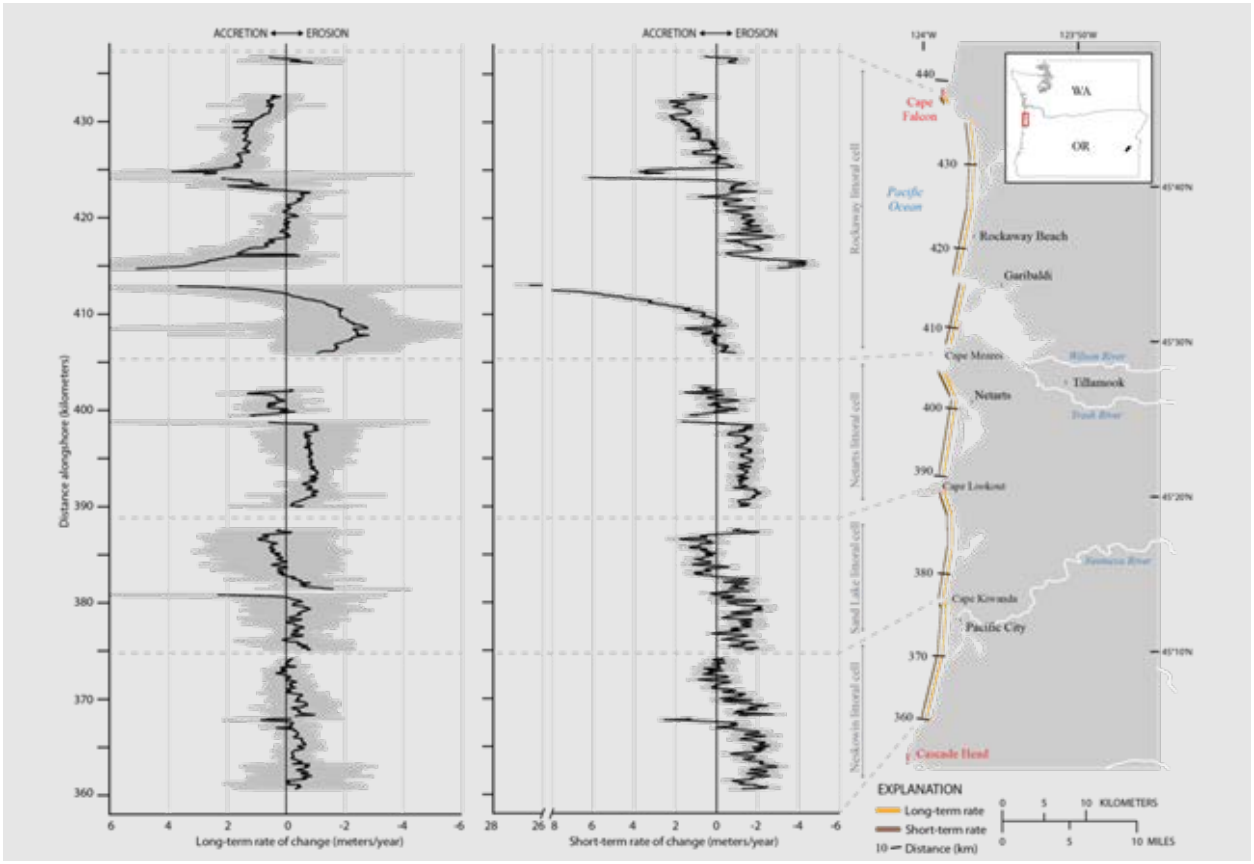
Shoreline Changes

Dune-backed beaches respond very quickly to storm wave erosion, sometimes receding tens of feet during a single storm and hundreds of feet in a single winter season. Beach monitoring studies undertaken by DOGAMI staff (http://nvs.nanoos.org/BeachMapping) have documented storm induced erosion of 30–60 ft from single storm events, while seasonal changes may reach as much as 90–130 ft on the dissipative, flat, sandy beaches of Oregon, and as much as 190 ft on the more reflective, steeper beaches of the south coast (e.g., adjacent to Garrison Lake, Port Orford). Furthermore, during the past 15 years a number of sites on the northern Oregon coast (e.g., Neskowin, Netarts Spit, and Rockaway Beach) have experienced considerable erosion and shoreline retreat. For example, erosion of the beach in Neskowin has resulted in the foredune having receded landward by as much as 150 ft since 1997. South of Twin Rocks near Rockaway Beach, the dune has eroded about 140 ft over the same time period. Continued monitoring of these study sites is now beginning to yield enough data from which trends (erosion or accretion rates) may be extrapolated. These latter datasets are accessible via the web (http://nvs.nanoos.org/BeachMapping).

Recently, studies undertaken by the USGS provide additional insights into the spatial extent of erosion patterns on the Oregon coast. Figure 3.3.1-7 provides analyses of both long-term (about 1900s to 2002) and short-term (about 1960s/80s to 2002) shoreline change patterns along the Tillamook County coast, confirming measured data reported by DOGAMI. As can be seen from the figure, long-term erosion rates (albeit low rates) dominate the bulk of Tillamook County (i.e., Bayocean Spit, Netarts, Sand Lake, and Neskowin littoral cells), while accretion prevailed in the north along Rockaway Beach and on Nehalem Spit. The significant rates of accretion identified adjacent to the mouth of Tillamook Bay are entirely due to construction of the Tillamook jetties, with the north jetty completed in 1917 and the south jetty in 1974. Short-term shoreline change patterns indicate that erosion has continued to dominate the bulk of the shoreline responses observed along the Tillamook County coast. Erosion is especially acute in the Neskowin, Sand Lake and Netarts littoral cells, and especially along Rockaway Beach. In many of these areas, the degree

of erosion remains so significant, that were communities to experience a major storm(s) in the ensuing winters, the risk of considerable damage to property and infrastructure in these areas would likely be high.

Figure 3.3.1-7: Long- and Short-Term Shoreline Change Rates for the Tillamook County Region



Source: Ruggiero, et al. (2013)

The processes of wave attack significantly affect shorelines characterized by indentations, known as inlets, that lead to estuaries or other enclosed bodies of water. Waves interact with ocean tides and river forces to control patterns of inlet migration. This is especially the case during El Niño. During an El Niño, large storm waves tend to arrive out of the south, which causes the mouth of the estuary to migrate to the north, where it may abut against the shoreline, allowing large winter waves to break much closer to the shore. This can result in significant “hotspot” erosion north of the estuary mouth. Recent examples of the importance of inlet dynamics during an El Niño are Alsea Spit near Waldport (Figure 3.3.1-8), Netarts Spit near Oceanside, and at Hunter Creek on the southern Oregon coast at Gold Beach.

Figure 3.3.1-8: Alsea Bay Spit Erosion as a Result of the 1982-83 El Niño (left), and State of the Beach in 2009 (right)

Source: DOGAMI
Notes: Yellow/black line delineates a riprap structure constructed to protect the properties from further erosion. Orange line defines the maximum extent of dune erosion due to wave attack as a result of the 1982-83 event. Note the northward migration of the estuary mouth compared to its position in 2009.

Floods

Flood Insurance Rate Maps (FIRMs) and Flood Insurance Studies (FISs) are also often used in characterizing and identifying flood-prone areas. FEMA conducted many FISs in the late 1970s and early 1980s. Included were "VE" zones, areas subject to wave action and ocean flooding during a "100-year" event that encompass the area extending from the surf zone to the inland limit of wave runup, and/or wave overtopping and inundation, and/or the location of the primary frontal dune or any other area subject to high-velocity wave action from coastal storms. Areas identified as VE zones are subject to more development standards than other flood zones. Between 2009 and 2014, DOGAMI worked with FEMA to remap FEMA coastal flood zones established for Oregon's coastal communities, utilizing improved topographic information, revised information on extreme storm waves and ocean water levels, and a revised methodology for calculating erosion, wave runup and overtopping. Tidal flooding, especially during perigean spring tides and El Niño events, already impacts low-lying coastal areas, including a stretch of Highway 101 just south of Seaside.

Landslides

Simple surface sloughing is the dominant process along bluff-backed shorelines. Other shorelines are backed by steep slopes, where deep-seated landslides and slumping are the dominant processes (Figure 3.3.1-9). The geologic composition of the bluff is a primary control on slope stability.

Headlands, generally composed of basalt, are more resistant to erosion and do not readily give way. In contrast, soft bluff-forming sandstone and mudstone are highly susceptible to slope movement. Prolonged winter rains saturate these porous bluff materials, increasing the likelihood of landslides.

The geometry and structure of bluff materials also affect slope stability by defining lines of weakness and controlling surface and subsurface drainage. As waves remove sediment from the toe of the bluff, the bluffs become increasingly vulnerable to slope failure due to increased exposure to wave attack. The extent to which the beach fronting the bluff acts as a buffer is thus important in this regard. Thus, a reduction in the sand beach volume in front of a bluff increases its susceptibility to wave erosion along its toe, which can eventually contribute to the failure of the bluff by undercutting of the base of the bluff, creating instability of the overhanging slope face.

A recent example of such a process occurred at Gleneden Beach in Lincoln County in November 2006 (Figure 3.3.1-9), when a large rip current embayment (an area of the beach that exhibits more erosion and beach narrowing due to removal of sand by rip currents) formed in front of a portion of the bluff, allowing waves to directly attack the base of the bluff. In a matter of two days, the bluff eroded by up to 30 ft, undermining the foundations of two homes, and almost resulting in their destruction.

Figure 3.3.1-9: Bluff Failure Due to Toe Erosion by Ocean Waves

Source: OPDR
Note: The top of the bluff eroded landward by about 30 ft over a 48-hour period in November 2006.

Similar processes occurred nearby during the 1972-73 winter, which led to one home having to be pulled off its foundation. Both examples provide a stark reminder of the danger of building too close to the beach and that episodic erosion events can happen without warning and can cause significant damage and hazards. It is important to note as well that under Oregon's Statewide Planning Goal 18, only oceanfront properties that were developed on or prior to January 1, 1977 are eligible for shoreline armoring, which is subjected to the permitting regulations of the Oregon Parks and Recreation Ocean Shores Division. Therefore, not all properties that face erosional issues are eligible to armor their property to prevent further erosion from occurring.

Landslide risk is especially high on the southern Oregon coast in Curry County, where multiple slide failures are presently affecting Highway 101. One of the largest recent events occurred on March 3, 2019 at Hooskanaden Creek, affecting travel on Highway 101 (Figure 3.3.1-10). Movement in the central part of the landslide near Highway 101 varied from 45 to 130 ft. Significant active landsliding is also evident on the central Oregon coast in the Beverly Beach littoral cell, located immediately north of Yaquina Head. Within this eight-mile stretch of highway, there are four active landslide blocks that require frequent remediation of the highway.

Figure 3.3.1-10: Landslide Movement Affecting U.S. Highway 101 at Hooskanaden Creek on March 3, 2019

Source: Michael Olsen, 2020.
Note: Inset Photo Shows the Overall Scale of the Landslide and Its Proximity to the Coast.

Climate Change and Sea Level Rise

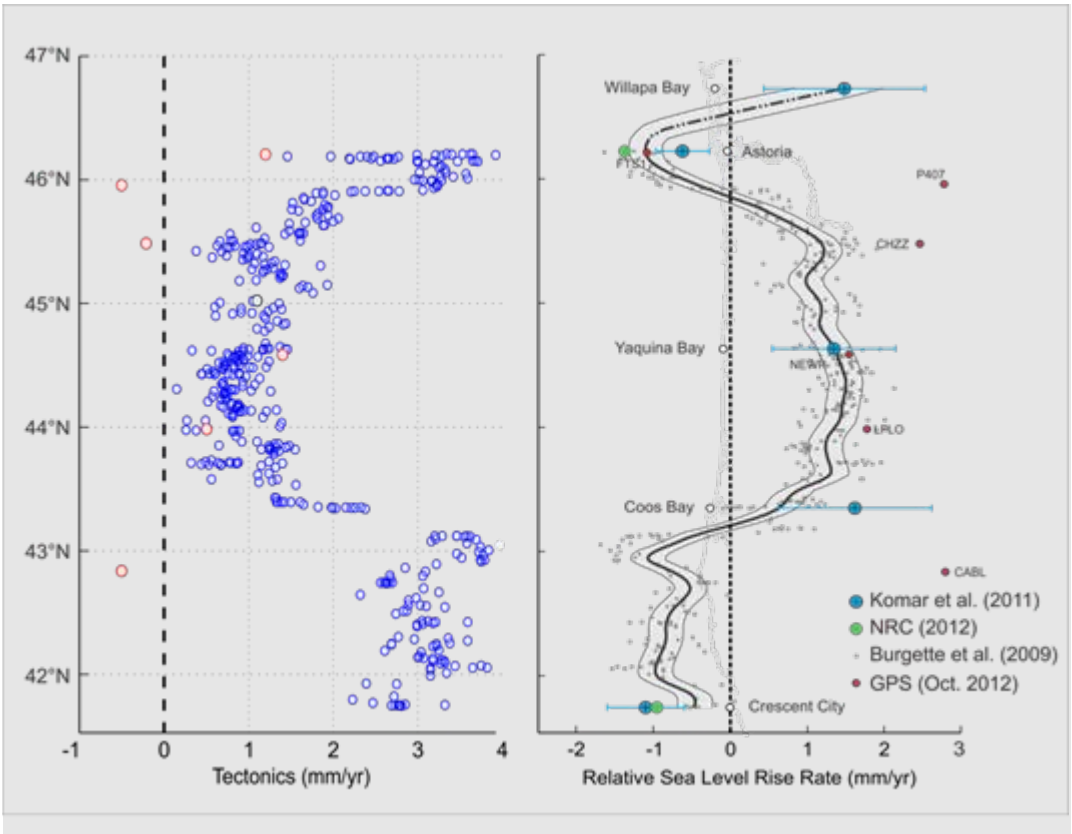
An understanding of the trends and variations in sea level on the Oregon coast provides important insights as to the spatial patterns of erosion and flood hazards. In general, tectonic uplift is occurring

at a much faster rate (about 2–4 mm/year) on the south coast (south of about Coos Bay), while the uplift rates on the central to northern Oregon coast are much lower, averaging about 1 mm/year (Figure 3.3.1-11, left). When combined with regional patterns of sea level change (Figure 3.3.1-11, right), it is apparent that the southern Oregon coast is essentially an emergent coast, with the coast rising at a much faster rate when compared with sea level. In contrast, the central to northern Oregon coast is a submergent coast due to the fact that sea level is rising faster than the land. Not surprisingly, it is the north coast that exhibits the most pervasive erosion and flood hazards when compared with the south coast.

In 2012, the National Research Council (2012) completed a major synthesis of the relative risks of sea level rise on the U.S. West Coast. The consensus from that report is that sea level has risen globally by on average 1.7 mm/year, while rates derived from satellite altimetry indicate an increase in the rate of sea level rise to 3.2 mm/year since 1993 (National Research Council, 2012). Combining data on glacial isostatic rebound (the rate at which the earth responds to the removal of ice from the last glaciations), regional tectonics, and future temperature patterns, the committee concluded that sea level on the Oregon coast would increase by approximately 2.1 ft by 2100.

Global measurements of sea level change continue to be quantified through satellite altimetry, with the most recent (February 2020) measurements indicating a net increase of 3.39 mm/year since 1993 (Copernicus Marine and Environment Monitoring Service (CMEMS), Aviso Satellite Altimetry Data website, Mean Sea Level Rise page, https://www.aviso.altimetry.fr/en/data/products/ocean-indicators-products/mean-sea-level.html). Regional projections of future sea level rise scenarios have also been updated for the United States, based on revised global projections of sea level change undertaken using global climate change modeling (Sweet and others, 2017). These revised data reflect the most up-to-date scientific information, including recent observational and modeling literature that examine the potential for rapid ice melt in Greenland and Antarctica. Based on these latest analyses, a physically plausible global sea level rise in the range of 6 ft to 8.9 ft is now more likely. Sweet and others (2017) define six global sea level rise scenarios, termed: Low, Intermediate-low, Intermediate, Intermediate-high, High and Extreme, which correspond to global sea level increases of 1 ft, 1.6 ft, 3.3 ft, 4.9 ft, 6.6 ft, and 8.2 ft respectively. These data can then be used to calculate regional estimates of sea level rise, after accounting for tectonic changes, glacial isostatic rebound, and shifts in ocean circulation patterns. For the Pacific Northwest, Sweet and others (2007) indicate that the regional sea level rise is projected to be less than the global average falling mainly under the Low-to-Intermediate scenarios (e.g., 0.3–3.3 ft).

Figure 3.3.1-11: Coast Variations in Rates of Tectonic Uplift, and Relative Sea Level Trends for the Oregon Coast



Source: Komar & Allan (2010); http://www.aviso.oceanobs.com/en/news/ocean-indicators/mean-sea-level/

Table 3.3.1-1: Projected Sea Level Rise for the Central Oregon Coast

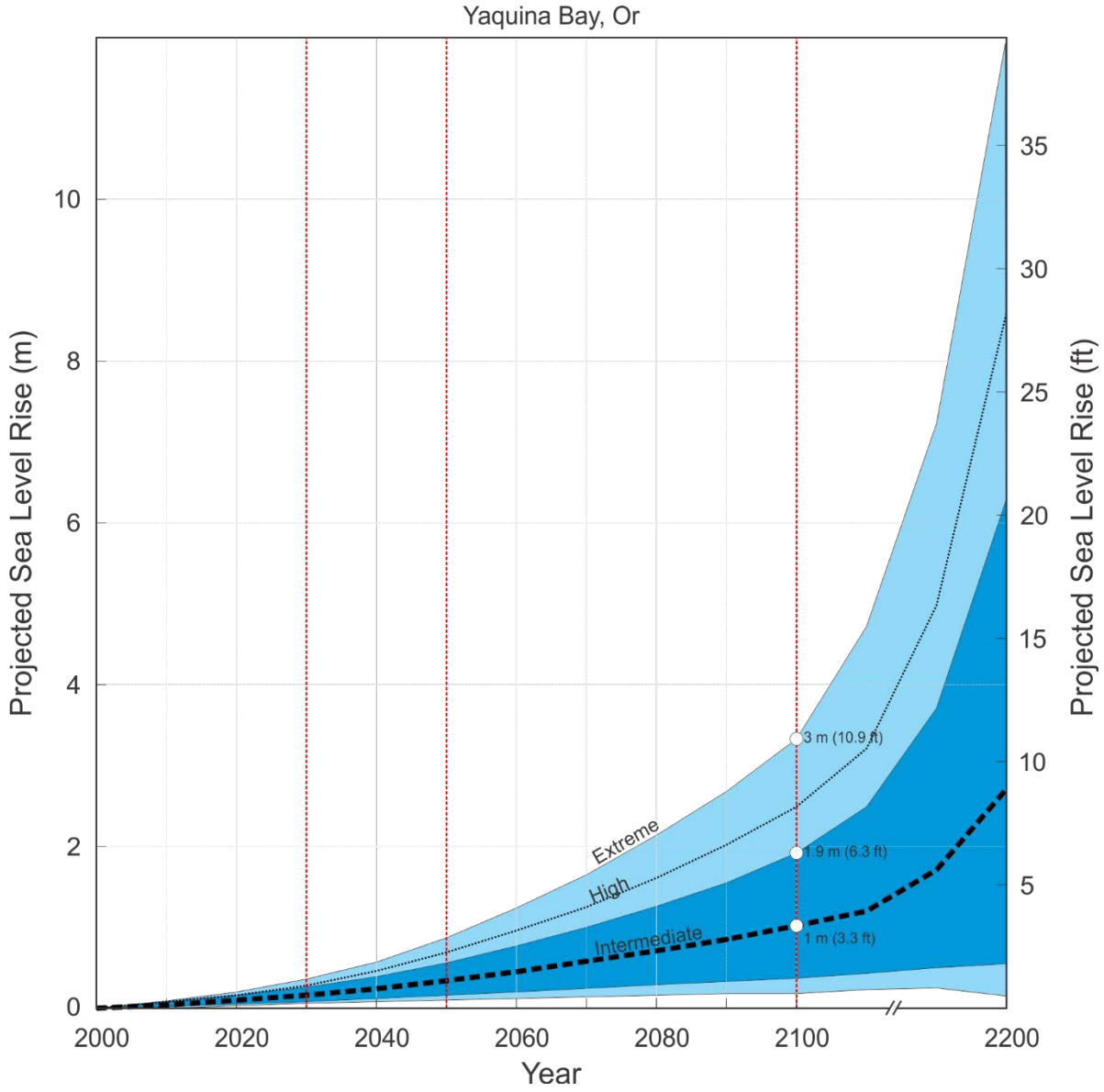
By Year 2030		By Year 2050		By Year 2100	
Projection	Range	Projection	Range	Projection	Range
0.5 ft	0.2–1.2 ft	1.1 ft	0.3–2.9 ft	3.4 ft	0.6–10.9 ft

Table 3.3.1-1 presents the revised Sweet and others (2017a) projected sea level rise findings for the Central Oregon coast. The largest increase in regional sea level is estimated to be 10.9 ft by 2100 (Figure 3.3.1-12) while the intermediate projection reflects an increase of about 3.4 ft by 2100. As noted previously, the extreme 10.9 ft projection reflects the now plausible scenario of a catastrophic failure of the Greenland and Antarctic ice sheets. Under this latter scenario, projected sea levels in 2200 could well exceed 30 ft along the Oregon coast.

Of importance, these projections assume that sea level is uniform year- round. However, as noted previously, sea level on the Oregon coast exhibits a pronounced seasonal cycle of about 0.8 ft between summer and winter, increasing to as much as 2 ft in response to the development of a

strong El Niño. Thus, when combined with projected future increases in regional sea level, it becomes apparent that the potential increase in mean sea level could be substantially greater depending on the time of year. For example, by 2100, sea level during an El Niño winter could be as much as 13 ft under the most extreme scenario, raising the mean shoreline position by that amount, which will have shifted upward and landward as beaches respond to the change in mean water levels. Based on these projections, it can be expected that areas presently classified as emergent (e.g., the southern Oregon coast), will become submergent over time as the rate of sea level rise surpasses tectonic uplift. Furthermore, erosion and flood hazards on the northern Oregon coast will almost certainly accelerate, increasing the risk to property. As sea levels rise, beaches and cliffs will also continue to erode; with increased development and armoring along the shoreline, the landward migration of the shoreline will be limited, leading to beach narrowing and sediment loss.

Figure 3.3.1-12: Projected Future Changes in Regional Sea Levels on the Oregon Coast.



Source: Created by Jonathan Allan, DOGAMI, with integrated sea level rise projections from Sweet and others (2017).

Human Activities

Human activities affect the stability of all types of shorelines. Large-scale human activities such as jetty construction and maintenance dredging have a long-term effect on large geographic areas. This is particularly true along dune-backed and inlet-affected shorelines such as the Columbia River and Rockaway littoral cells (Figure 3.3.1-3). The planting of European beach grass (*Ammophila arenaria*) since the early 1900s and, more recently, American beach grass (*Ammophila breviligulata*) has

locked up sand in the form of high dunes. Such a process can contribute to a net loss in the beach sand budget and may help drive coastal erosion.

Residential and commercial development can affect shoreline stability over shorter time periods and 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 affect shoreline stability.

While site-specific coastal engineering efforts such as the construction of riprap revetments is less likely to cause direct adverse impacts to the littoral cell as a whole, the cumulative effect of constructing many of these structures along a particular shore (e.g., as has occurred along the communities of Gleneden Beach, Siletz Spit, Lincoln City, Neskowin, Pacific City, and Rockaway) will almost certainly decrease the volume of sediment being supplied to the beach system, potentially affecting the beach sediment budget and hence the stability of beaches within those littoral cells. Shoreline armoring structures can also lead to increased erosion of neighboring properties, known as flanking erosion.

Heavy recreational use in the form of pedestrian and vehicular traffic can affect shoreline stability over shorter time frames and smaller spaces. Because these activities may result in the loss of fragile vegetative cover, they are a particular concern along dune-backed shorelines. Graffiti carving along bluff-backed shorelines is another byproduct of recreational use that can damage fragile shoreline stability.

3.3.1.2 Historic Coastal Hazard Events

Table 3.3.1-2: Historic Coastal Hazard Events in Oregon

Date	Location	Description
Jan. 1914	Newport	damage (Nicolai Hotel)
1931	Rockaway	coastal damage from December storm
Oct–Dec. 1934	Waldport and Rockaway	flooding (Waldport) coastal damage (Rockaway Beach)
Dec. 1935	Cannon Beach and Rockaway Beach	coastal damage
Jan. 1939	coastwide	severe gale; damage: coastwide severe flooding (Seaside, and Ecola Creek near Cannon Beach): multiple spit breaches (southern portion of Netarts Spit) storm damage (along the shore of Lincoln City and at D River) flooding (Waldport)

Date	Location	Description
		extensive damage (Sunset Bay Park) storm surge overtopped foredune (Garrison Lake plus Elk River lowland)
Dec. 1940	Waldport	flooding
1948	Newport	wave damage (Yaquina Arts Center)
Jan. 1953	Rockaway	70-ft dune retreat; one home removed
Apr. 1958	Sunset Bay State Park Newport	flooding (Sunset Bay); wave damage (Yaquina Arts Center in Newport)
Jan.–Feb. 1960	Sunset Bay State Park	flooding
1964	Cannon Beach	storm damage
Dec. 1967	Netarts Spit Lincoln City Newport Waldport	damage: coastwide State constructed wood bulkhead to protect foredune along 600 ft section (Cape Lookout State Park campground) flooding and logs (Lincoln City) wave damage (Yaquina Arts Center, Newport) flooding (Waldport) Storm damage (Beachside State Park washed up driftwood (Bandon south jetty parking lot)
1971–73	Siletz Spit	high tide line eroded landward by 300 ft Feb. 1973; one home completely destroyed; spit almost breached logs through Sea Gypsy Motel (Nov. 1973)
1982–83	Alsea Spit	northward migration of Alsea Bay mouth; severe erosion
1997–98	Lincoln and Tillamook Counties	El Niño winter (second strongest on record); erosion: considerable
1999	coastwide	five storms between January and March; coastal erosion: extensive, including: significant erosion (Neskowin, Netarts Spit, Oceanside, Rockaway beach); overtopping and flooding (Cape Meares) significant erosion along barrier beach (Garrison Lake); overtopping 27-ft high barrier

Date	Location	Description
Dec. 2007	Tillamook and Clatsop Counties	windstorm
Dec. 7-11, 2015,	Tillamook and Clatsop Counties	coastal and riverine flooding in response to several days of heavy rain. large storm waves exceeding 30 ft on Dec 11th resulted in coastal erosion issues in several communities.
Feb. 2018	Curry County	major coastal landslide at Hooskanaden, located in southern Curry County
2019-2020	Siletz Spit	significant erosion over the 2019-20 winter resulted in several homes impacted and the need for emergency permits for coastal engineering.
2024	Coos, Lincoln, Tillamook Counties; CTSI	Oregon Severe Winter Storms, Straight-line Wind, Landslides, and Mudslides

Sources: Allan & Priest (2001); Allan & Komar (2002); Allan, et al. (2003), (2006); Allan & Hart (2007), (2008); Allan, et al. (2009), (2012); Allan & Stimely (2013); Komar (1986) (1987); Komar & Rea (1976); Komar & McKinney (1977), (1997); Komar & Allan (2010); Peterson, et al. (1990); Priest (1999); Revell, et al. (2002); Schlicker, et al. (1973); Stembridge (1975); and Terich and Komar (1974)

3.3.1.3 Risk Maps

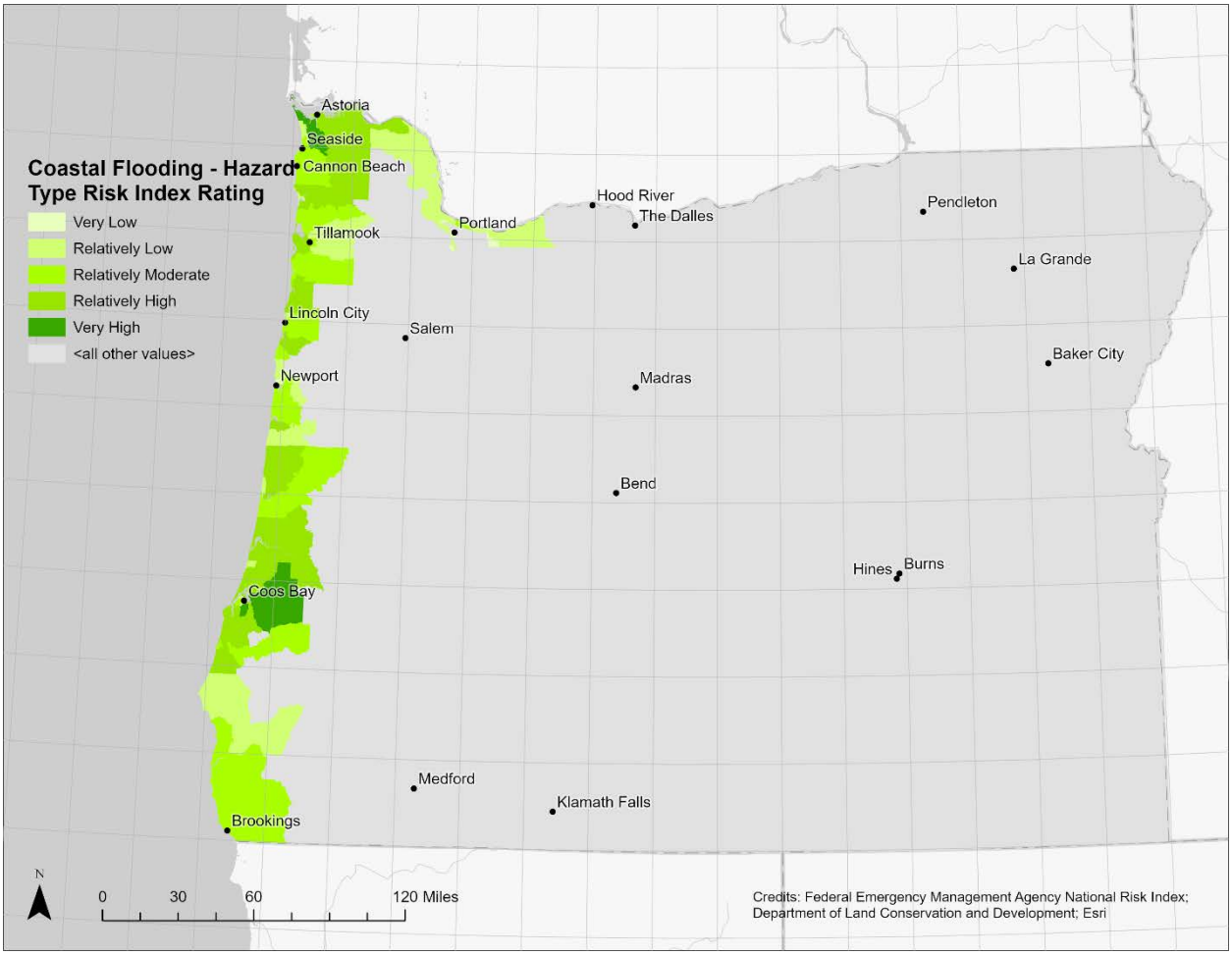
The maps in this section highlight places where the state might work with communities to develop mitigation projects.

The National Risk Index produces a measure of monetary losses experienced over the period of record. This emphasizes historic costs of harm and would direct mitigation resources to where the costs have been the greatest. Mitigation in these locations would save money over the long term.

In contrast to the National Risk Index, the Oregon Natural Hazards Risk Assessment used indicators of harm based on percentages rather than counts of exposed entities or monetary loss. This captures the potential for disruption within a census tract. The higher the percentage of entities affected, the more disruption to those living or working in the census tract.

The Oregon Natural Hazards Risk Assessment produced two statewide summary maps showing distribution of potential harm. The first map uses both socioeconomic and hazard factors. The second map uses hazard factors alone. The maps show the importance of recognizing the cost of disruption not only to buildings and infrastructure, but also to people, especially vulnerable populations. Both types of losses can be mitigated.

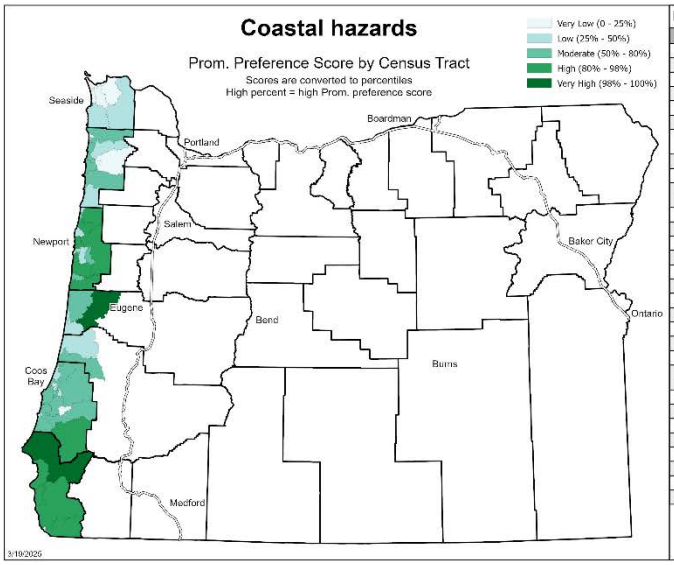
Figure 3.3.1-13 Coastal Flooding Risk Rating from the FEMA Risk Index Rating (NRI)



Source: Federal Emergency Management Agency, National Risk Index for Coastal Flooding. Last updated by FEMA in March 2023. Data accessed on February 12, 2025 from National Risk Index | FEMA.gov.
Note: Ranking based on national percentiles.

Figure 3.3.1-14 and Figure 3.3.1-15 show risk rankings by census tract for coastal flooding from the Oregon Natural Hazards Risk Assessment. Darker colors show census tracts with higher risk. Figure 3.3.1-14 shows census tracts ranked using hazard and socioeconomic vulnerability indicators. Figure 3.3.1-15 shows census tracts ranked using only hazard indicators, without using socioeconomic vulnerability indicators. Cities are included for locational reference only and do not show risk by city. Chapter 9 has additional details and examples of the information available from the risk assessment model.

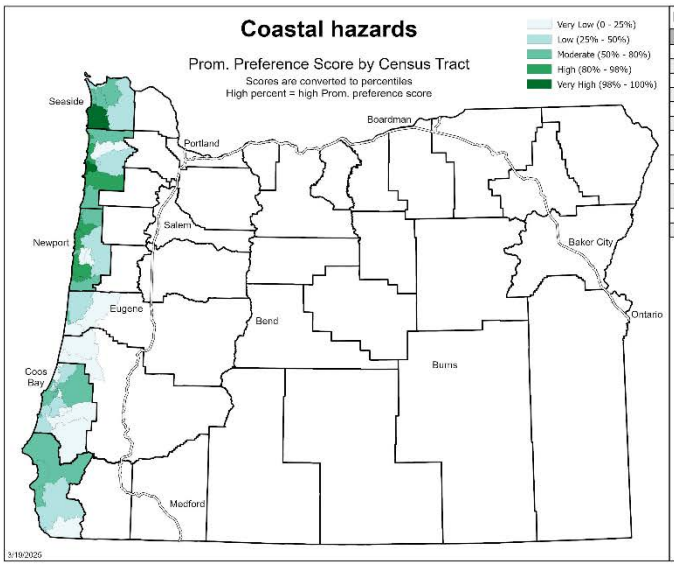
Figure 3.3.1-14 Coastal Hazards Results of Oregon Risk Assessment using PROMETHEE Ranking with Socioeconomic Indicators Included



Indicators used for the hazard Hazard indicators are worth 35% of the total weight.

Hazard	Indicator Name	Direction	Weight	Short Description
Coastal hazards	CFL_pct_bld	1	0.029	Percentage of SBFO buildings exposed to coastal flooding.
Coastal hazards	Hwy_FL_pct	1	0.029	Major roadways number of miles that are exposed to flood hazard.
Coastal hazards	CFL_pct_CF	1	0.029	Percentage of critical facilities exposed to coastal flooding.
Coastal hazards	Hist_CE_ct	1	0.029	Percentage of historic buildings exposed to coastal erosion.
Coastal hazards	SBFO_CE_pct	1	0.029	Percentage of SBFO buildings exposed to coastal erosion.
Coastal hazards	Port	1	0.029	Presence of marine port infrastructure
Coastal hazards	Bridge_Scour	1	0.029	Number of bridges that are at risk from scour during a 100-year flood.
Coastal hazards	CRS_Rate	1	0.029	Community Rating System (NFIP) score for communities.
Coastal hazards	ImpervSurf_Pct	1	0.029	Percentage of impervious surface.
Coastal hazards	FIRM_Diff	1	0.029	Number of years difference between median year built and FIRM date.
Coastal hazards	FL_Haz_Area	1	0.029	Area of tract in 100-year flood hazard.
Coastal hazards	RepeatLoss	1	0.029	Repetitive loss structures
General	EP_MINRTY	1	0.046	Percentage of Black, Indigenous, and People of Color (2020 Census).
General	HousingTenure	-1	0.046	Housing tenure from the US Census.
General	EP_MOBILE	1	0.046	Percentage of people that live in mobile homes
General	Median_YrBlt	-1	0.046	Median year built of general building stock based on HAZUS default.
General	HospitalDistMile	1	0.046	Distance from tract centroid to nearest hospital.
General	NatResrcJobs	1	0.046	Rate of natural resource jobs.
General	PRED3_PE	1	0.046	Community Resilience Estimate
General	Hosp_Beds	-1	0.046	Estimated number of hospital beds based on square footage .
General	Pct_Adherents	-1	0.046	Percentage of members to a religious group
General	Mitigation	-1	0.046	Number of migitation projects (grouped by zip code and evenly distributed to overlaying tracts)
General	Watch	-1	0.046	Neighborliness: Will watch neighbor's house
General	CountyTax	-1	0.046	County tax rate
General	CityTax	-1	0.046	City tax rate
General	Cultural	-1	0.009	Number of cultural-related buildings
General	Favors	-1	0.009	Neighborliness: Willing to do favors for neighbor
General	Advice	-1	0.009	Neighborliness: Seeks advice from neighbor
General	Parties	1	0.009	Neighborliness: Attended parties that occur in neighborhood
General	Visits	-1	0.009	Neighborliness: Has visited neighbor's house

Figure 3.3.1-15 Coastal Hazards Results of Oregon Risk Assessment using PROMETHEE Ranking without Socioeconomic Indicators Included



Indicators used for the hazard

Hazard	Indicator Name	Direction	Weight	Short Description
Coastal hazards	CFL_pct_bld	1	0.083	Percentage of SBFO buildings exposed to coastal flooding.
Coastal hazards	Hwy_FL_pct	1	0.083	Major roadways number of miles that are exposed to flood hazard.
Coastal hazards	CFL_pct_CF	1	0.083	Percentage of critical facilities exposed to coastal flooding.
Coastal hazards	Hist_CE_ct	1	0.083	Percentage of historic buildings exposed to coastal erosion.
Coastal hazards	SBFO_CE_pct	1	0.083	Percentage of SBFO buildings exposed to coastal erosion.
Coastal hazards	Port	1	0.083	Presence of marine port infrastructure
Coastal hazards	Bridge_Scour	1	0.083	Number of bridges that are at risk from scour during a 100-year flood.
Coastal hazards	CRS_Rate	1	0.083	Community Rating System (NFIP) score for communities.
Coastal hazards	ImpervSurf_Pct	1	0.083	Percentage of impervious surface.
Coastal hazards	FIRM_Diff	1	0.083	Number of years difference between median year built and FIRM date.
Coastal hazards	FL_Haz_Area	1	0.083	Area of tract in 100-year flood hazard.
Coastal hazards	RepeatLoss	1	0.083	Repetitive loss structures

3.3.2 Droughts

Despite its rainy reputation, the state of Oregon is often confronted with continuing challenges associated with drought and water scarcity. Precipitation in Oregon follows a distinct spatial and temporal pattern; it tends to fall mostly in the cool season (October–March). The Cascade Mountains block rain-producing weather patterns, creating a very arid and dry environment east of these mountains (Figure 3.3.2-1). Moist

air masses originating from the Pacific Ocean cool and condense when they encounter the mountain range, depositing precipitation primarily on the inland valleys and coastal areas.

Oregon's water-related challenges are greater than just the temporal and spatial distribution of precipitation in Oregon. A rapidly growing population in the American West has placed a greater demand on this renewable, yet finite resource. The two terms, drought and water scarcity, are not necessarily synonymous; distinctly, water scarcity implies that demand is exceeding the supply. The combined effects of drought and water scarcity are far-reaching and merit special consideration.

Drought is typically measured in terms of water availability in a defined geographic area. It is common to express drought with a numerical index that ranks severity. Most federal agencies use the Palmer Method which incorporates precipitation, runoff, evaporation, and soil moisture. However, the Palmer Method does not incorporate snowpack as a variable. Therefore, it does not provide a very accurate indication of drought conditions in Oregon and the Pacific Northwest, although it can be very useful because of its long-term historical record of wet and dry conditions.

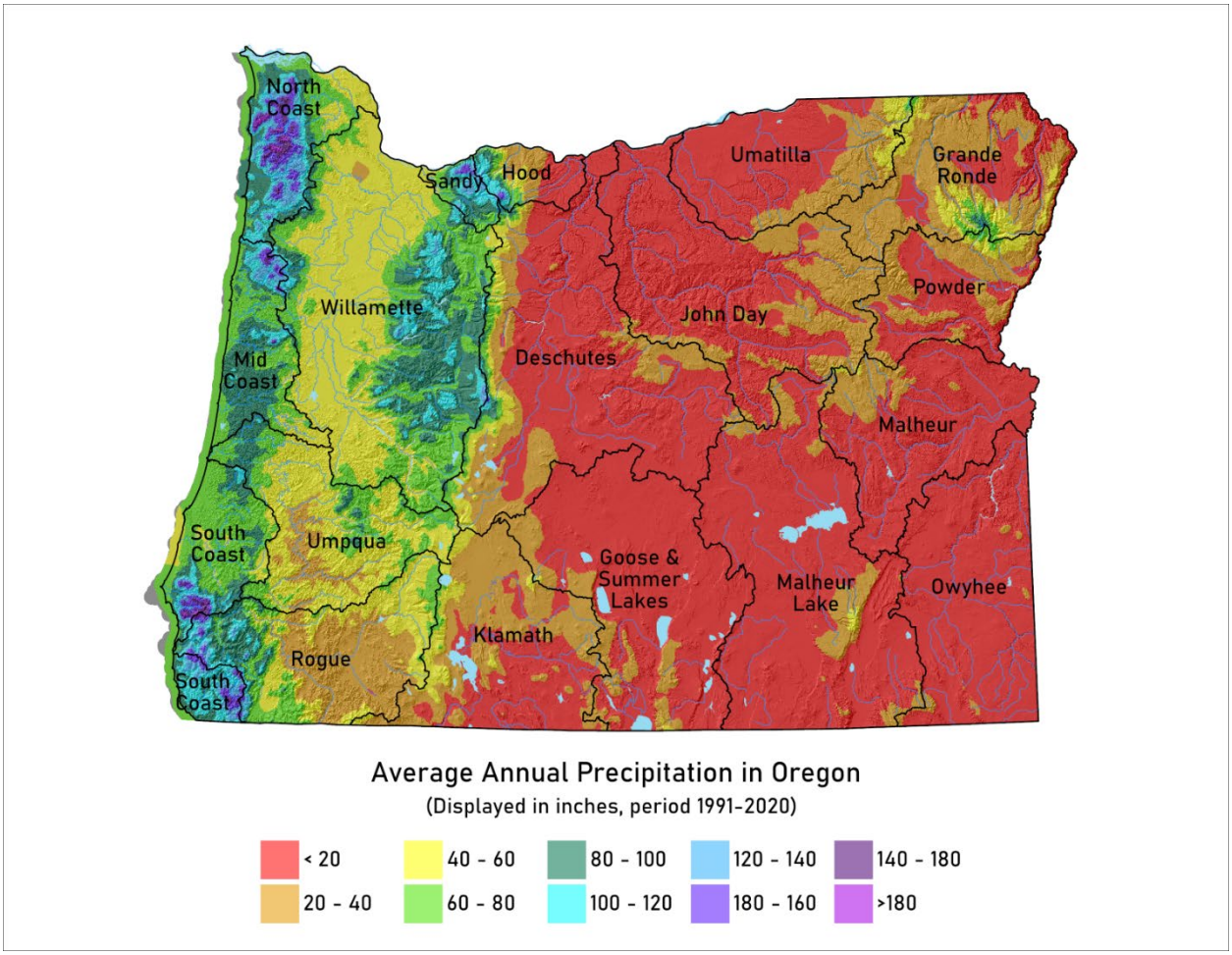
Snow droughts are expected to occur more often under climate change. There are two types of snow drought: dry and warm snow droughts. Dry snow drought is precipitation that falls as snow, but little precipitation falls. Warm snow drought is classified when ample precipitation occurs but falls as rain. The 2015 drought in Oregon was a "snow drought" and serves as a good example of what future climate projections indicate may become commonplace by mid-21st century (Dalton, Dello, Hawkins, Mote, & Rupp, 2017). Going forward, drought indices that can account for a changing climate, such as the Standard Precipitation-Evapotranspiration Index (SPEI), may provide a more accurate estimate of future drought risks.

Oregon's Emergency Operations Plan includes a Drought Annex for the purposes of coordinating state and federal agency response to drought emergencies caused by water shortages and to provide emergency water supplies for human consumption under conditions of inadequate supply. The Annex outlines several steps and lists major responsibilities of various federal, state, and local jurisdictions. It also includes a description of federal drought assistance programs and guidelines for water curtailment planning and program development.

3.3.2.1 Analysis and Characterization

Defining drought can be difficult given the issue of both water supply and demand. Redmond (2002) puts forth a simple definition that encapsulates both supply and demand, "drought is insufficient water to meet needs." Oregon's Legislative Assembly describes drought as a potential state emergency when a lack of water resources threatens the availability of essential services and jeopardizes the peace, health, safety, and welfare of the people of Oregon (Oregon Revised Statute §539.710).

Figure 3.3.2-1: Oregon Average Annual Precipitation, 1991–2020



Sources: PRISM Climate Group, Oregon State University (http://www.prism.oregonstate.edu/); map by Oregon Water Resources Department.

Droughts can be characterized by the dominant impact caused by increased demand or decreased supply. In the early 1980s, researchers with the National Drought Mitigation Center and the National Center for Atmospheric Research located more than 150 published definitions of drought. There clearly was a need to categorize the hazard by "type of drought." The following definitions are a response to that need. However, drought cannot always be neatly characterized by the following definitions, and sometimes all four definitions can be used to describe a specific instance of drought.

Meteorological or climatological droughts usually are defined in terms of the departure from a normal precipitation pattern and the duration of the event. Drought is a slow-onset phenomenon that usually takes at least three months to develop and may last for several seasons or years.

Agricultural droughts link the various characteristics of meteorological drought to agricultural impacts. The focus is on precipitation shortages and soil-water deficits. Agricultural drought is largely the result of a deficit of soil moisture. A plant's demand for water is dependent on prevailing weather conditions, biological characteristics of the specific plant, its stage of growth, and the physical and biological properties of the soil.

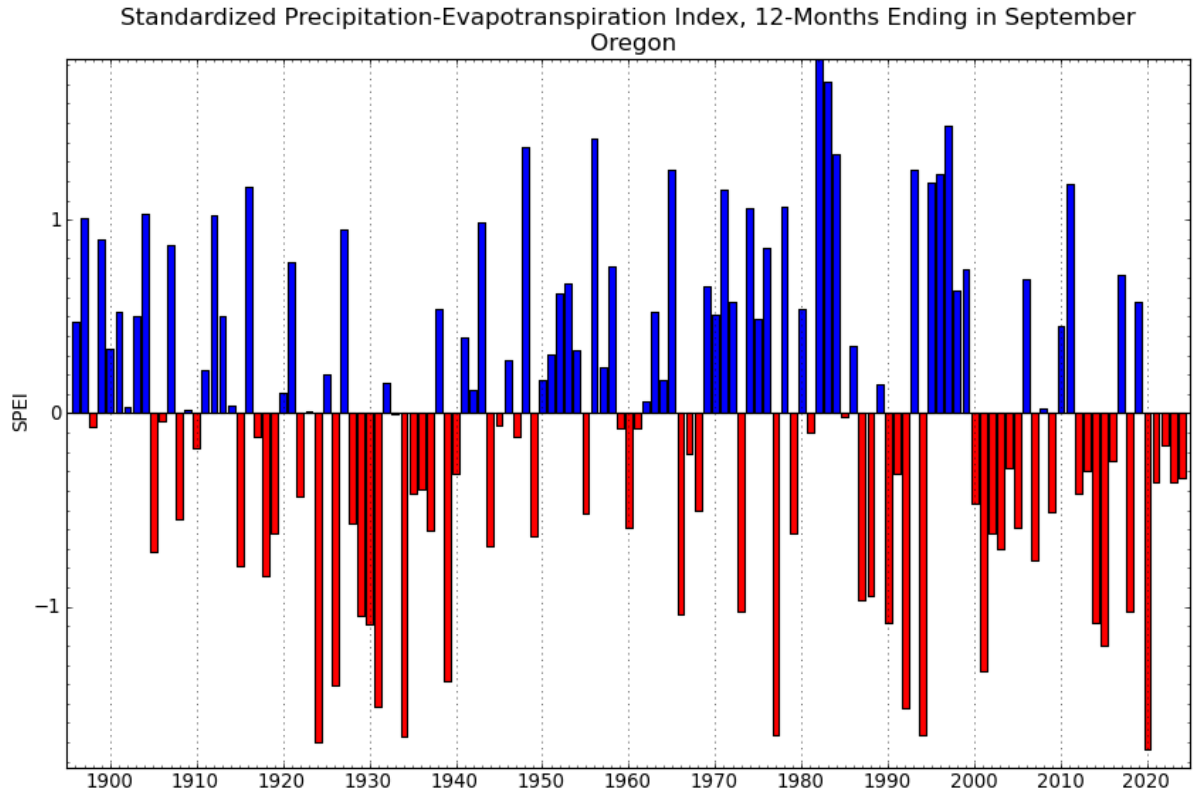
Hydrological droughts refer to deficiencies in surface water and sub-surface water supplies. It is reflected in the level of streamflow, lakes, reservoirs, and groundwater. Hydrological measurements are not the earliest indicators of drought. When precipitation is reduced or deficient over an extended period, the shortage will be reflected in declining surface and sub-surface water levels.

Socioeconomic droughts occur when physical water shortage begins to affect people, individually and collectively. Most socioeconomic definitions of drought associate it with supply, demand, and economic good. One could argue that a physical water shortage with no socio-economic impacts is a policy success.

3.3.2.2 History of Droughts in Oregon

Oregon records, dating back to the late 1800s, associate drought with a departure from expected precipitation. Droughts in the Pacific Northwest can persist for a few years, but rarely prolong for a decade. The Dust Bowl era (1930s) had many years with below average precipitation, which caused problems for agriculture, but every year in that decade was not considered to be a drought year. However, three water years in the 1930s fall in the top ten lowest statewide Standard Precipitation-Evapotranspiration Index (SPEI) values on record (Table 3.3.2-1). While droughts are often referred to as happening in a calendar year, it is more appropriate to define them by water year. The water year begins at the start of the cool, rainy season on October 1 and continues through September 30 of the following year. For example, Water Year 2024 started on October 1, 2023.

Figure 3.3.2-2: Water Year Standard Precipitation-Evapotranspiration Index (SPEI) for Oregon



Source: West Wide Drought Tracker, https://wrcc.dri.edu/wwdt/time/, with the following selections: Oregon, SPEI, 1895–2024, September, 12-month. Created 12-03-2024. Graphic courtesy OWRD

Table 3.3.2-1: Water Years with the Lowest SPEI Values, Averaged Statewide, on Record (1895–2024) for the State of Oregon

Rank	Water Year	SPEI Value
1	2020	-1.74
2	1924	-1.70
3	1934	-1.67
4	1994	-1.67
5	1977	-1.66
6	1992	-1.52
7	1931	-1.51
8	1926	-1.41
9	1939	-1.39
10	2001	-1.33

Source: West Wide Drought Tracker, https://wrcc.dri.edu/wwdt/time/, with the following selections: Oregon, SPEI, 1895–2024, September, 12-month

Low stream flows prevailed in western Oregon during the period from 1976-81, but the worst water year, by far, was 1977, the single driest year of the century. The Portland Airport received only 7.19 inches of precipitation between October 1976 and February 1977, only 31 percent of the average 23.16 inches for that period. This drought also impacted California and other parts of the West Coast. It is often acknowledged as one of the most significant droughts in Oregon's history and fittingly shows up as the fifth lowest SPEI value statewide.

The 1992 drought was not as severe as the 1976-77 drought; however, it did occur toward the end of several years of drier than normal conditions in the late 1980s and early 1990s, making it the peak year for drought conditions. The Governor declared a drought emergency for all Oregon counties (Executive Order 92-21). Forests throughout the state suffered from a lack of moisture. Fires were common and insect pests, which attacked the trees, flourished.

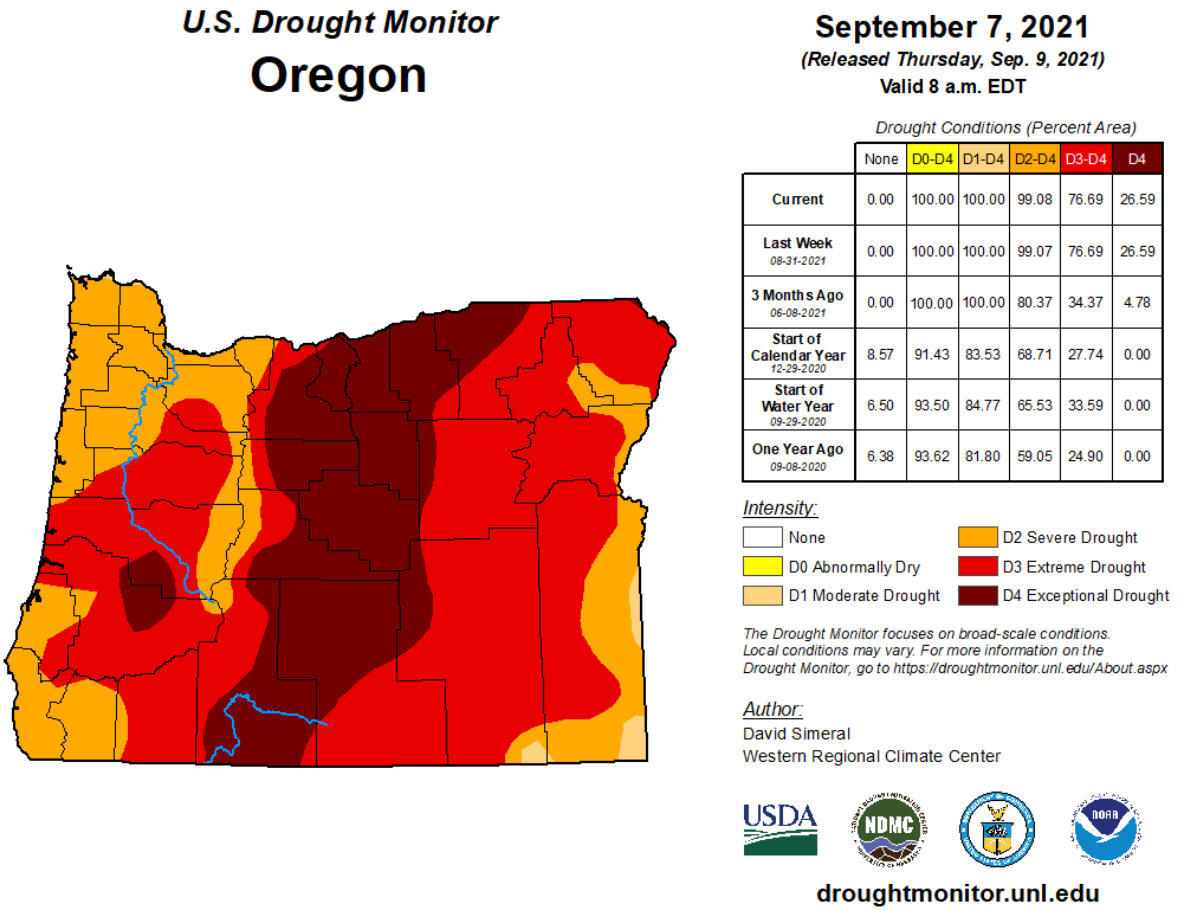
In 2001 and 2002, Oregon experienced drought conditions, affecting six out of eight regions. During the 2005 drought, the Governor issued declarations for 13 counties, all east of the Cascades, and the USDA issued three drought declarations, overlapping two of the Governor's. State declarations were made for Baker, Wallowa, Wheeler, Crook, Deschutes, Klamath, Lake, Hood River, Wasco, Sherman, Gilliam, Morrow, and Umatilla Counties. Federal declarations were made in Coos, Klamath, and Umatilla Counties. Federal drought declarations, similar to declarations by Oregon's governor, provide emergency relief and response actions by various agencies. The U.S. Department of Agriculture, for example, can provide accessibility to emergency loans for crop losses. Since 2001, the Governor has declared a drought in 18 out of 24 years (2001–2024), in at least one Oregon county. Most of these declarations have involved one or more counties in Regions 4-8.

In 2015, Oregon had its warmest year on record. Winter precipitation amounts that year were near normal, but winter temperatures that were 5–6°F above average caused the precipitation that did fall to fall as rain instead of snow, reducing mountain snowpack accumulation. This resulted in record low snowpack across the state, earning official drought declarations for 25 of Oregon's 36 counties (Dalton, Dello, Hawkins, Mote, & Rupp, 2017). At the peak of the drought which began in 2014, all of Oregon was in severe or extreme drought, according to the U.S. Drought Monitor. Recent research has indicated that human-caused climate change exacerbated the 2015 drought in Oregon (Dalton, Dello, Hawkins, Mote, & Rupp, 2017). The 2015 drought in Oregon was a "snow drought" and serves as a good example of what future climate projections indicate may become commonplace by mid-21st century (Dalton, Dello, Hawkins, Mote, & Rupp, 2017).

2021 was Oregon's fourth warmest year on record, with average temperatures 2.9°F above normal. It was also the 16th driest year, with precipitation 6.54 inches below the average. July 2021 was the hottest July ever recorded in the state, with temperatures 6.6°F above normal, which contributed to a flash drought early in the summer. As a result, by September 2021, over 25 percent of Oregon was experiencing exceptional drought (the highest level on the U.S. Drought Monitor), and nearly the entire state was in severe drought conditions (Figure 3.3.2-3). By the end of the year, 26 of Oregon's 36 counties had received state drought declarations. Although the state's snowpack peaked above the historical median, overall precipitation was below normal. This, combined with the prolonged drought severity from the previous year

(lowest SPEI on record), led to the increased severity of drought conditions despite the above-normal snowpack.

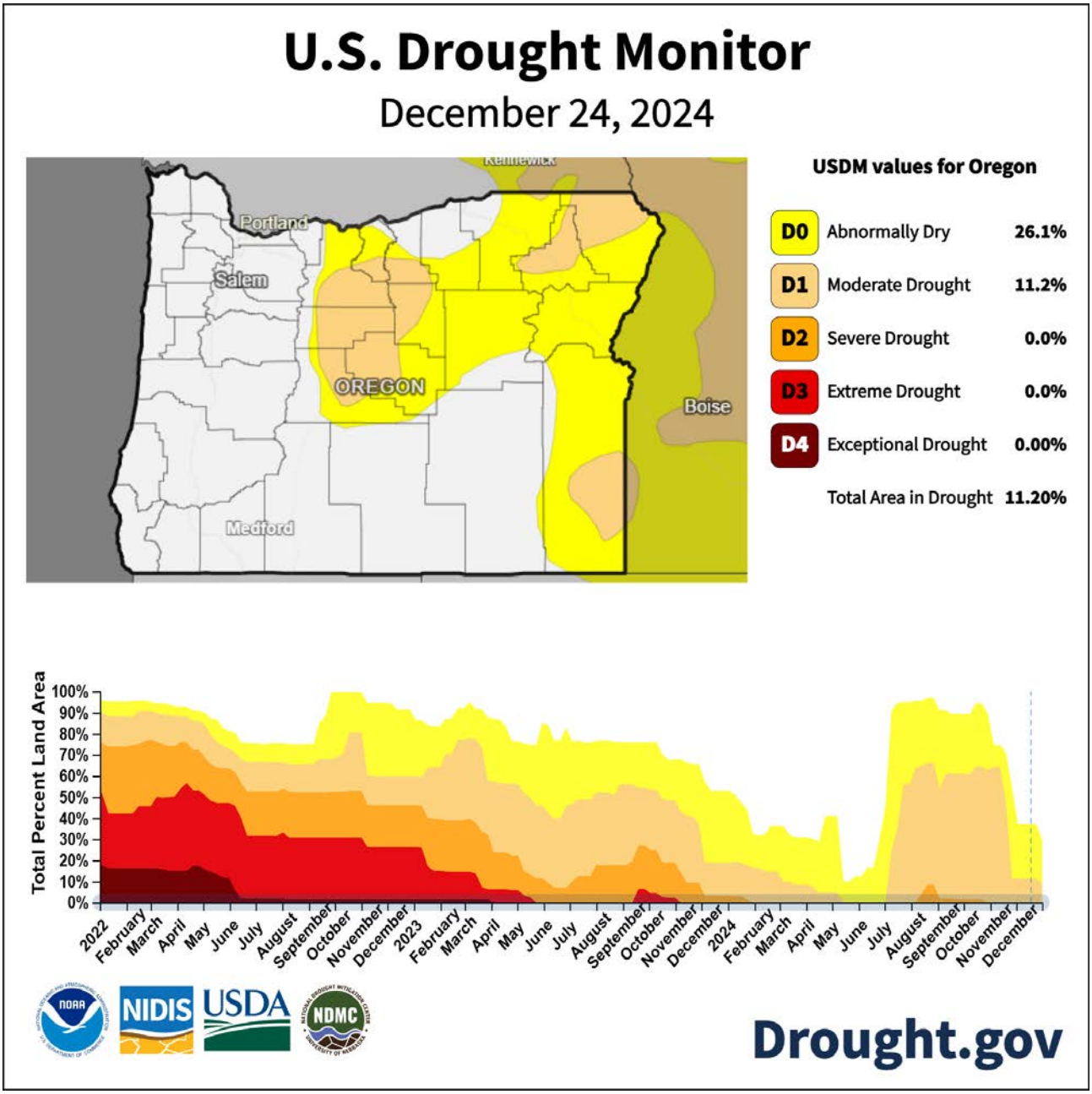
Figure 3.3.2-3 September 7, 2021 U.S. Drought Monitor Report for Oregon



2021 was Oregon's fourth warmest year on record. Source: U.S. Drought Monitor (http://droughtmonitor.unl.edu/)

No significant droughts occurred in Oregon between 2022 and 2024. Less than 20% of Oregon's land area experienced exceptional drought in spring 2022, while an added 30% of land area experienced extreme drought from 2022 to 2023. In 2022, 17 counties of Oregon's 36 counties received drought declarations. In 2023, 13 counties received drought declarations, and in 2024, 4 counties received drought declarations.

Figure 3.3.2-4 December 24, 2024 U.S. Drought Monitor Report for Oregon.



No significant droughts occurred between 2022 and 2024 in Oregon. Source: US Drought Monitor. (http://droughtmonitor.unl.edu/)

3.3.2.3 Impacts

Droughts are not just a summer-time phenomenon; winter droughts can have a profound impact on the state's agricultural sector, particularly east of the Cascade Mountains.

Even though drought may not be declared as often in Western Oregon as in counties east of the Cascades, when drought conditions do develop in the Willamette Valley, the impacts are widespread and severe when both winter snow and spring/summer rain are low. Reasons for broad and significant impact include:

- Higher population density and growing population in the Willamette Valley;
- Dependence on surface water supplies for many municipalities, agriculture and industries from large flood control reservoirs in the Willamette river system;
- Agriculture is a major industry becoming increasingly dependent on irrigation;
- Increased frequency of toxic algal blooms in the Willamette system reservoirs, resulting in restrictions on use of water from reservoirs for drinking (i.e., for human and animals). Affected waters may not be safe for agricultural irrigation, and other uses; necessitating purchasing and transporting water from alternative sources;
- Since drought is typically accompanied by earlier onset of snowmelt (e.g., during flood control or early storage season), little or no snowmelt runoff is stored until later;
- Earlier start to growing season, before the start of the irrigation season, means that crops may not be irrigated until the irrigation season begins;
- Insufficient number of farm workers available because the growing season began before the workers were scheduled to arrive; and
- Responsibilities to recovering anadromous fish.

These are relatively recent and developing concerns, in particular on livestock and some other agricultural operations, and therefore there is no single comprehensive source or other sources for information to assess economic impacts. Impacts of drought on state-owned facilities related to agriculture would include impacts to research conducted in outdoor settings, such as at extension stations and research farms.

Below-average snowfall in Oregon's higher elevations has a far-reaching effect on the entire state, especially in terms of hydroelectric power generation, irrigation, recreation, and industrial uses. In March of 2014, Mount Ashland Ski Resort in southern Oregon announced that it would be unable to open due to the lack of snow. The following year the Ski Resort had to make snow in order to open. The lack of snow has affected other regions of the state as well. In the Klamath Basin, the Natural Resources Conservation Service reports that the mountains are generally snow-free below 5,000 feet. The Taylor Butte SNOTEL site at elevation 5,030 feet was snow-free on March 1, 2014, a first for the site since it was installed in 1979. Five long-term snow measurement sites in the Klamath basin set new record lows for March 1 snowpack. In fact, 81 percent of measurement sites west of 115°W (near the eastern border of Nevada) set record low April 1 snowpack in 2015, a quarter of which recorded no snow for the first time ((Mote, et al., 2016)).

There also are environmental consequences. A prolonged drought in Oregon's forests promotes an increase of insect pests, which in turn damage trees already weakened by a lack of water. In the Willamette Valley, for example, there has been an unusual pattern of tree mortality involving Douglas fir, grand fir, and western red cedar. Water stress brought on by drought and other factors is the central cause in these mortality events (Oregon Department of Forestry, 2008).

A moisture-deficient forest constitutes a significant fire hazard (see the **Wildfire** section of this Plan). The 2020 wildfire season was one of the most severe in the Pacific Northwest. The Oregon Forest Resources Institute's 2021 report on the 2020 Labor Day fires reported 919,700 acres burned across five megafires—fires greater than 100,000 acres-- and 12 fires ranging from 112 to 50,951 acres, with an estimated economic impact of $5.9 billion to Oregon's forest sector (OFRI 2021). In addition, drought and water scarcity add another dimension of stress to imperiled species.

The following information addresses the impact of a severe or prolonged drought on the population, infrastructure, facilities, economy, and environment of Oregon:

Population

Droughts can affect all segments of Oregon's population, particularly those employed in water-dependent activities (e.g., agriculture, hydroelectric generation, recreation, etc.). For example, in 2015 farmers in eastern Oregon's Treasure Valley received a third of their normal irrigation water (Dalton, Dello, Hawkins, Mote, & Rupp, 2017). Also, domestic water users may be subject to stringent conservation measures (e.g., rationing) during times of drought and could see increases in electricity consumption and associated costs.

Infrastructure

Infrastructure such as highways, bridges, energy and water conveyance systems, etc., is typically unaffected by drought. However, drought can cause structural damage. An example would be areas of severe soil shrinkage. In these uncommon situations, soil shrinkage would affect the foundation upon which the infrastructure was built. In addition, water-borne transportation systems (e.g., ferries, barges, etc.) could be impacted by periods of low water.

Critical/essential facilities

Facilities affected by drought conditions include communications facilities, hospitals, and correctional facilities that are subject to power failures. Storage systems for potable water, sewage treatment facilities, water storage for firefighting, and hydroelectric generating plants also are vulnerable. Low water also means reduced hydroelectric production, especially as the habitat benefits of water compete with other beneficial uses.

State-owned or -operated facilities

A variety of state-owned or -operated facilities could be affected by a prolonged drought. The most obvious include schools, universities, office buildings, health-care facilities, etc. Impacts of drought on state-owned facilities related to agriculture would include impacts to research conducted in outdoor settings, such as at extension stations and research farms. There is no single comprehensive source or other sources for information to assess economic impacts to the state or state-owned facilities. Power outages are always a concern. Maintenance activities (e.g., grounds, parks, etc.) may be curtailed during periods of drought. The Oregon Parks and Recreation Department operates several campground and day-use facilities that could be impacted by a

drought. For example, in 2015 visitation at Detroit Lake decreased 26 percent due to low water levels and unusable boat ramps (Dalton, Dello, Hawkins, Mote, & Rupp, 2017).

Economy

Drought has an impact on a variety of economic sectors. These include water-dependent activities and economic activities requiring significant amounts of hydroelectric power. The agricultural sector is especially vulnerable as are some recreation-based economies (e.g., boating, fishing, water or snow skiing). Whole communities can be affected. This was particularly evident during the 2001 water year when many Oregon counties sought relief through state and federal drought assistance programs.

Water Year 2001 was the third driest water year in Oregon's climate history; the drought was one of the most economically significant in the state's history. The community of Detroit, in Marion County, suffered economic hardships when lake levels became too low to support recreational summer activities. The drought directly affected over 200,000 irrigated acres in the Klamath River Basin. Farmers were among the first to be affected, followed by local agricultural support industries (e.g., pesticides, fertilizer, farm equipment, etc.), as well as Native American Tribes which depend on local fisheries.

The 2015 drought during the state's warmest year on record also saw major economic impacts, straining summer recreational activities such as skiing, boating, fishing, and hunting, as well as the local economies that depend on visitors. Detroit Lake, for example, saw a 26 percent decline in visitors due to low water levels and inaccessible boat ramps. Winter recreational activities also felt the impact of a record-low snowpack. Mt. Ashland ski resort was not able to open during the 2014-15 ski season.

Limited water supply and high temperatures damaged crops and reduced yields, and ranchers in multiple counties struggled with dry pastures and limited water for livestock. Heat-stressed cattle were fed supplemental rations to help provide necessary nutrients. Some ranchers shipped cattle to feedlots earlier than normal or weaned calves early, due to a lack of feed and water. There is no single comprehensive source or other sources for information to assess economic impacts of drought impacts on agriculture, particularly west of the Cascades.

The 2015 fire season for the Pacific Northwest was notable for its severity and cost. The Oregon Department of Forestry estimates that large-fire costs for state agencies amounted to $94.4 million, more than $70 million in additional expenses compared to the 10-year average of $22.3 million.

The 2020 wildfires in Oregon had a significant impact on agriculture and food sectors. According to the Oregon Wine Board, the 2020 crop year saw a 20 percent decline in industry revenues (Sorte et al. 2021). Wildfire smoke affected agricultural production by altering the taste of crops and resulted in the absorption of smoke toxicants (Fleishman, 2023).

Documenting drought conditions, especially its impacts on people and the environment, is an important component of understanding and preparing for future droughts. Using drought emergency relief funds, the state of Washington completed an economic assessment that quantifies

the impacts of the 2015 drought on the state's farmers and ranchers, an effort that had not previously been done at the statewide level.

Oregon does not have the resources to conduct a thorough analysis of drought's impact to various sectors. Today, most impact-related data are collected anecdotally. The state should invest in ways to track and quantify the effects of drought and assist the most vulnerable jurisdictions.

Environment

Oregon has several fish species listed as threatened or endangered under the Endangered Species Act (ESA). Some of these species have habitat requirements that are jeopardized by the needs or desires of humans. For example, in times of scarcity, the amount of water needed to maintain habitat for fish species may conflict with the needs of consumptive uses of water. The state of Oregon is committed to implementation of the ESA and the viability of a productive economic base. There are no easy solutions, only continuous work to resolve difficult drought situations.

There were several significant fish die-offs in 2015. Most noteworthy in the Willamette, Clackamas, John Day, and Deschutes Rivers and some hatcheries, where high water temperatures amplified the effects of naturally occurring parasites. Half of Oregon's hatcheries were affected by drought conditions in 2015. The Department of Fish and Wildlife implemented a daily fishing curtailment regulation in nearly every stream in Oregon in 2015. This was the first time that a statewide curtailment was implemented.

In late June 2021 Oregon experienced record-high air temperatures during an extreme heat wave ("heat dome"). This heat dome was the most intense in the observational record for the Pacific Northwest (Thompson et al. 2022). This resulted in extreme temperatures that lead to high rates of foliage scorch and heat stress. The U.S. Forest Service estimated that more than 888 mi^2 of forest were impacted in Oregon and Washington (Fleishman, 2023). The effects of this ranged from impaired metabolism of surviving leaves to eventual tree mortality (Filewod and Thomas, 2014).

3.3.2.4 Historic Drought Events

Table 3.3.2-2 Historic Droughts and Dry Periods in Oregon

Date	Location	Description
1928-41	Statewide	Prolonged drier than normal conditions that caused major problems for agriculture; the three Tillamook burns, in the normally wet coastal range, the first in 1933, were the most significant impacts of this very dry period.
1976-77	Western Oregon	The 1977 drought was one of the most significant on record in western Oregon.
1985–94	Statewide	Generally dry period, capped by statewide droughts in 1992 and 1994; 10 consecutive years of dry conditions caused problems throughout the state, such as fires and insect outbreaks.
2001-02	Affected all regions except Regions 2, 3	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.

Date	Location	Description
2003	Regions 5–8	Governor-declared drought issued in seven counties: Sherman, Wheeler, Crook, Baker, Wallowa, Malheur, and Harney.
2004	Regions 5–8	Governor-declared drought issued in four counties: Morrow, Klamath, Baker, and Malheur.
2005	Regions 5–7	Affected area: 13 of Oregon's 36 counties.
2007	Regions 6–8	Governor-declared drought emergency in Lake, Grant, Baker, Union, Malheur, and Harney Counties.
2008	Region 5	Governor-declared drought emergency in Sherman and Gilliam Counties.
2010	Region 6	Governor-declared drought emergency for Klamath County and contiguous counties.
2012	Region 6	Governor-declared drought emergency for the Lost River Basin, located in Klamath County and Lake County.
2013	Regions 5–8	Governor-declared drought in Gilliam, Morrow, Klamath, Baker, and Malheur Counties.
2014	Regions 4, 6–8	Governor-declared drought in 10 counties: Klamath, Lake, Malheur, Harney, Jackson, Josephine, Crook, Wheeler, Grant, and Baker; Oregon experienced its third driest Nov.–Jan. period since 1895.
2015	statewide	Governor-declared drought in 25 counties, with federal declarations in all counties. Oregon experienced its warmest year on record (1895–2019) resulting in record low snowpack across the state. All of Oregon was in severe or extreme drought at the peak of the drought in August, according to the U.S. Drought Monitor.
2018	Regions 4 – 8, 1	Governor-declared drought in 11 counties.
2020	Region 1, 6	Governor-declared drought in 15 counties. Lowest SPEI on record (-1.74).
2021	Regions 1, 3 – 8	Governor-declared drought in 26 counties. Most of Oregon was in severe drought and over 25 percent of the state was in exceptional drought at the peak of the drought in September. Warmest July on record.
2022	Regions 4 – 8	Governor-declared drought in 17 counties.
2023	Regions 1, 4 – 8	Governor-declared drought in 13 counties.
2024	Regions 6 – 8	Governor-declared drought in 4 counties. Second warmest July on record.

Sources: Taylor and Hatton (1999); Governor-declared drought declarations obtained from the Oregon State Archives division

3.3.2.5 Risk Maps

The maps in this section highlight places where the state might work with communities to develop mitigation projects.

The National Risk Index produces a measure of monetary losses experienced over the period of record. This emphasizes historic costs of harm and would direct mitigation resources to where the costs have been the greatest. Mitigation in these locations would save money over the long term.

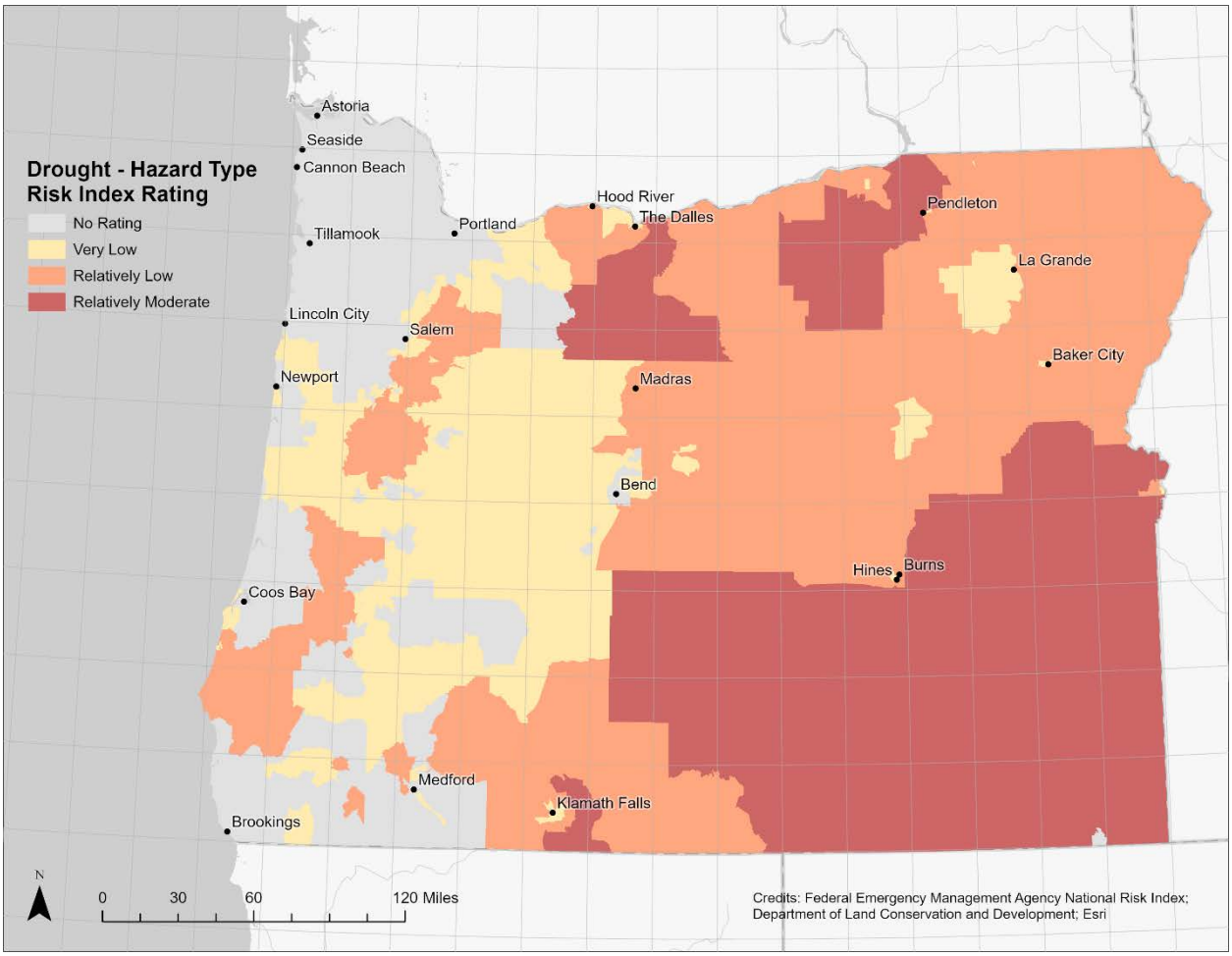
In contrast to the National Risk Index, the Oregon Natural Hazards Risk Assessment used indicators of harm based on percentages rather than counts of exposed entities or monetary loss. This captures the potential

for disruption within a census tract. The higher the percentage of entities affected, the more disruption to those living or working in the census tract.

The Oregon Natural Hazards Risk Assessment produced two statewide summary maps showing distribution of potential harm. The first map uses both socioeconomic and hazard factors. The second map uses hazard factors alone. The maps show the importance of recognizing the cost of disruption not only to buildings and infrastructure, but also to people, especially vulnerable populations. Both types of losses can be mitigated.

The climate change maps show where risk is projected to increase. Areas with a high risk and a high increase in risk would be especially good places to work with communities to find mitigation projects.

Figure 3.3.2-4 Drought Risk Rating from the FEMA Risk Index Rating (NRI)

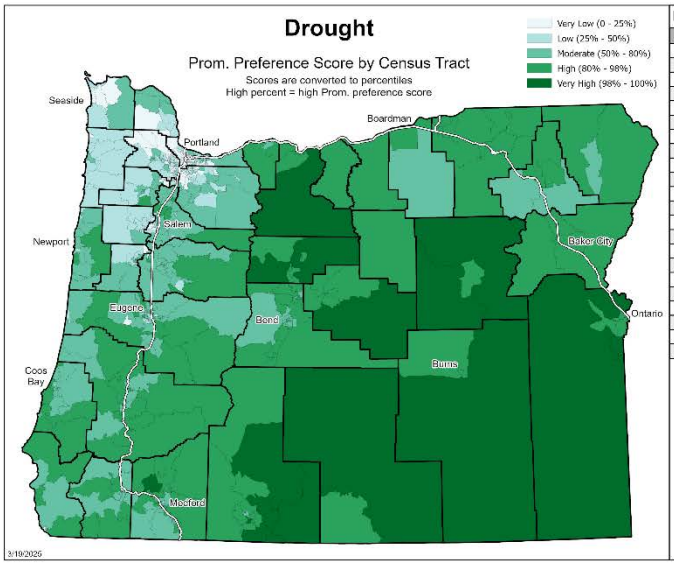


Source the Federal Emergency Management Agency, National Risk Index for Drought. Data accessed on February 12, 2025 from National Risk Index | FEMA.gov.
Note: Ranking based on national percentiles. Last updated by FEMA in March 2023.

Figure 3.3.2-5 and Figure 3.3.2-6 show risk rankings by census tract for drought from the Oregon Natural Hazards Risk Assessment. Darker colors show census tracts with higher risk. Figure 3.3.2-5 shows census tracts ranked using hazard and socioeconomic vulnerability indicators. Figure 3.3.2-6 shows census tracts

ranked using only hazard indicators, without using socioeconomic vulnerability indicators. Cities are included for locational reference only and do not show risk by city. Chapter 9 has additional details and examples of the information available from the risk assessment model.

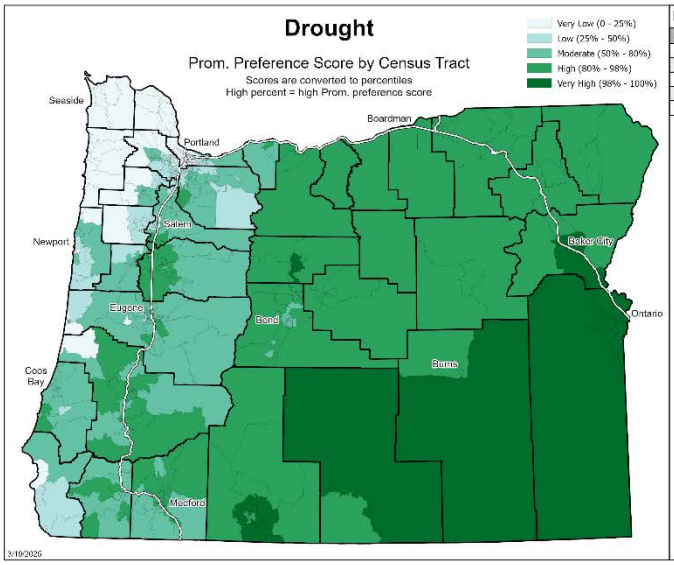
Figure 3.3.2-5 Drought Results of Oregon Risk Assessment using PROMETHEE Ranking with Socioeconomic Indicators Included



Indicators used for the hazard Hazard indicators are worth 35% of the total weight.

Hazard	Indicator Name	Direction	Weight	Short Description
Drought	Drght_NRI_rate	1	0.07	Drought rate from the NRI.
Drought	Drght_Events	1	0.07	Number of drought events from the NRI.
Drought	Drght_AL_AG	1	0.07	Annualized loss for agriculture from NRI.
Drought	Over90th	1	0.07	Mean days that are above the historic 90th percentile temp
Drought	Over90F	1	0.07	Mean days above 90 degrees Fahrenheit
General	EP_MINRTY	1	0.05	Percentage of Black, Indigenous, and People of Color (2020 Census)
General	HousingTenure	-1	0.05	Housing tenure from the US Census.
General	EP_MOBILE	1	0.05	Percentage of people that live in mobile homes
General	Median_Yrblt	-1	0.05	Median year built of general building stock based on HAZUS default.
General	HospitalDistMile	1	0.05	Distance from tract centroid to nearest hospital.
General	NatResnJobs	1	0.05	Rate of natural resource jobs.
General	PRED3_PE	1	0.05	Community Resilience Estimate
General	Hosp_Beds	-1	0.05	Estimated number of hospital beds based on square footage .
General	Pct_Adherents	-1	0.05	Percentage of members to a religious group
General	Watch	-1	0.05	Neighborliness: Will watch neighbor's house
General	CountyTax	-1	0.05	County tax rate
General	CityTax	-1	0.05	City tax rate
General	Cultural	-1	0.01	Number of cultural-related buildings
General	Favors	-1	0.01	Neighborliness: Willing to do favors for neighbor
General	Advice	-1	0.01	Neighborliness: Seeks advice from neighbor
General	Parties	-1	0.01	Neighborliness: Attended parties that occur in neighborhood
General	Visits	-1	0.01	Neighborliness: Has visited neighbor's house

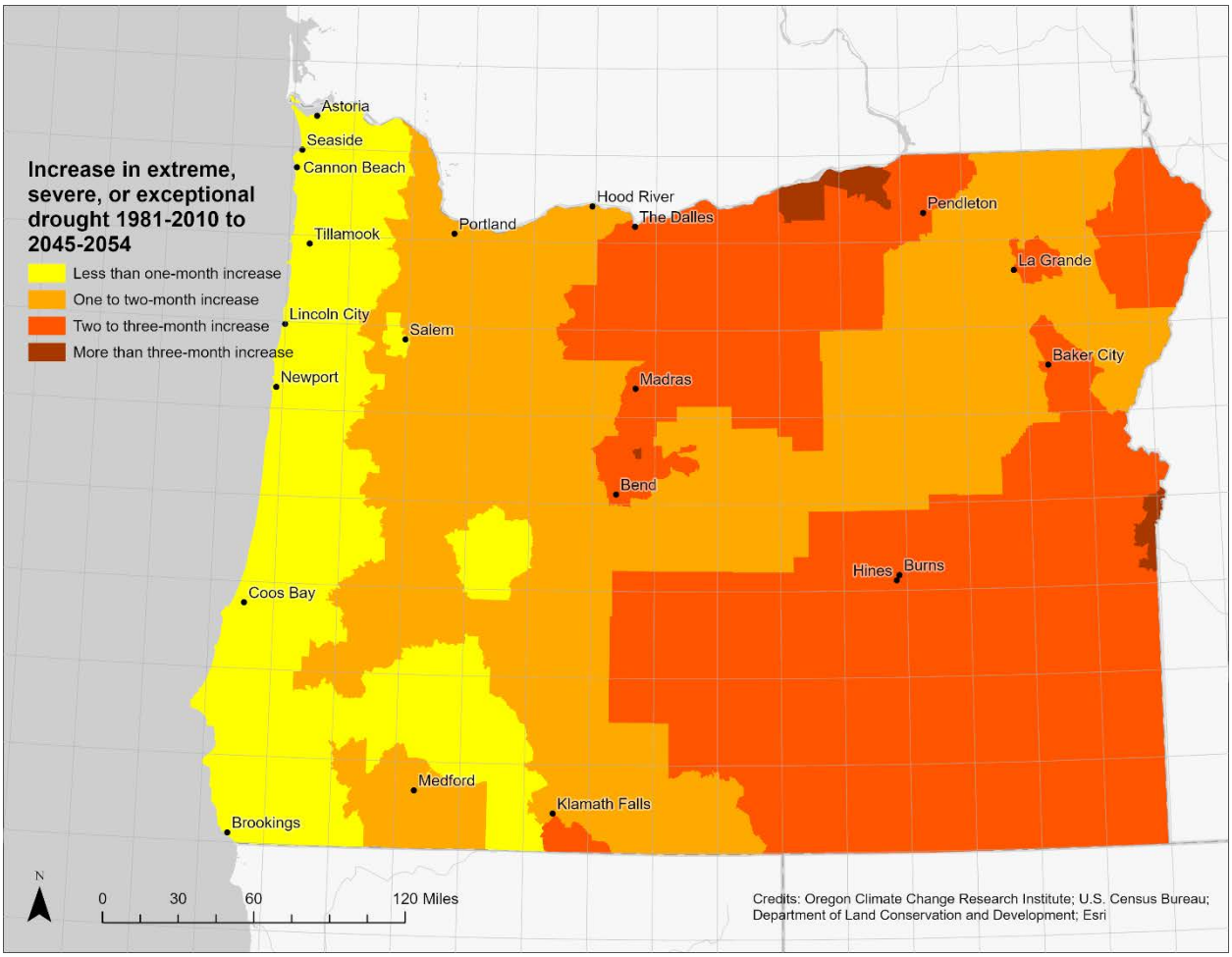
Figure 3.3.2-6 Drought Results of Oregon Risk Assessment using PROMETHEE Ranking without Socioeconomic Indicators Included



Indicators used for the hazard

Hazard	Indicator Name	Direction	Weight	Short Description
Drought	Drght_NRI_rate	1	0.2	Drought rate from the NRI.
Drought	Drght_Events	1	0.2	Number of drought events from the NRI.
Drought	Drght_AL_AG	1	0.2	Annualized loss for agriculture from NRI.
Drought	Over90th	1	0.2	Mean days that are above the historic 90th percentile temp
Drought	Over90F	1	0.2	Mean days above 90 degrees Fahrenheit

Figure 3.3.2-7 Change in Drought Conditions: Change from 1981-2010 to 2045-2054 in months per year of severe, extreme, or exceptional drought as defined by The Standardized Precipitation-Evapotranspiration Index with an accumulation period of 12 months (SPEI12)



Source: Data provided by OCCR, 2025. Graphic produced by DLCD.

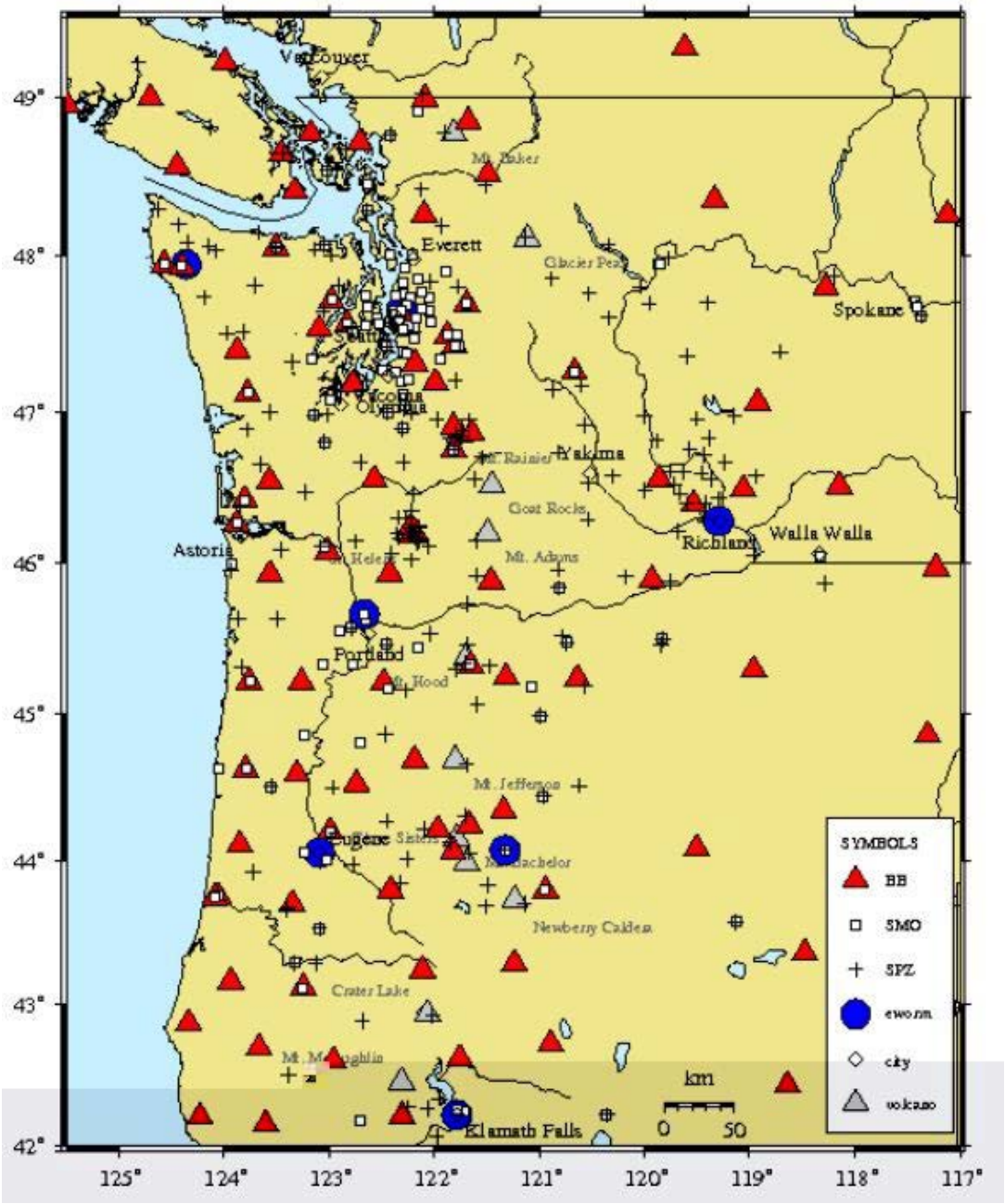
3.3.3 Earthquakes

Oregon has experienced few damaging earthquakes during its recorded history, leading to complacency and lack of attention to earthquake-resistant design and construction. Since the mid-1980s, an increasing body of geologic and seismologic research has changed the scientific understanding of earthquake hazards in Oregon, and in recent years several large and destructive earthquakes around the world have heightened public awareness. Recognized hazards range from moderate sized crustal earthquakes in eastern Oregon to massive subduction zone megathrust events off the Oregon coast. Indigenous peoples in the Pacific Northwest, who experienced the 1700 earthquake and tsunami, passed down their knowledge through oral histories and storytelling long before Western science fully recognized these hazards. All have the potential for significant damage as long as most of Oregon's buildings and infrastructure have inadequate seismic resistance. The scale of structural retrofit and replacement needed to make Oregon earthquake safe is huge, and will take decades to implement. To manage the human and economic impact of the next damaging

earthquake will require thoughtful and comprehensive emergency response planning, based on realistic loss estimates driven by accurate and detailed geologic and seismologic, structural and cultural information. To minimize the human and economic impact of the next damaging earthquake will require a sustained program of public education, forward-thinking research, and structural replacement and retrofit, based on cost-effective earthquake resistant design and a combination of public funding and private sector incentives.

3.3.3.1 Analysis and Characterization

Figure 3.3.3-1 Earthquake Monitoring Stations in the Pacific Northwest

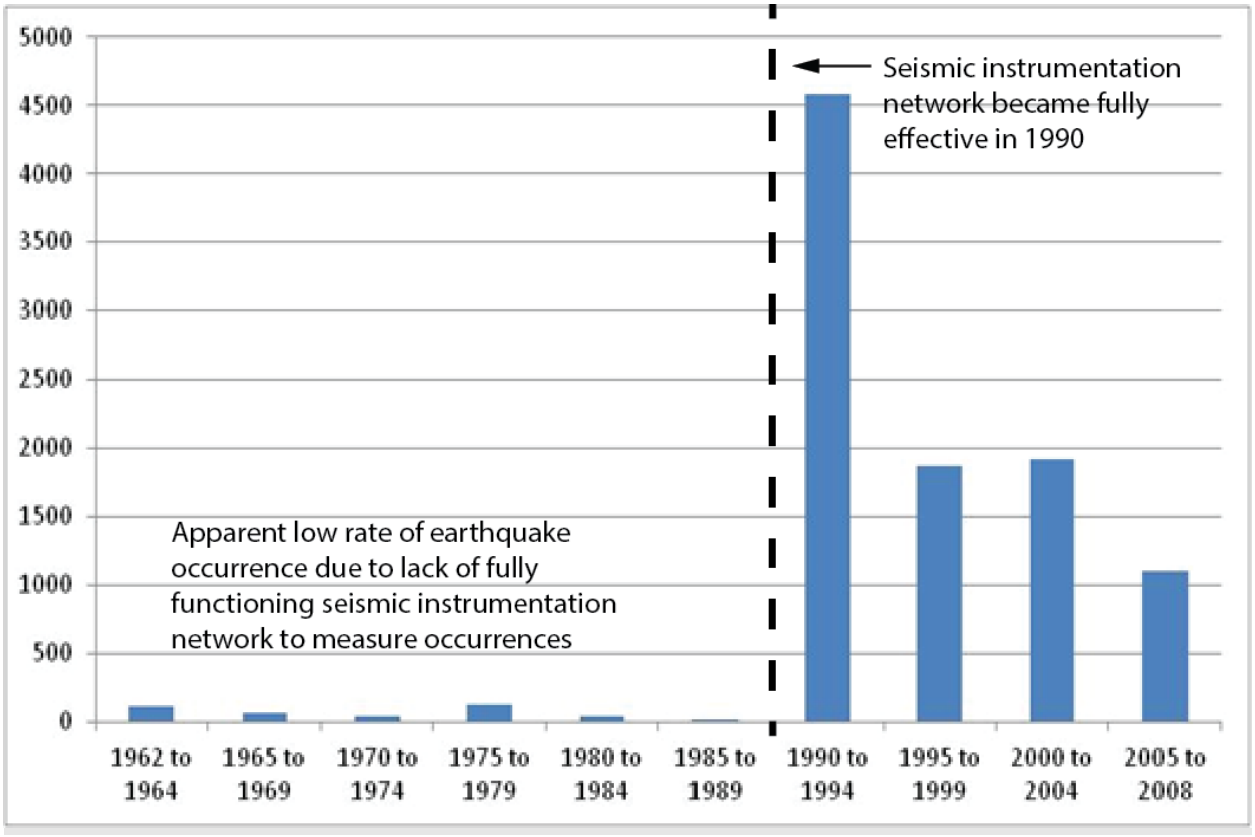


The Source: Pacific Northwest Seismic Network (http://www.pnsn.org/). Earthquake monitoring network system is operated out of the University of Washington by the Pacific Northwest Seismic Network.

Earthquake Sources

Earthquakes are a highly variable natural phenomenon. The vast majority occur when two masses of rock in the earth's crust abruptly move past each other along a large crack or fracture called a fault. The energy released as the two parts slide along the fault produces waves of shaking that people perceive as an earthquake. Faults typically build up stress over decades to millennia in response to large-scale movement of the earth's tectonic plates. Even the most active faults only produce damaging earthquakes at intervals of a century or more, and for many the intervals are much longer. As a result, it is very difficult to forecast the likelihood of an earthquake on a particular fault because scientists rarely have a long enough record to determine a statistically meaningful return period (average time between earthquakes).

Figure 3.3.3-2 Annual Rate of Earthquake Occurrence in Oregon, in 5-Year Increments



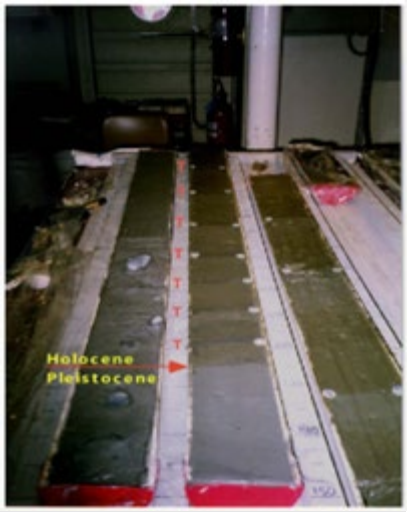
Note: Seismic instruments began operation in 1970, but the network only became fully effective in 1990. Spike in earthquake numbers in the early 1990s is due to aftershocks from the 1993 Scotts Mills and Klamath Falls earthquakes. This account is limited to earthquake recordings captured by seismic instruments, which excludes earthquakes experienced and documented by indigenous peoples prior to the development proliferation of modern seismic instruments.

The history of earthquakes in a region comes from three types of information. Instrumental data comes from networks of seismic recording instruments (seismographs) that are widely deployed in the Pacific Northwest.

Seismic networks can detect very small earthquakes, locate them to within a few miles, and determine their magnitude accurately. Seismographs have only existed for about a century, and in Oregon, the instrumental record is really only complete and modern from about 1990 on. Historical felt location data comes from verbal and written reports of earthquake effects. The felt record extends back to the mid-1800s for Oregon, but only locates moderate to large earthquakes, and those only with an accuracy of tens or even hundreds of miles.

Paleoseismic data use geologic records of earthquake effects to determine the approximate size and timing of earthquakes that happened in prehistoric times. The paleoseismic record can extend back for thousands or tens of thousands of years, but provides only approximate information about the size, time, and place of past large earthquakes.

Figure 3.3.3-3: Deep Sea Sediment Cores that Record Past Megathrust Earthquakes off the Oregon Coast



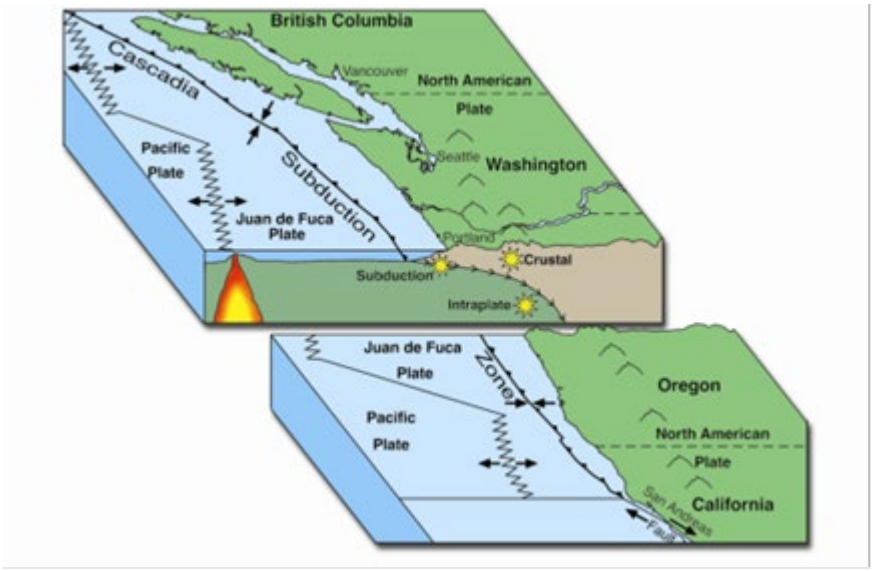
Source: Goldfinger, et. al. (2012)
Not: Red T's mark the top of each layer

In Oregon, the combined earthquake history derived from these three sources clearly outlines two major types of earthquake hazard and two less significant sources. By far the greatest is the hazard posed by infrequent **megathrust earthquakes** on the Cascadia Subduction Zone. The second major hazard comes from smaller **crustal earthquakes** on faults in or near populated areas, which includes all of Oregon's damaging historic earthquakes. Intraplate earthquakes in the subducting slab, which have been historically damaging in the Puget Sound area, are possible in Oregon but no damaging prehistoric or historic events are known. Finally, earthquakes associated with Oregon's many young volcanoes may produce damaging shaking in communities close to the volcano. The Cascadia Subduction Zone is the boundary between two of the earth's crustal plates. These continent-sized

plates are in constant slow motion, and the boundaries between plates are the site of most earthquake activity around the globe. At the Cascadia Subduction Zone, the Juan De Fuca plate, located offshore of Oregon and Washington, slides to the northeast and under the North American plate, which extends from the Oregon coast clear to the middle of the Atlantic Ocean. The Juan de Fuca plate slides beneath the continent (subducts) at about 1.5 inches per year, a speed which has been directly measured using high-accuracy GPS. The fault that separates the plates extends from Cape Mendocino in Northern California to Vancouver Island in British Columbia, and slopes down to the east from the sea floor. The fault is usually locked, so that rather than sliding slowly and continuously, the 1.5 inches per year of subduction motion builds tremendous stress along the fault. This stress is periodically released in a megathrust earthquake, which can have a magnitude anywhere from 8.3 to 9.3.

Figure 3.3.3-4 is a schematic three-dimensional diagram with the generalized locations of the three types of earthquake sources found in Oregon: subduction zone, crustal, and intraplate.

Figure 3.3.3-4: General Source Areas for Subduction Zone, Crustal Earthquakes, and Intraplate Earthquakes



Source: DOGAMI

The Cascadia Subduction Zone closely mirrors the subduction zone in northern Japan that produced the 2011 Tohoku earthquake (Figure 3.3.3-5). This magnitude 9 megathrust event and its associated tsunami captured the world's attention with unforgettable images of destruction on a massive scale. This is a window into Oregon's future, as this is the very type of earthquake that science says is likely on the Cascadia Subduction Zone. Particular attention must be paid to the incredibly destructive tsunami that accompanied the Tohoku earthquake, and community must plan for a similar tsunami in Oregon. (See the **Tsunami** section of this Plan for more information about tsunamis in Oregon.)

Figure 3.3.3-5: Comparison of the Northern Japan Subduction Zone in and the Cascadia Subduction Zone

Source: DOGAMI
Note: Yellow patches are the measured earthquake rupture zone in Japan, modeled earthquake rupture zone in Oregon.

Crustal earthquakes occur for the most part on shore on much smaller faults located in the North American plate. These are the more familiar “California-style” earthquakes with magnitudes in the 5 to 7 range. Although much smaller than the megathrust earthquakes, crustal earthquakes may occur much closer to population centers, and are capable of producing severe shaking and damage in localized areas. For many parts of eastern Oregon, crustal faults dominate the hazard, and they may also have a significant impact in the Portland region and Willamette Valley.

Intraplate earthquakes are a third type that is common in the Puget Sound, where they represent most of the historical record of damaging events. In Oregon, these earthquakes occur at much

lower rates, and none have ever been close to a damaging magnitude. They contribute little to the aggregate hazard in most of Oregon.

3.3.3.2 Earthquake Effects

Earthquake damage is largely controlled by the strength of shaking at a given site. The strength of shaking at any point is a complex function of many factors, but magnitude of the earthquake (which defines the amount of energy released) and distance from the epicenter or fault rupture, are the most important. The ripples in a pond that form around a dropped pebble spread out and get smaller as they move away from the source. Earthquake shaking behaves in the same way: you can experience the same strength of shaking 10 miles from a magnitude 6 earthquake as you would feel 100 miles from a magnitude 9 earthquake.

Two measurement scales are used to describe the magnitude and intensity of earthquakes. To measure the magnitude, the "moment magnitude" (M_w, or M) scale uses the Arabic numbering scale. It provides clues to the physical size of an earthquake (NOAA-OAR-CPO-2014-2003692) and is more accurate than the previously used Richter scale for larger earthquakes. The second scale, the "modified Mercalli," measures the shaking intensity at a point and is based on felt observations and is therefore more subjective than the mathematically derived moment magnitude. It uses Roman numerals to indicate the severity of shaking. It is important to understand the relationship between the intensity of shaking the amount of damage expected from a given earthquake scenario.

Table 3.3.3-1 gives an abbreviated description of the 12 levels of Modified Mercalli intensity.

Table 3.3.3-1 Levels of Modified Mercalli Intensity

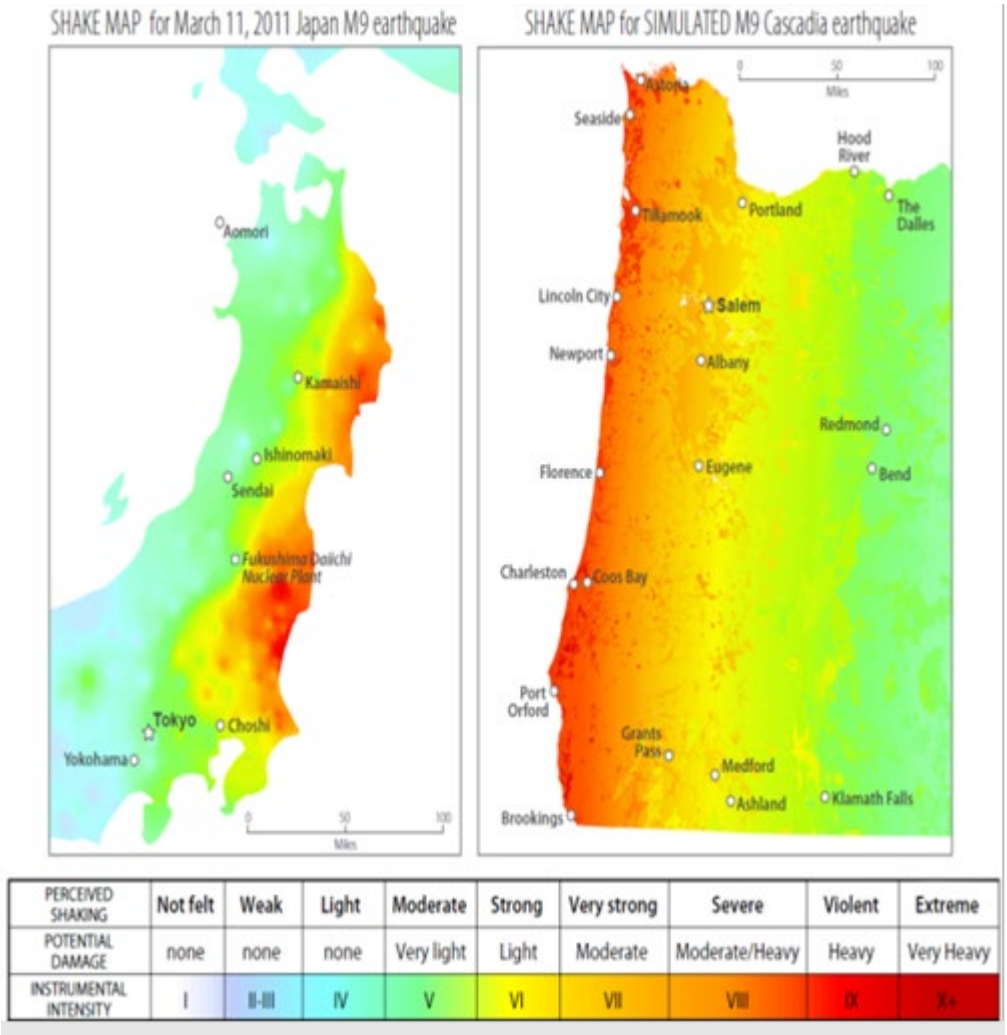
Level	Intensity
I	not felt except by a very few under especially favorable conditions
II	felt only by a few persons at rest, especially on upper floors of buildings
III	felt quite noticeably by persons indoors, especially on upper floors of buildings; many people do not recognize it as an earthquake; standing motor cars may rock slightly; vibrations similar to the passing of a truck; duration estimated
IV	felt indoors by many, outdoors by few during the day; at night, some awakened; dishes, windows, doors disturbed; walls make cracking sound; sensation like heavy truck striking building; standing motor cars rocked noticeably
V	felt by nearly everyone; many awakened; some dishes, windows broken; unstable objects overturned; pendulum clocks may stop
VI	felt by all, many frightened; some heavy furniture moved; a few instances of fallen plaster; damage slight
VII	damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken

Level	Intensity
VIII	damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse; damage great in poorly built structures; fall of chimneys, factory stacks, columns, monuments, walls; heavy furniture overturned
IX	damage considerable in specially designed structures; well-designed frame structures thrown out of plumb; damage great in substantial buildings, with partial collapse; buildings shifted off foundations
X	some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations; rails bent
XI	few, if any (masonry) structures remain standing; bridges destroyed; rails bent greatly
XII	damage total; lines of sight and level are distorted; objects thrown into the air

Sources: http://earthquake.usgs.gov/learn/topics/mercalli.php, abridged from *The Severity of an Earthquake* (http://pubs.usgs.gov/gip/earthq4/severitygip.html); U.S. Geological Survey General Interest Publication 1989-288-913

Future megathrust earthquakes on the Cascadia Subduction Zone (CSZ) will occur off the coast, and the strength of shaking will decrease inland. Oregon coastal communities will experience violent to severe shaking, but the Portland area and Willamette Valley communities are far enough inland that they will feel very strong to severe. Because of the size of the megathrust fault, the shaking will impact all of Oregon west of the Cascades, will still be felt to the east of the Cascades, and will extend to northern California and British Columbia. The other unique characteristic of megathrust earthquakes is that the strong shaking will last for several minutes, in contrast to a large crustal earthquake, which might shake for only 30 seconds. The long duration of shaking contributes greatly to damage, as structures go through repeated cycles of shaking. Figure 3.3.3-6 shows a side-by-side comparison of ShakeMaps for (a) the 2011 M9 earthquake in Japan, and (b) a simulated M9 CSZ event in Oregon.

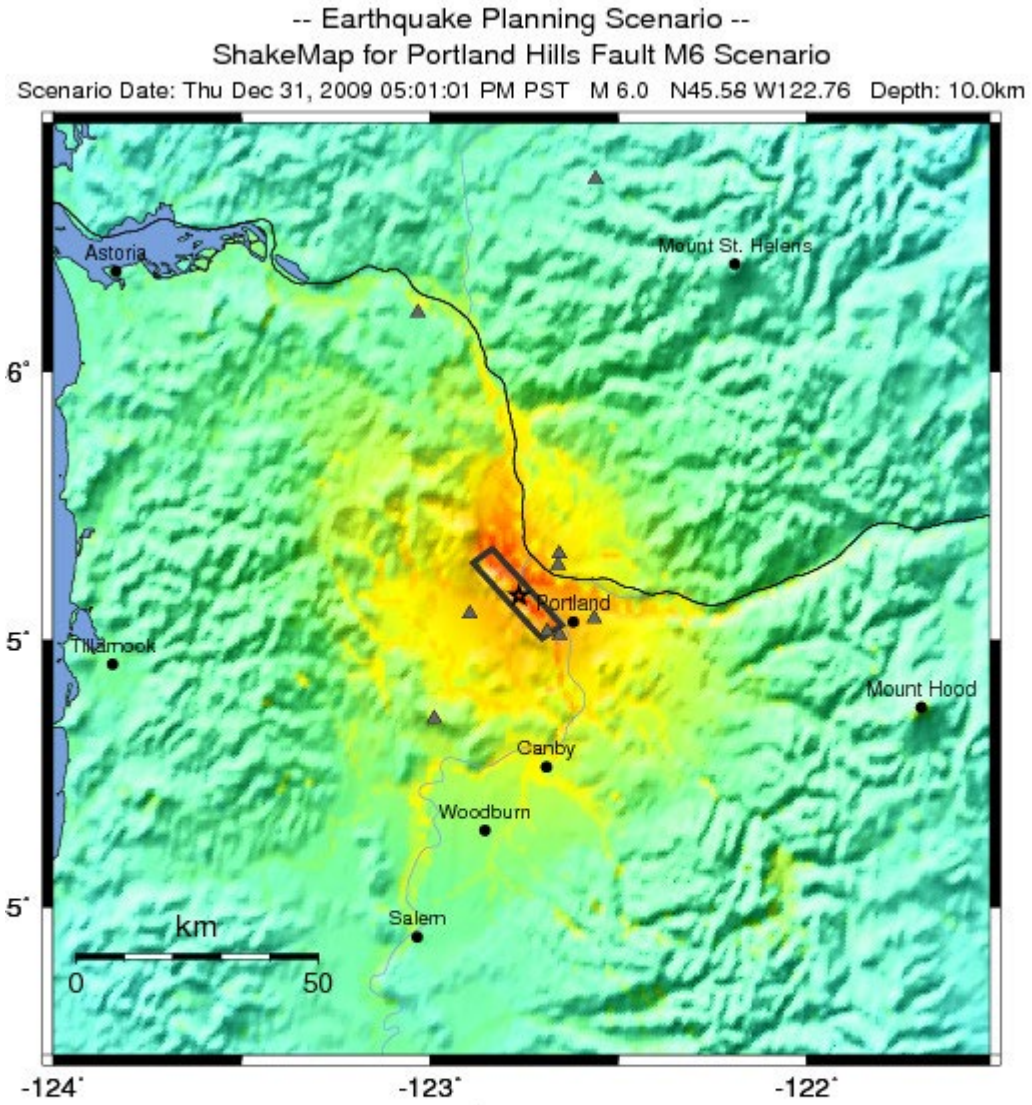
Figure 3.3.3-6: Comparison of Measured Shaking from Tohoku Earthquake and Simulated Shaking from M9 Cascadia Megathrust Earthquake.



Source: DOGAMI, *Cascadia* Winter 2012 (http://www.oregongeology.org/pubs/cascadia/CascadiaWinter2012.pdf)

Future crustal earthquakes will occur along one of many Oregon fault lines; the shaking will be strongest near the epicenter, and will decrease fairly quickly as you move away. For example, a magnitude 6 earthquake in Klamath Falls may cause significant damage near the epicenter, but will be only weakly felt in Medford or Eugene. Figure 3.3.3-7 shows an M6 crustal fault ShakeMap scenario along the Portland Hills fault.

Figure 3.3.3-7: Simulated Shaking from M6.0 Crustal Earthquake on the Portland Hills Fault.



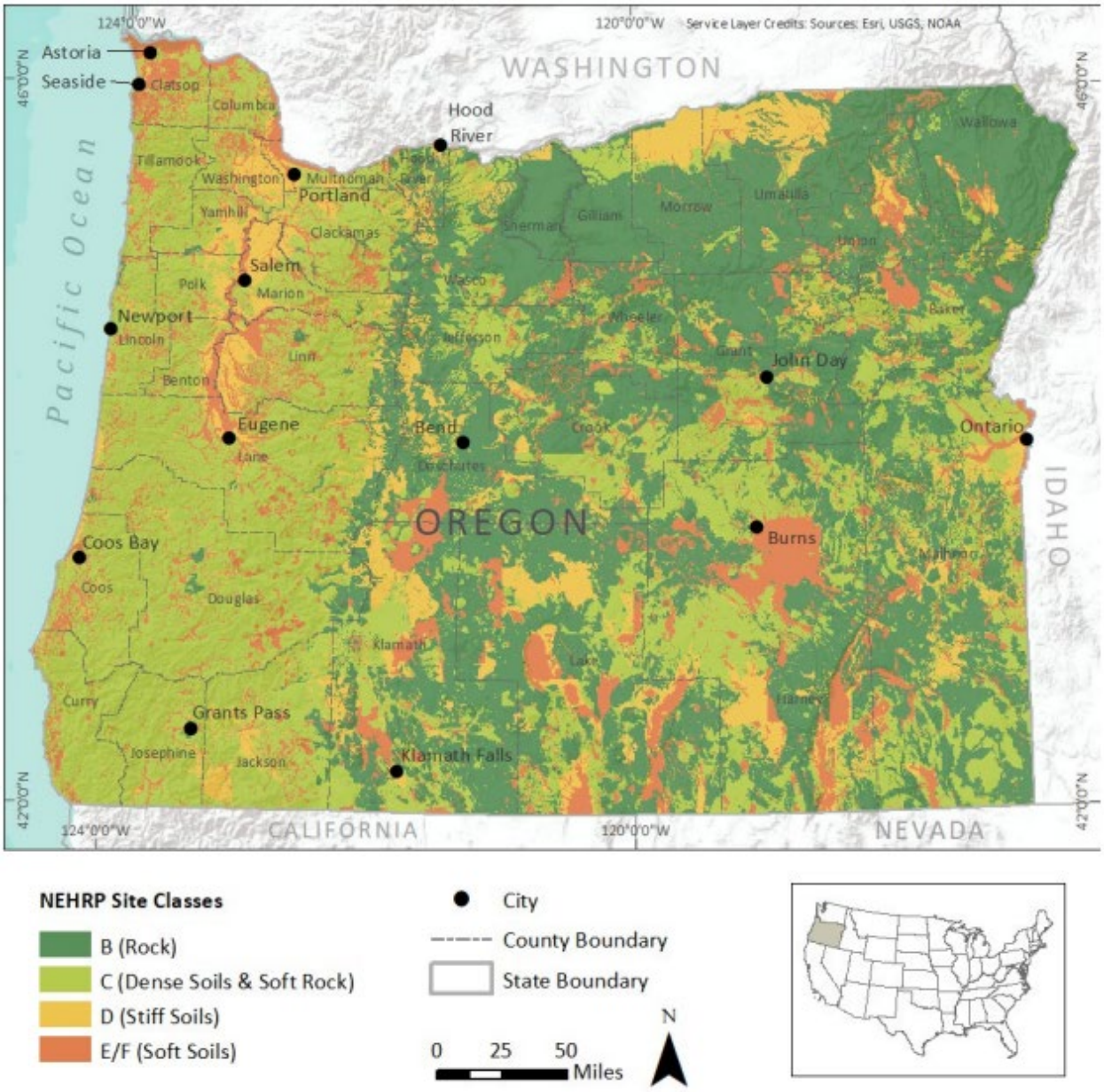
PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Moderate/Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	*<.17*	*.17-1.4*	*1.4-3.9*	*3.9-9.2*	*9.2-18*	18-34	34-65	65-124	>124
PEAK VEL.(cm/s)	<0.1	0.1-1.1	1.1-3.4	3.4-8.1	*8.1-16*	*16-31*	*31-60*	*60-116*	*>116*
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+

Source: U.S. Geological Survey

The other important factor in controlling earthquake damage is the contribution of local geology. Soft soils can strongly amplify shaking (Figure 3.3.3-8), loose saturated sand or silt can liquefy, causing dramatic

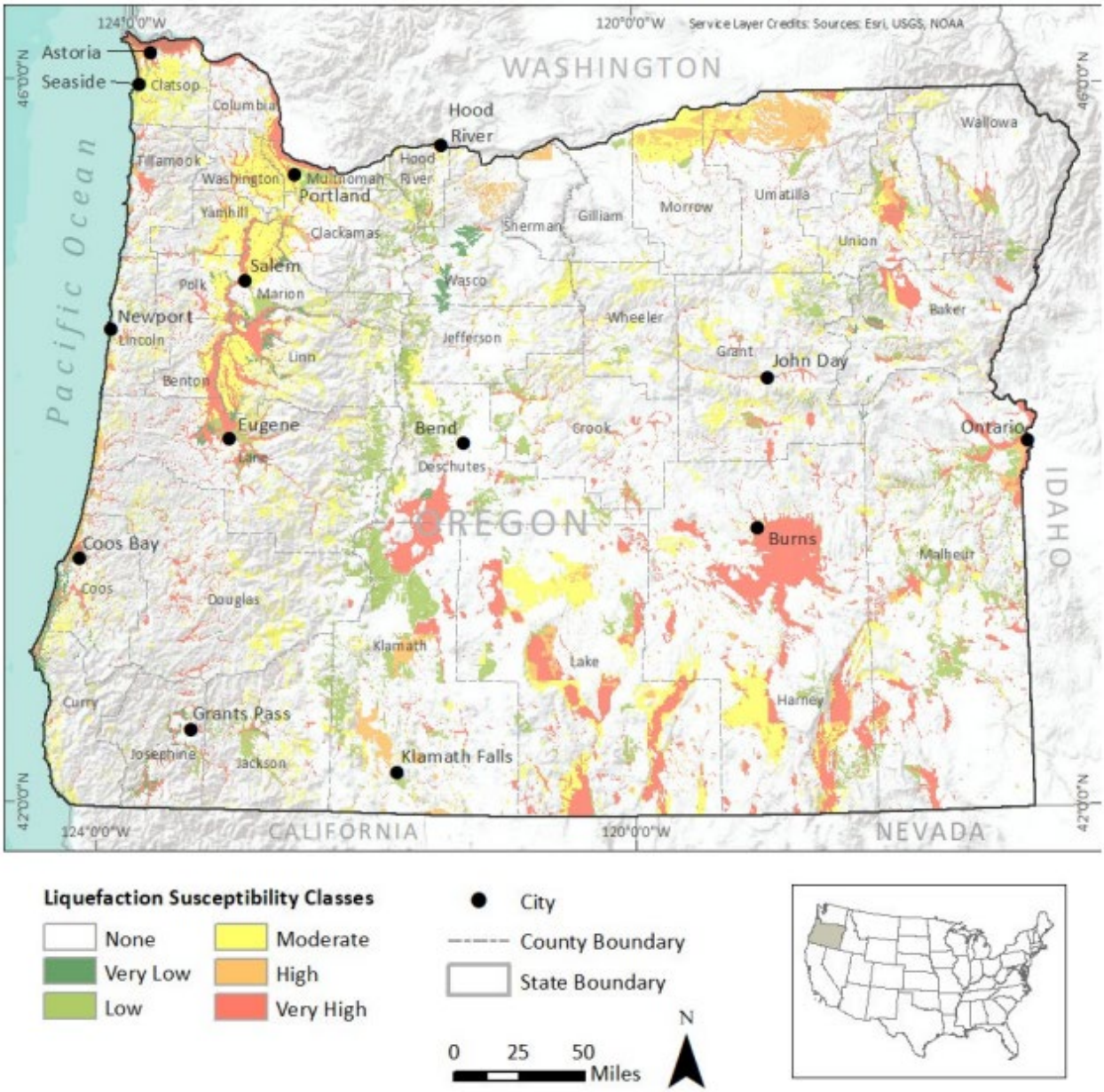
damage, and new landslides can occur on steep slopes while existing landslide deposits may start to move again. These effects can occur regardless of earthquake source, and the geologic factors that cause them can be identified in advance by geologic and geotechnical studies. Liquefaction- and earthquake-induced landslides are both more likely to occur during the several minutes of shaking produced by a megathrust earthquake, and these effects are expected to be widespread during the next event (Figure 3.3.3-9, Figure 3.3.3-10, and Figure 3.3.3-11). In 2013, DOGAMI published a suite of statewide earthquake hazard maps with GIS files in Open-File Report O-13-06, Ground motion, ground deformation, tsunami inundation, co-seismic subsidence, and damage potential maps for the 2012 Oregon Resilience Plan for Cascadia Subduction Zone earthquakes (Madin & Burns, 2013); http://www.oregongeology.org/pubs/ofr/p-O-13-06.htm). In 2021 DOGAMI updated those maps with more detailed geologic information using funds from Oregon DAS-GEO in the Oregon Seismic Hazard Database, release 1.0 (OSHD 1); DOGAMI - Digital Data Publication Preview - Oregon Seismic Hazard Database (OSHD), release 1.0 (OSHD-1). OSHD-1.0 is an update and extension of similar data published by Madin and Burns (2013) to support the 2013 Oregon Resilience Plan prepared by the Oregon Seismic Safety Policy Advisory Commission (OSSPAC, 2013). The co-seismic geohazard layers are updated with many areas of new surficial geology mapping that have been done using high-resolution lidar topographic data, providing greatly improved accuracy and confidence in defining areas with different co-seismic geohazard conditions. The Madin and Burns (2013) report was based on a single simulation of an Mw 9.0 Cascadia Subduction Zone earthquake, which does not significantly affect eastern Oregon. OSHD-1.0 adds the shaking maps and derivative products based on the USGS probabilistic model, which provide consistent hazard information across the entire state. In addition, OSHD-1.0 uses an ensemble of 30 Mw 9 Cascadia subduction earthquake simulations recently published by the USGS (Wirth and others, 2021), which better represents the possible variability of shaking.

Figure 3.3.3-8: Soils Map Showing Where Soils Can Amplify Earthquake Ground Shaking.



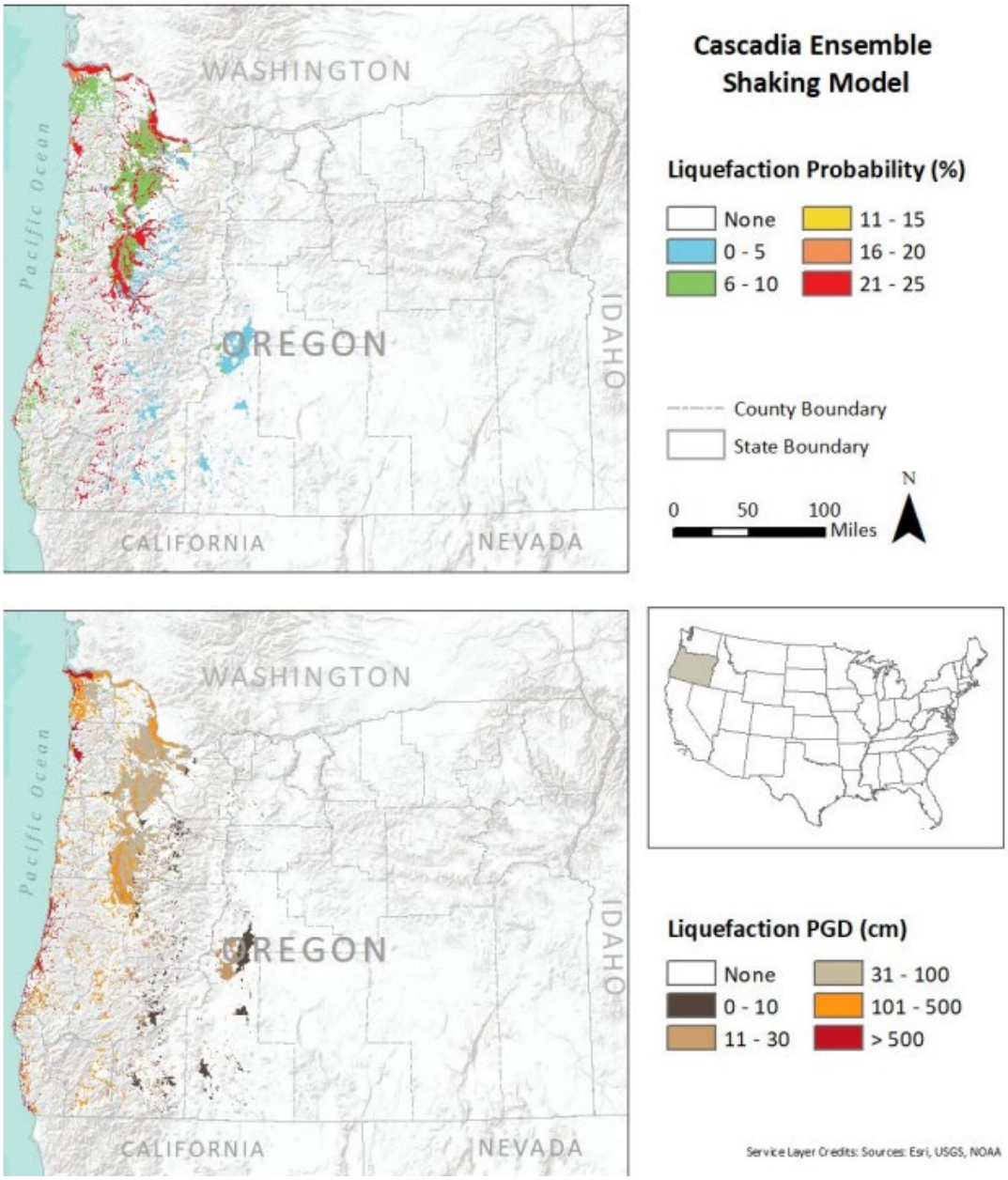
This NEHRP site class map shows areas where soils can amplify the earthquake ground shaking. NEHRP site class F soils (dark orange on map) are prone to produce the greatest amplification.
Source: Madin et al. (2021)

Figure 3.3.3-9: Liquefaction Susceptibility Class Map. This liquefaction susceptibility map shows areas where soils can liquefy due to the earthquake ground shaking. Areas in red are most prone to liquefy.



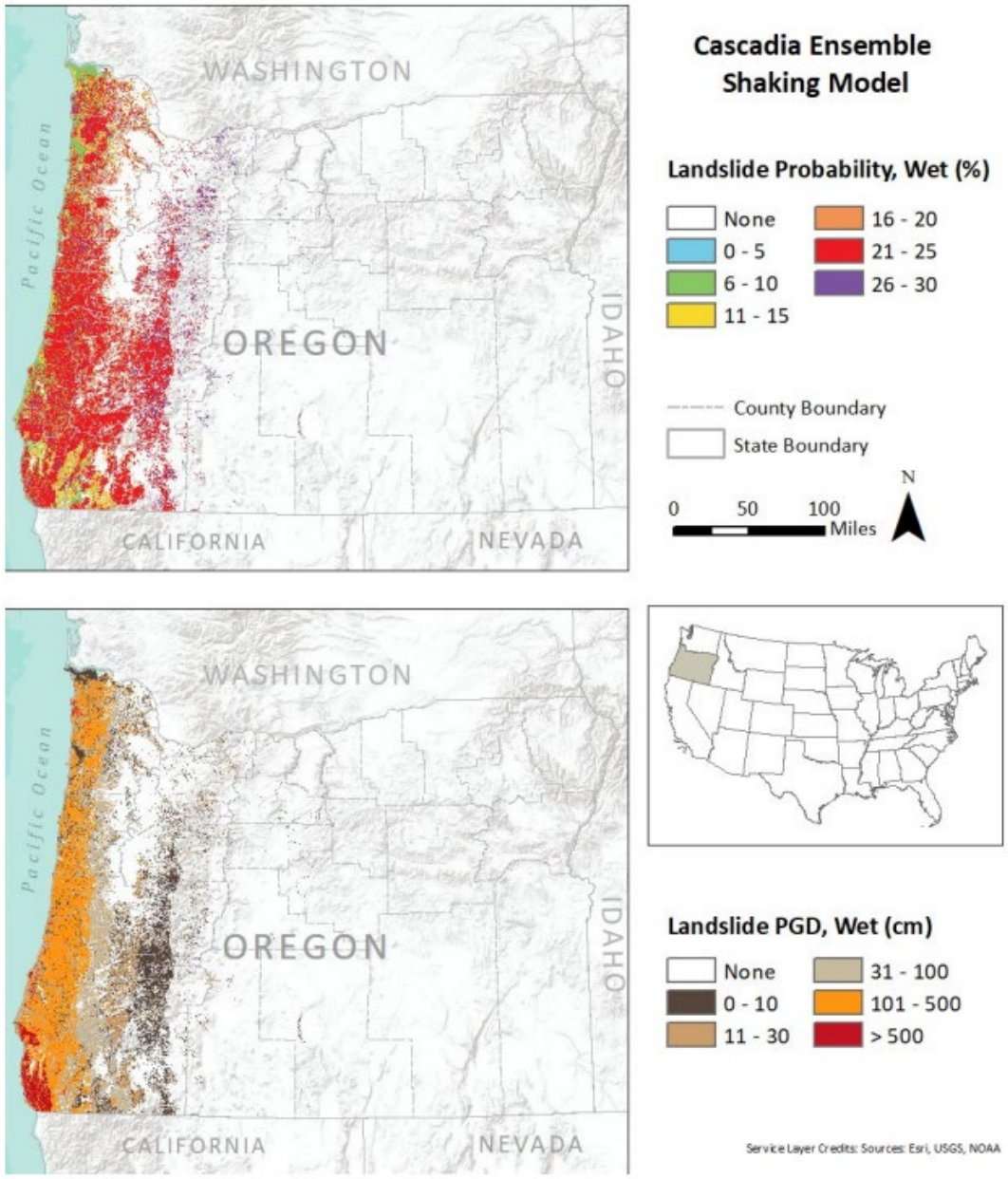
Source: Madin et al. (2021).

Figure 3.3.3-10: Liquefaction Probability and Lateral Spread PGD for the Cascadia ensemble shaking model. This liquefaction probability map shows the probability of soil liquefaction due to a magnitude 9 Cascadia earthquake. Areas in dark red have the highest probability.



Source: Madin et al. (2021).

Figure 3.3.3-11: Expected Displacement Map. This landslide hazard map shows areas and amount of expected landslide displacement due to a magnitude 9 Cascadia earthquake under wet conditions. Areas in red have the highest displacement.



Source: Madin et al. (2021).

3.3.3.3 Historic Earthquake Events

Table 3.3.3-2 lists historic earthquakes in Oregon from both CSZ events and combined crustal events.

Table 3.3.3-2 Historic Earthquakes in Oregon

Date	Location	Description
1873[1]	Del Norte County, Calif.	felt in Portland; localized chimney damage as far north as Port Orford, Oregon
1877[1]	Portland, Oregon	intensity VII; chimney damage
1892[1]	Portland, Oregon	intensity VI; affected area: 26,000 square kilometers; buildings swayed, people terrified and rushed into the street; felt in Astoria and Salem
1893[1]	Umatilla, Oregon	intensity VI-VII; damage to buildings in Umatilla
1896[1]	McMinnville, Oregon	intensity VI; three shocks in succession in McMinnville; main shock felt at Portland and Salem
1906[1]	Paisley, Oregon	intensity V; three additional shocks followed within 1.5 hours
1913[1]	Seven Devil's Mountains of western Idaho	intensity V; broke windows and dishes
1915[1]	Portland, Oregon	intensity V; three shocks reported; rattled dishes, rocked chairs, and caused fright at Portland
1923[1]	southern Oregon	intensity V; plaster fell at Alturas, California; tremor felt at Lakeview, Oregon
Apr. 8, 1927[1]	eastern Baker County,	maximum intensity V (Halfway and Richland); center: eastern Baker County; felt widely over eastern Oregon
July 15 – Nov. 1936[1]	Milton-Freewater, Oregon	intensity VII; magnitude 5.75; center: near the State line between Milton-Freewater, Oregon, and Walla Walla, Washington; affected area: 272,000 sq km in the two states and Idaho; ground cracking observed 6.5 km west of Freewater; marked changes in flow of well water chimneys damaged, plaster broken and walls cracked in Freewater and Umapine; total damage: $100,000; numerous aftershocks up to Nov. 17 (more than 20 moderate shocks during the night and stronger ones (V) on July 18 and Aug. 4 and 27)
Dec. 29, 1941[1]	Portland, Oregon	intensity VI; affected area: 13,000 sq km (Portland); felt at Hillsboro, Sherwood, Yamhill, and into Washington (Vancouver and Woodland); windows broken
Apr. 13, 1941[1]	Olympia, Wash.	magnitude 7.0; at Olympia, Washington, and a broad area around the capital city; fatalities: 8; damage: $25 million; affected area: 388,000 sq km; damage: widespread (Oregon); injuries: several (Astoria and Portland); maximum intensity: VIII (Clatskanie and Rainier); chimneys twisted and fell; damage to brick and masonry
Dec. 15, 1953[1]	Portland, Oregon	intensity: VI; minor damage (Portland area); affected area: 7,700 sq km; one cracked chimney and slight damage to fireplace tile; plaster cracking (Portland and Roy, Oregon, and Vancouver, Washington)
Nov. 16, 1957[1]	Salem, Oregon	intensity VI; affected area: 11,600 sq km (northwestern Oregon); frightened all in the city and cracked plaster (West Salem)
Aug. 18, 1961[1]	Albany/Lebanon, Oregon	intensity VI; magnitude 4.5; affected area: 18,000 sq km; felt region extended into Cowlitz County, Wash; damage: minor (Albany and Lebanon, south of the 1957 center); felt in both cities; two house chimneys toppled, and plaster cracked
Nov. 6, 1961[1]	Portland, Oregon	intensity VI; affected area: 23,000 sq km (northwestern Oregon and southwestern Washington); principle damage: plaster cracking; part of a chimney fell, and windows and lights broke
May 26 – June 11, 1968[1]	Oregon/Calif. border	intensity: VI; magnitude: 4.7; affected area: 18,000 sq km (in the two states); series of earthquakes near the Oregon-California border; chimneys fell or cracked, and

Date	Location	Description
		part of an old rock cellar wall fell; ground fissures in Bidwell Creek Canyon, near Fort Bidwell, California
1993[2]	Scott's Mills, Oregon	5.7 M_w; largest earthquake since 1981; felt from Puget Sound to Roseburg, Oregon[4]
1993[3]	Klamath Falls, Oregon	5.9 M_w and 6.0 M_w[3]; affected area: 130,000 sq km (southwestern Oregon and northern California); losses: concentrated in downtown area; intensity VII in downtown Klamath Falls and immediate vicinity and to the Oregon Institute of Technology, but surrounding experienced intensity VI[5]; fatalities: 2
2001[2]	Nisqually, Wash.	felt as far south as central Oregon
Jan. 4, 2015	NW Nevada	M4.1, 1.5 km deep
Jan. 22, 2015	NW Nevada	M4.5, 1.5 km deep
May 8, 2015	Pacific Ocean, west of Coos Bay, Oregon	M4.4, 10 km deep
Jul. 4, 2015	east of Springfield, Oregon	M4.0, 8 km deep
Jul. – Dec. 2015	NW Nevada	M4.0-4.7, 1.3-1.5 km deep; cluster of earthquakes
Nov. 29, 2019	Port Orford, Oregon	M4.5, 16.7 km deep
Feb. 8, 2020	Pacific Ocean west of Coos Bay, Oregon	M4.7, 10 km deep
Dec. 5, 2024	Cape Medocino, California	M 7.0; quake felt in Medford, Oregon

Sources:
(1) USGS. Oregon Earthquake History. Retrieved October 28, 2013, http://earthquake.usgs.gov/earthquakes/states/oregon/history.php ;
(2) USGS. Earthquake Archive. Retrieved October 28, 2013, http://earthquake.usgs.gov/earthquakes/search/ ;
(3) Sherrod (1993) ;
(4) Thomas, et al. (1996) ;
(5) Dewey (1993) ;
(6) Bott & Wong (1993) ;
(7) Pacific Northwest Seismic Network, Retrieved May 22, 2020, https://pnsn.org/events?custom_search=true

3.3.3.4 Risk Maps

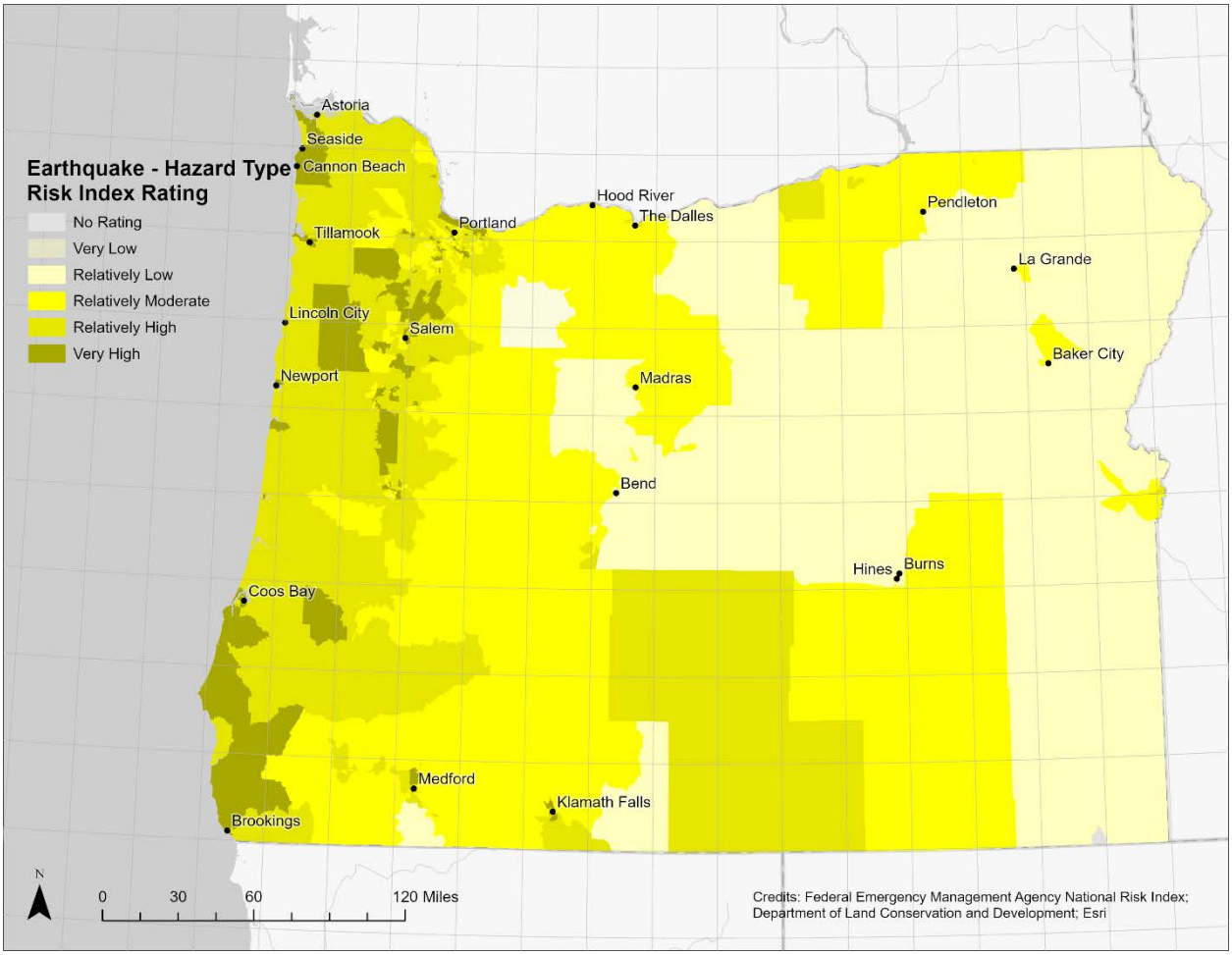
The maps in this section highlight places where the state might work with communities to develop mitigation projects.

The National Risk Index produces a measure of monetary losses experienced over the period of record. This emphasizes historic costs of harm and would direct mitigation resources to where the costs have been the greatest. Mitigation in these locations would save money over the long term.

In contrast to the National Risk Index, the Oregon Natural Hazards Risk Assessment used indicators of harm based on percentages rather than counts of exposed entities or monetary loss. This captures the potential for disruption within a census tract. The higher the percentage of entities affected, the more disruption to those living or working in the census tract.

The Oregon Natural Hazards Risk Assessment produced two statewide summary maps showing distribution of potential harm. The first map uses both socioeconomic and hazard factors. The second map uses hazard factors alone. The maps show the importance of recognizing the cost of disruption not only to buildings and infrastructure, but also to people, especially vulnerable populations. Both types of losses can be mitigated.

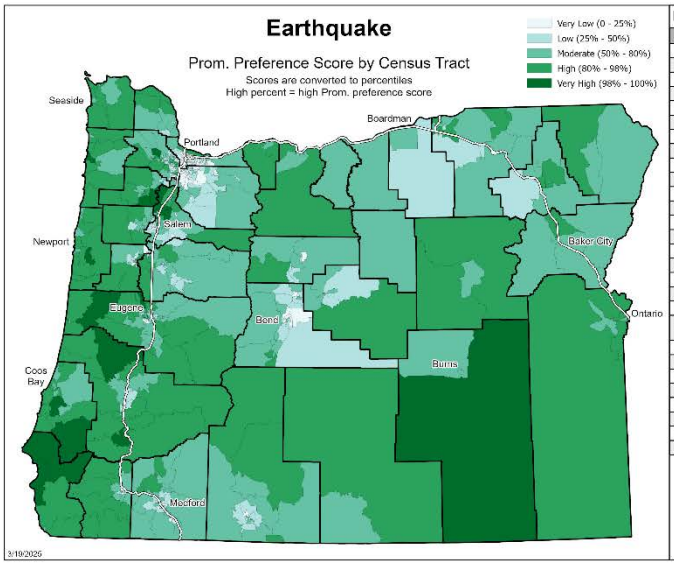
Figure 3.3.3-12: Earthquake Risk Rating from the NRI: Risk Index Rating from the Federal Emergency Management Agency, National Risk Index for Earthquake.



Source: Federal Emergency Management Agency, National Risk Index for Earthquake. Ranking based on national percentiles. Last updated by FEMA in March 2023. Data accessed on February 12, 2025 from National Risk Index | FEMA.gov.

Figure 3.3.3-13 and Figure 3.3.3-14 show risk rankings by census tract for earthquakes from the Oregon Natural Hazards Risk Assessment. Darker colors show census tracts with higher risk. Figure 3.3.3-13 shows census tracts ranked using hazard and socioeconomic vulnerability indicators. Figure 3.3.3-14 shows census tracts ranked using only hazard indicators, without using socioeconomic vulnerability indicators. Cities are included for locational reference only and do not show risk by city. Chapter 9 has additional details and examples of the information available from the risk assessment model.

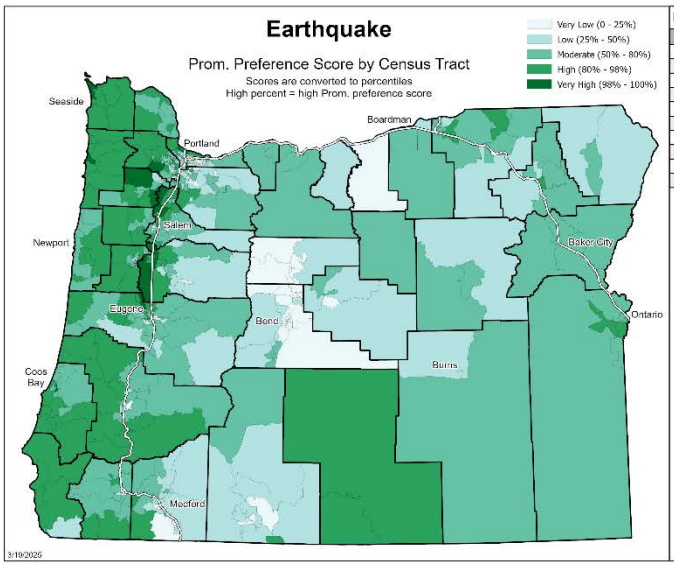
Figure 3.3.3-13: Earthquake Results of Oregon Risk Assessment using PROMETHEE Ranking with Socioeconomic Indicators Included.



Indicators used for the hazard Hazard indicators are worth 35% of the total weight.

Hazard	Indicator Name	Direction	Weight	Short Description
Earthquake	LQ_pct_bld	1	0.035	Pct. SBFO buildings exposed to Moderate to Very High liq.
Earthquake	LQ_pct_CF	1	0.035	Pct. critical facilities exposed to Moderate to Very High liq.
Earthquake	EQCSZ_pct_CF	1	0.035	Pct. of red or yellow-tagged critical facilities (CSZ Deterministic).
Earthquake	EQ25_pct_CF	1	0.035	Pct. of yellow-tagged critical facilities (2500 Probabilistic).
Earthquake	Hist_LQ_ct	1	0.035	Pct. historic buildings exposed to Moderate to Very High liq.
Earthquake	Hwy_LQ_pct	1	0.035	Major roadway miles exposed to Moderate to Very High liq.
Earthquake	Eqk_NRI_rate	1	0.035	Earthquake risk from NRI.
Earthquake	LQ_Haz_Area	1	0.035	Area of tract in high or very high liquefaction hazard.
Earthquake	Bridges_LIQ	1	0.035	Number of bridges within high or very high liquefaction hazard.
Earthquake	PGA_2500	1	0.035	Average shaking in tract from 2500-year probabilistic earthquake.
General	EP_MINRTY	1	0.046	Percentage of Black, Indigenous, and People of Color (2020 Census).
General	HousingTenure	-1	0.046	Housing tenure from the US Census.
General	EP_MOBILE	1	0.046	Percentage of people that live in mobile homes
General	Medien_Yrblt	-1	0.046	Median year built of general building stock based on HAZUS default.
General	HospitalDistMile	1	0.046	Distance from tract centroid to nearest hospital.
General	NatResrcJobs	1	0.046	Rate of natural resource jobs.
General	PRED3_PE	1	0.046	Community Resilience Estimate
General	Hosp_Beds	-1	0.046	Estimated number of hospital beds based on square footage .
General	Pct_Adherents	-1	0.046	Percentage of members to a religious group
General	Mitigation	-1	0.046	Number of migitation projects (grouped by zip code and evenly distributed to overlaying tracts)
General	Watch	-1	0.046	Neighborliness: Will watch neighbor's house
General	CountyTax	-1	0.046	County tax rate
General	CityTax	-1	0.046	City tax rate
General	Cultural	-1	0.009	Number of cultural-related buildings
General	Favors	-1	0.009	Neighborliness: Willing to do favors for neighbor
General	Advice	-1	0.009	Neighborliness: Seeks advice from neighbor
General	Parties	-1	0.009	Neighborliness: Attended parties that occur in neighborhood
General	Visits	-1	0.009	Neighborliness: Has visited neighbor's house

Figure 3.3.3-14: Earthquake Results of Oregon Risk Assessment using PROMETHEE Ranking without Socioeconomic Indicators Included



Indicators used for the hazard

Hazard	Indicator Name	Direction	Weight	Short Description
Earthquake	LQ_pct_bld	1	0.1	Pct. SBFO buildings exposed to Moderate to Very High liq.
Earthquake	LQ_pct_CF	1	0.1	Pct. critical facilities exposed to Moderate to Very High liq.
Earthquake	EQCSZ_pct_CF	1	0.1	Pct. of red or yellow-tagged critical facilities (CSZ Deterministic).
Earthquake	EQ25_pct_CF	1	0.1	Pct. of yellow-tagged critical facilities (2500 Probabilistic).
Earthquake	Hist_LQ_ct	1	0.1	Pct. historic buildings exposed to Moderate to Very High liq.
Earthquake	Hwy_LQ_pct	1	0.1	Major roadway miles exposed to Moderate to Very High liq.
Earthquake	Eqk_NRI_rate	1	0.1	Earthquake risk from NRI.
Earthquake	LQ_Haz_Area	1	0.1	Area of tract in high or very high liquefaction hazard.
Earthquake	Bridges_LIQ	1	0.1	Number of bridges within high or very high liquefaction hazard.
Earthquake	PGA_2500	1	0.1	Average shaking in tract from 2500-year probabilistic earthquake.

3.3.4 Extreme Heat

Extreme heat conditions are defined as weather that is much hotter and sometimes more humid than average for a particular time and place (EPA, 2016). Heat waves are generally defined as extreme heat conditions lasting at least three consecutive days. In 2021, a heat dome event in June and a heat wave in August together contributed to more than 100 deaths in Oregon (OHA Center for Health Statistics, 2024). Extreme heat is associated with more fatalities than any other severe weather event in the United States,

yet heat-related illnesses and deaths are largely preventable. Extreme heat affects everyone, has wide-ranging health impacts, and can worsen certain health conditions, sometimes resulting in premature death and disability. Heat-related illness can occur when the body cannot cool itself or when sweating and dehydration causes an electrolyte imbalance, resulting in heat cramps, heat exhaustion, heatstroke or hyperthermia (CDC, 2024c). Multiple contributing factors can lead to heat-related deaths in addition to extreme heat. These factors may include chronic health conditions, age, sex, taking certain medications, and substance use (illicit drugs and alcohol).

Humidity, lack of acclimatization, and exposure to consecutive days of heat with limited overnight cooling, can increase susceptibility to heat-related illness. Humidity is an important factor in how hot it feels. As air becomes more humid, the human body is less able to cool off by sweating when temperatures are high. The body can adapt to heat through acclimatization, which is achieved by gradually increasing the amount of time spent in hot conditions (CDC, 2024b). People who are less acclimatized to heat are more susceptible to heat-related illness. Consecutive days of heat (three or more days) and minimal overnight cooling compromises the body's ability to regulate temperature and recover from high daytime temperatures.

Older adults (aged 65 and over), infants and children, people who are pregnant, people with chronic conditions including mental illness, people with lower income (without air conditioners and limited access to cooling centers), those experiencing homelessness, athletes, and outdoor and seasonal workers are at increased risk of heat-related illness (CDC, 2024a). Communities residing in urban areas (urban heat islands), emergency responders, people with disabilities, individuals who are socially isolated, and pets and service and support animals are also at risk of exposure to extreme heat (NIHHIS, n.d). Extreme heat is also associated with pre-term births and lower birth weight in babies (Dresser et al., 2024). Literature on the impacts of extreme temperatures among incarcerated populations is limited, but emerging studies suggest an association between ambient heat (indoor temperature) and increased mortality risk in incarceration settings (Skarha et al., 2023; Skarha et al., 2020).

Oregon Health Authority (OHA) set a goal to eliminate health inequities in Oregon by 2030. OHA is the first health agency in the nation to set such an ambitious goal. To be successful, state agencies must continue to identify the needs of communities at disproportionate risk of climate-driven environmental hazards in addition to increasing equitable access to health care. As climate-driven events increase in frequency, intensity and duration, all Oregonians need robust, equitable and climate-resilient systems to mitigate public health risks, protect natural resources, and to close the equity gap among those most vulnerable.

In 2023, OHA's Public Health Division established Public Health Advisory Board indicators to measure the public health system's progress in building community resilience to the health effects of climate change, such as reducing the incidence of heat-related illnesses and respiratory diseases. Current goals for reducing extreme heat impacts by 2030 include: Reducing heat-related illness by 50 percent; Reducing heat-related hospitalizations by 60 percent; and Reducing heat-related deaths by 70 percent.

OHA's Healthy Homes Grant Program received $30 million from the Oregon Legislature to provide grants to eligible entities that in turn provide home improvements for low-income and environment justice communities. These grant funds can be used in a variety of ways to improve the health and safety of occupants. Some specific examples that address heat include the installation of heat pumps, weatherization, and improvements to the home that reduce the reflection of heat on or around the residence, including planting trees and installing green or cool roofs. OHA selected 34 organizations statewide to receive this first round of grant funding, and the funds will be distributed in early 2025.

In the 2023-25 biennium, OHA is funding 194 community-based organizations (CBOs) nearly $42 million to implement activities that promote community health and well-being through the Public Health Equity Grant Program. Of these, 57 CBOs are engaged in climate and health adaptation work. CBOs are encouraged to focus on the priorities of the communities they serve, which includes heat mitigation. Examples of projects include access to greenspaces and community gardens, protection from wildfires, education and training, policy and advocacy, youth engagement, and nutrition and food sovereignty. The spectrum of these projects reflects the broad range of climate impacts across Oregon as well as the diverse opportunities for community-based climate solutions.

With support from public health modernization, local public health authorities (LPHAs) are receiving funds to support climate and health resilience work. By June 30, 2025, each LPHA is required to complete a local or regional climate adaptation plan. Plans will include an assessment of climate impacts within each respective jurisdiction (including heat) and will identify strategies to adapt to climate impacts. This is the second biennium where legislative investment has included a focus on climate and health adaptation planning and is a relatively new body of work. OHA provides direct technical assistance and has partnered with LPHAs to convene a community of practice to share resources and create opportunities for regional collaborations.

Effective June 15, 2022, Oregon Occupational Safety and Health Administration (OSHA) adopted a permanent rule to protect workers from heat-related illnesses. The rule applies when the heat index (apparent temperature) equals or exceeds 80 degrees Fahrenheit in indoor or outdoor work environments (Figure 3.3.4-1). Oregon OSHA also adopted rules for worker protection from wildfire smoke, effective July 1, 2022.

Following the heat dome event in 2021, the Oregon Legislature directed the Oregon Department of energy to conduct an Oregon cooling needs study with focus on households living in housing most vulnerable to heat. These housing types include publicly supported housing, manufactured and mobile homes, agricultural workforce housing, and RVs used as homes. The study found that the estimated total cost to provide the health and safety baseline level of cooling equipment to avoid the worst effects of extreme heat events is $604,400,000 (ODE, 2023).

Though there is no dollar value that can be placed on human life, CDC WISQARS provides medical costs and estimated value of statistical lives (based on actuarial models) of lives lost to heat death. Estimates for Oregon heat fatalities in recent years available are as follows:

Table 3.3.4-1: Deaths with heat as a contributing factor

Year	Number of Heat-Related Deaths	Total Medical Costs*	Total Value of Statistical Life*	Combined Medical Costs + Value of Statistical Life*
2018	4	$51,094.71	$37,092,857.14	$37,144,285.71
2019	3	$45,370.56	$25,826,666.67	$25,872,222.22
2020	2	$11,395.20	$21,360,000.00	$21,371,200.00
2021	134	$848,944.10	$1,040,372,670.81	$1,040,372,670.81

Year	Number of Heat-Related Deaths	Total Medical Costs*	Total Value of Statistical Life*	Combined Medical Costs + Value of Statistical Life*
2022	22	$239,184.85	$159,161,538.46	$159,402,692.31

*Estimated as a proportion of unintentional deaths from natural environmental causes.
Source: CDC Web-based Injury Statistics Query and Reporting System (WISQARS)

The cost of heat-related illness emergency department visits and hospitalizations in Oregon are as follows:

Table 3.3.4-2: Heat-Related Illness Emergency Department Visits

Year	Number of ED Visits*	Median Cost per Visit	Total Annual Cost
2018	545	$1,112.48	$966,688.55
2019	421	$1,070.54	$808,217.61
2020	364	$1,283.89	$984,847.12
2021	1105	$1,293.54	$3,862,789.57
2022	731	$1,342.78	$1,930,277.75
2023	613	$1,418.17	$1,050,564.33

*Includes patients that were treated and released from the ED and not admitted to the hospital. Represents hospital-specific cost to charge ratios.
Source: Oregon Health Authority Hospital Reporting Program, Office of Health Analytics

Table 3.3.4-3: Heat-related illness hospitalizations

Year	Number of Admissions	Median Cost per Visit	Total Annual Cost
2018	35	$8,210.82	$411,470.16
2019	29	$5,891.79	$357,927.77
2020	37	$11,478.39	$509,072.44
2021	181	$10,979.12	$3,292,879.89
2022	64	$14,956.59	$1,227,105.56
2023	74	$10,569.54	$1,153,341.66

Represents hospital-specific cost to charge ratios.
Source: Oregon Health Authority Hospital Reporting Program, Office of Health Analytics. See supplemental document for the methods to estimate costs.

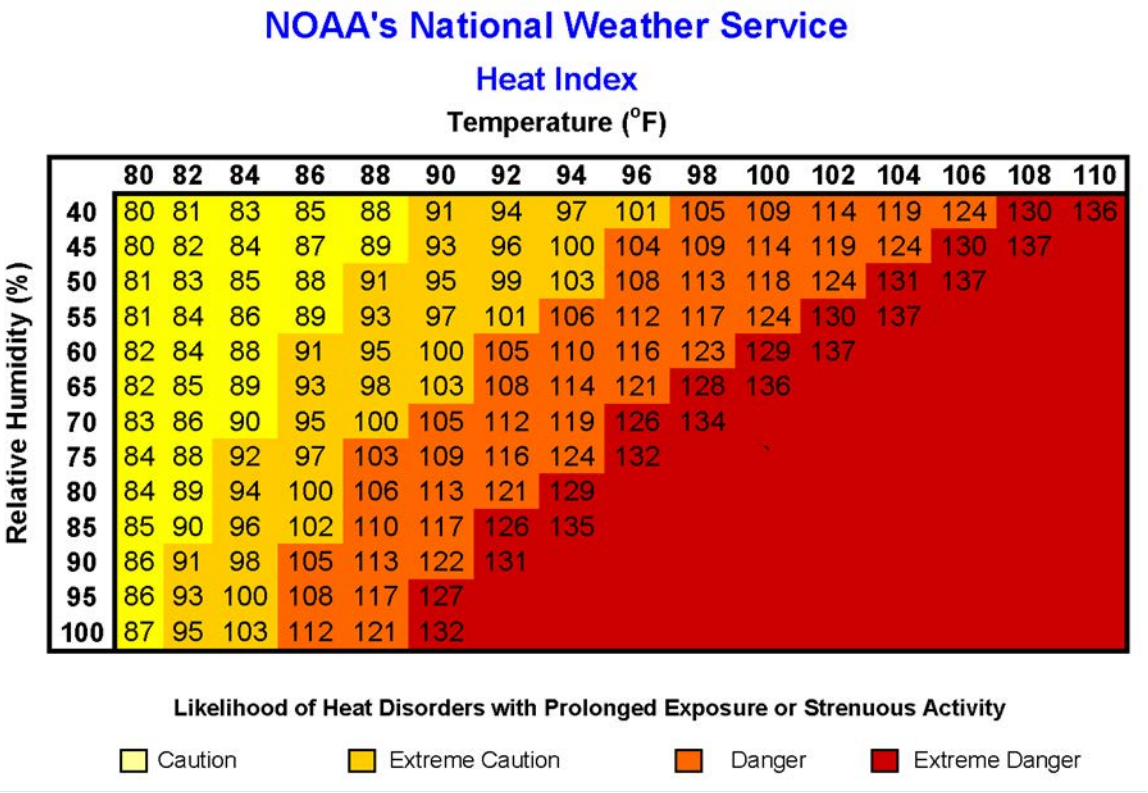
3.3.4.1 Analysis and Characterization

Synoptic conditions that drive extreme heat events in the Pacific Northwest include, upper-level ridges—or large areas of high atmospheric pressure—and strong offshore flow. There are several ways to measure extreme heat. One common way is to count the number of days with temperatures above a certain threshold, such as days with temperatures above 90°F. Areas that climatologically see the greatest number of very hot temperature days include inland areas at lower elevations in eastern Oregon, as well as parts of southern Oregon, particularly the Rogue River Valley. Human-caused climate change is already contributing to the severity of such events (Vose, Easterling, Kunkel, LeGrande, & Wehner, 2017).

Oregon experienced some of the hottest years on record in 2021 and 2022 as measured by days at or above 90°F [Fleishman, 2023]. Recent extremely hot summers (2021, 2022, and 2023) in highly populated parts of western Oregon have been unprecedented and have brought increased interest in the effect of global warming on local summer temperatures. In Oregon's biggest city, Portland, summer extreme heat in terms of annual total days over 90°F has steadily increased in frequency and severity despite large year-to-year variability. In 2021-2023, the average number of days per year with temperatures at or above 90°F was greater than the average from 2011-2020 in Portland, Salem, Eugene, The Dalles, Pendleton, Ontario and Medford. The hot summers of 2021, 2022, and 2023 serve as wake-up calls for what is to come, as they are good examples of what is projected to be relatively common by the mid-21st century.

The National Weather Service issues extreme heat warnings when the NWS HeatRisk exceeds Major or Extreme HeatRisk. The heat index is a measure of how hot it feels combining both temperature and relative humidity. As relative humidity increases, a given temperature can feel even hotter. Figure 3.3.4-1 displays NOAA's National Weather Service rubric for temperature and relative humidity according to the danger of heat-related illnesses.

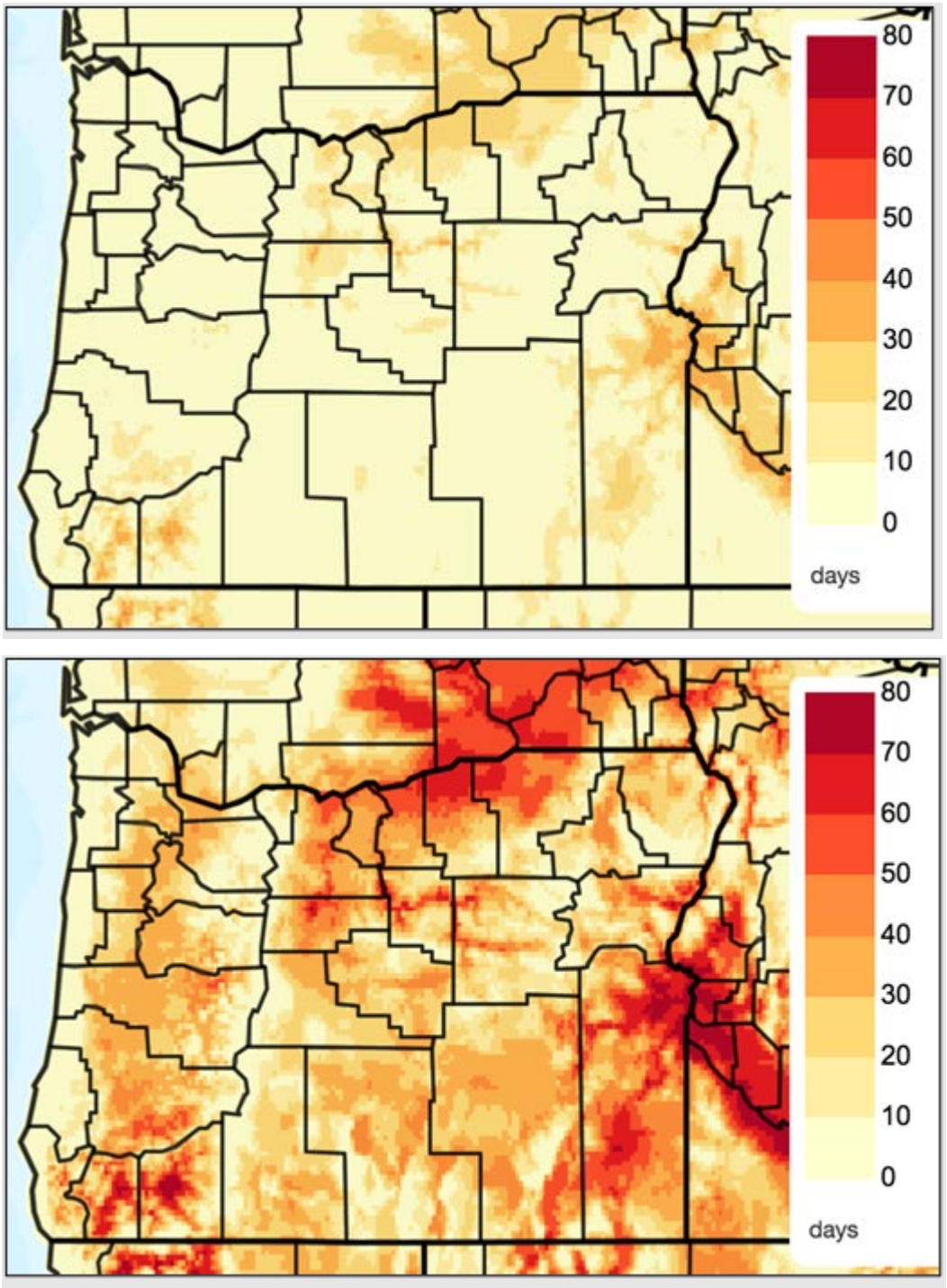
Figure 3.3.4-1:NOAA National Weather Service Heat Index.



Source: https://www.weather.gov/phi/heat

There have historically been few places in Oregon that experience substantial number of days with heat index greater than 90°F. Under future climate change, however, nearly the entire state could see substantial increases in such extreme heat days (Figure 3.3.4-2).

Figure 3.3.4-2: Frequency of Days April–October with Heat Index ≥ 90°F in Historic (1971–2000, top) and Future (2040–2069, bottom) Periods under RCP 8.5



Note: Displayed is the multi-model mean derived from 18 downscaled CMIP5 climate models.
Source: Northwest Climate Toolbox, https://climatetoolbox.org/tool/climate-mapper

3.3.4.2 Historic Extreme Heat Events

Table 3.3.4-4: Historic Heat and Excessive Heat Events in Oregon

Date	Location	Notes
July 26–28, 1998	Region 2	A three-day heat wave brought record high temperatures to western Oregon. The high temperature of 99 degrees at Portland International Airport on the 26th eclipsed the previous record for that date of 98 set in 1988, and the high of 101 on the 28th broke the previous daily record of 99 set in 1973. In Eugene, the high of 102 on the 26th broke the previous daily record of 101 set in 1988, and the 105 degrees on the 27th tied the record high for the month of July. There was one reported death from heat-related illness.
July 10–14, 2002	Region 5–7	A record-breaking heat wave shattered many daily record high temperatures across the state, with a few locations breaking all-time records.
June 24–26, 2006	Region 1–3, 5	A broad upper ridge of unusually high height coupled with a thermally induced surface trough of low pressure lingered over the Pacific Northwest for several days. This pattern resulted in persistent offshore flow, and therefore many days of record-smashing high temperatures. Many cities in Oregon saw record-breaking daily high temperatures for multiple days in a row.
July 20-24, 2006	Region 1–3, 5, 7	An unusually strong ridge of high pressure brought several days of record breaking hot and humid weather to NW Oregon. Many cities in Oregon saw record-breaking daily high temperatures for multiple days in a row. Many daily maximums were between 10 and 20 degrees above normal. A few sites reported record high minimum temperatures during this very humid event; a couple broke all-time record high minimums as well. 4500 homes lost power during this event. In north central and eastern Oregon, daily maximum temperatures between 100 and 113 degrees were observed at lower elevations, with temperatures 90 to 100 degrees at elevations up to 4000 feet. Several people were treated for heat related illness.
June 28–30, 2008	Region 2, 3, 5, 7	An upper-level ridge and thermal trough across the Pacific Northwest produced temperatures above 100 degrees for two consecutive days breaking records in many locations. Two people died of heat-related illness.
August 15–17, 2008	Region 5–7	Excessive Heat Event: An upper-level ridge and dry air brought excessive heat into eastern Oregon. Many locations experienced multiple days of at least 100-degree temperatures.
July 25–26, 2010	Region 5, 7	Excessive Heat Event: Temperatures topped 100 degrees for two successive days in Hermiston, Pendleton, 5 miles northeast of Pendleton, Ione, Echo, Arlington, and Umatilla.
August 1, 2011	Region 5	A dry weak westerly flow aloft under a broad upper-level high pressure system combined with a surface thermal trough to bring several days of temperatures in the 90s.
July 1, 2014	Region 3	An upper-level ridge combined with a surface thermal trough and low-level offshore winds resulted in a hot day across Northwest Oregon where inland temperatures peaked in the upper 90s inland and the upper 80s along the coast.
June 7–9, 2015	Region 2	An unseasonably strong upper-level ridge of high pressure resulted in hot temperatures early in June where high temperatures were in the low to mid 90s, which were around 20 degrees higher than the seasonal normals. The low temperatures were also

Date	Location	Notes
		unseasonably warm. The hospital visits for heat-related illness for Northwest Oregon increased by 50 during this period.
June 26–28, 2015	Region 2, 3	Excessive Heat Event: A strong upper-level ridge of high pressure resulted in hot temperatures across Northwest Oregon. Afternoon temperatures peaked in the low 90s to the low 100s, which are around 20 degrees warmer than the seasonal normals. Monsoonal moisture and onshore winds resulted in fairly high humidities (40 to 50 percent in the afternoons) making the temperatures feel 2 to 5 degrees warmer than they were. The mid-level moisture also added to an increase of thunderstorms around the region. Clouds from these thunderstorms limited overnight radiation cooling. Nighttime temperatures were in the mid-60s to low 70s, which are 10 to 15 degrees warmer than the seasonal normals. There were several new daily records set for the warmest low temperatures. The Multnomah County had 10 emergency room visits for heat related illnesses. There were two reported drownings, including one at nighttime.
July 1–5, 2015	Region 2, 3	A strong upper ridge over the region resulted in hot weather for the Willamette Valley where temperatures peaked 10 to 15 degrees Fahrenheit above the seasonal normal. High Temperatures were in the mid-90s to low 100s. The low temperatures were also unseasonably warm.
July 28–30, 2015	Region 2, 3	Excessive Heat Event: A strong upper-level ridge resulted in excessively warm temperatures where the high temperatures were 15 to 20 degrees Fahrenheit above the seasonal normal. High temperatures were in the upper 90s to around 105 for the Willamette Valley. The daily maximum temperature of 105 degrees at Eugene broke the previous record of 99 last set in 2003. Emergency Preparedness officials opened cooling shelters. Several people were treated for heat related illnesses at medical centers. Local newspapers reported 3 separate incidents where children were left in hot cars in the Eugene area.
August 18–19, 2015	Region 2	Excessive Heat Event: Strong high pressure at the surface and aloft over the area resulted in excessively hot temperatures across northwest Oregon. Warming aloft combined with offshore winds and a thermal trough west of the Cascades contributed to the heat. Temperatures peaked in the mid to upper 90s, which is 10 to 15 degrees above the seasonal normal in most areas. Daily high temperatures broke several records at area airports.
June 2–5, 2016	Region 3	Excessive Heat Event: Unseasonably strong ridge of high pressure resulted in a period of early-season hot temperatures across Northwest Oregon. Temperatures of 95 to 100 in early June led to people seeking relief at local rivers. Three drownings were reported.
August 11–14, 2016	Region 2	Ridge of high pressure led to hot temperatures across Northwest Oregon. Temperatures in the upper 80s to mid-90s lead to people seeking relief at local rivers. Two river drownings were reported in the Greater Portland Metro area during this heat event.
August 25-26, 2016	Region 1, 2	Ridge of high pressure and offshore winds brought temperatures along the North Oregon Coast up into the mid-80s to mid-90s on August 25. Inland, temperatures on August 25-26 reached the upper 90s. Temperatures in the mid-80s to mid-90s lead to people seeking relief at local rivers, lakes, and beaches. One swimmer drowned. News reported 8 runners were taken to the hospital with heat-related injuries during the Hood-to-Coast relay through Portland.
May 22-23, 2017	Region 2	Ridge of high pressure brought a couple days of warm weather. Temperatures climbed up into the upper 80s to low 90s in many locations across the area. Early season heat led people to seek relief in local rivers and lakes. While air temperatures were warm, river and lake temperatures were still cold, leading to two drownings across the area.

Date	Location	Notes
August 1–4, 2017	Region 2–4, 6	Excessive Heat Event: Strong high pressure brought record breaking heat to many parts of southwest, south central, and northwest Oregon. Region 2–3: The record-breaking heat led people to seek relief at local rivers. Two people drowned while swimming. Region 4: Reported high temperatures during this interval ranged from 98 to 112 degrees (Jackson), 95 to 110 degrees (Douglas), 87 to 109 degrees (Josephine, eastern Curry). Region 6: Reported high temperatures during this interval ranged from 82 to 102 degrees.
July 12–17, 2018	Region 2, 3, 4	Region 2–3: High pressure over the region led to a stretch of hot day July 12 through July 17th. Hot temperatures led people to cool off in local rivers. There were two drownings recorded on July 16 and July 18. Temperatures on July 16th near the Sandy River in Troutdale got up to 98 degrees. Region 4: Strong high pressure coupled with very dry air brought very hot temperatures to the area during this interval. High temperatures ranged from 89 to 105 degrees (Jackson) and from 91 to 104 degrees (Josephine, eastern Curry).
June 11–12, 2019	Region 4 and eastern Curry County	Strong high pressure and a very dry air mass made for hot conditions over southwest Oregon during this interval. Reported high temperatures ranged from 95 to 101 degrees (Jackson), 89 to 101 degrees (Douglas), 88 to 105 degrees (Josephine, eastern Curry).
August 27-28, 2019	Region 4 and eastern Curry County	Excessive Heat Event: High pressure aloft forced a thermal trough near the coast to move inland, bringing hot and dry conditions to the inland west side valleys in southwest Oregon. Reported high temperatures in this zone ranged from 99 to 106 degrees on 08/27 and from 92 to 95 degrees on 08/28. Low temperatures on the morning of 08/28 ranged from 50 to 67 degrees.
June 26 – 28, 2021	Region 2	A “heat dome” weather pattern caused extreme temperatures across the Portland Metro region, severely impacting people, transportation networks, and the economy. In the greater Portland Metro area, 93 deaths were reported.

Source: NOAA Storm Events Database https://www.ncdc.noaa.gov/stormevents

3.3.4.3 Risk Maps

The maps in this section highlight places where the state might work with communities to develop mitigation projects.

The National Risk Index produces a measure of monetary losses experienced over the period of record. This emphasizes historic costs of harm and would direct mitigation resources to where the costs have been the greatest. Mitigation in these locations would save money over the long term.

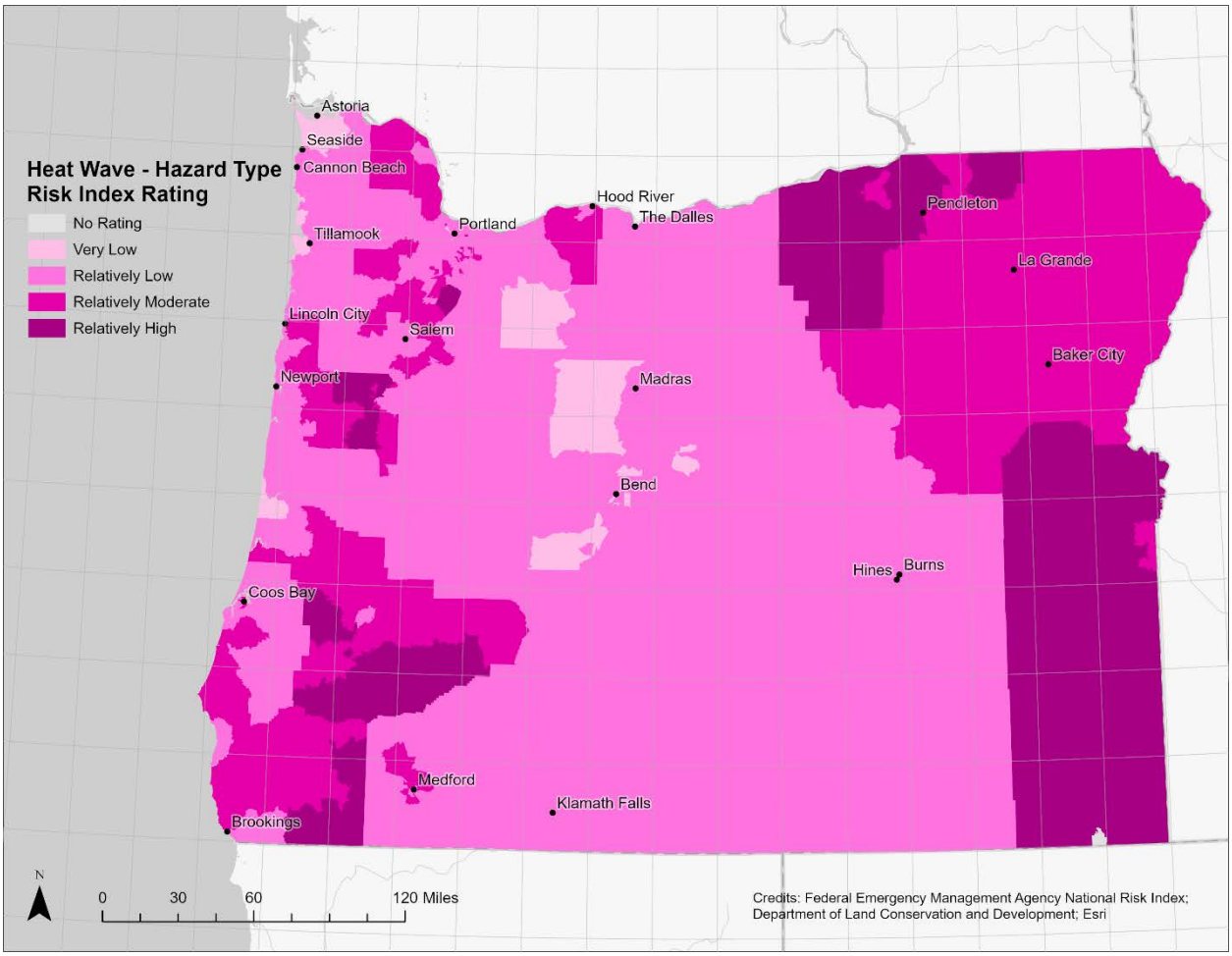
In contrast to the National Risk Index, the Oregon Natural Hazards Risk Assessment used indicators of harm based on percentages rather than counts of exposed entities or monetary loss. This captures the potential for disruption within a census tract. The higher the percentage of entities affected, the more disruption to those living or working in the census tract.

The Oregon Natural Hazards Risk Assessment produced two statewide summary maps showing distribution of potential harm. The first map uses both socioeconomic and hazard factors. The second map uses hazard

factors alone. The maps show the importance of recognizing the cost of disruption not only to buildings and infrastructure, but also to people, especially vulnerable populations. Both types of losses can be mitigated.

The climate change maps show where risk is projected to increase. Areas with a high risk and a high increase in risk would be especially good places to work with communities to find mitigation projects.

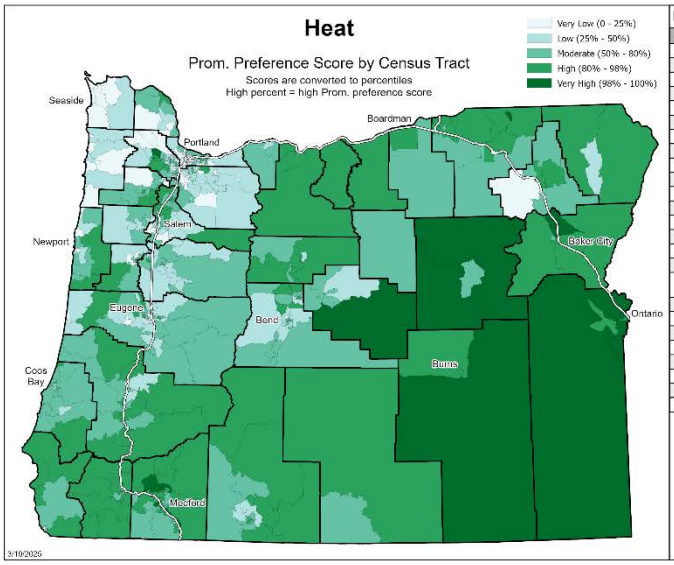
Figure 3.3.4-3: Heat Wave Risk Rating from the NRI: Risk Index Rating from the Federal Emergency Management Agency, National Risk Index for Heat Wave.



Source: Federal Emergency Management Agency, National Risk Index for Heat Wave. Ranking based on national percentiles. Last updated by FEMA in March 2023. Data accessed on February 12, 2025 from National Risk Index | FEMA.gov.

Figure 3.3.4-4 and Figure 3.3.4-5 show risk rankings by census tract for extreme heat from the Oregon Natural Hazards Risk Assessment. Darker colors show census tracts with higher risk. Figure 3.3.4-4 shows census tracts ranked using hazard and socioeconomic vulnerability indicators. Figure 3.3.4-5 shows census tracts ranked using only hazard indicators, without using socioeconomic vulnerability indicators. Cities are included for locational reference only and do not show risk by city. Chapter 9 has additional details and examples of the information available from the risk assessment model.

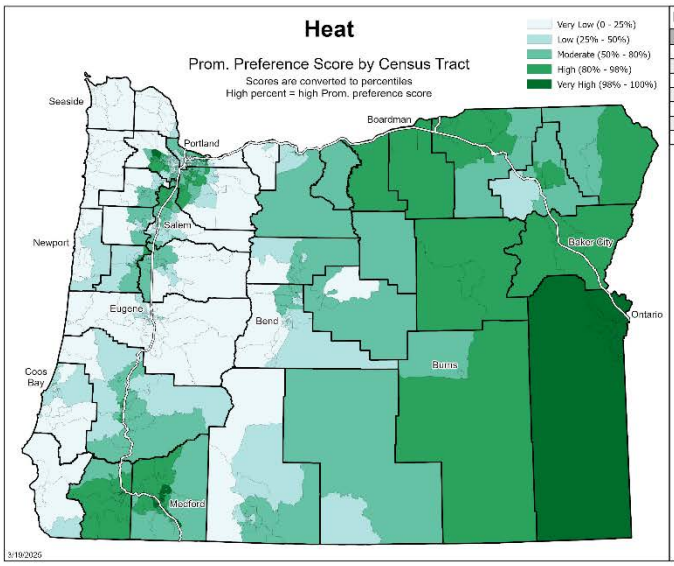
Figure 3.3.4-4: Extreme Heat Results of Oregon Risk Assessment using PROMETHEE Ranking with Socioeconomic Indicators Included.



Indicators used for the hazard Hazard indicators are worth 35% of the total weight.

Hazard	Indicator Name	Direction	Weight	Short Description
Heat	Over90th	1	0.05	Mean days that are above the historic 90th percentile temp
Heat	Over90F	1	0.05	Mean days above 90 degrees Fahrenheit
Heat	Heat_Events	1	0.05	Number of heat events.
Heat	Heat_ALAG	1	0.05	Annualized loss to agriculture from heat.
Heat	Heat_ALPOP	1	0.05	Annualized loss to population from heat.
Heat	OutdoorJobs	1	0.05	Rate of jobs that occur outside.
Heat	TreeCan_avg	-1	0.05	Tree canopy density
General	EP_MINRTY	1	0.046	Percentage of Black, Indigenous, and People of Color (2020 Census).
General	HousingTenure	-1	0.046	Housing tenure from the US Census.
General	EP_MOBILE	1	0.046	Percentage of people that live in mobile homes
General	Medien_Yrblt	-1	0.046	Median year built of general building stock based on HAZUS default.
General	HospitalDistMile	1	0.046	Distance from tract centroid to nearest hospital.
General	NatResrcJobs	1	0.046	Rate of natural resource jobs.
General	PRED3_PE	1	0.046	Community Resilience Estimate
General	Hosp_Beds	-1	0.046	Estimated number of hospital beds based on square footage .
General	Pct_Adherents	-1	0.046	Percentage of members to a religious group
General	Mitigation	-1	0.046	Number of migitation projects (grouped by zip code and evenly distributed to overlaying tracts)
General	Watch	-1	0.046	Neighborliness: Will watch neighbor's house
General	CountyTax	-1	0.046	County tax rate
General	CityTax	-1	0.046	City tax rate
General	Cultural	-1	0.009	Number of cultural-related buildings
General	Favors	-1	0.009	Neighborliness: Willing to do favors for neighbor
General	Advice	-1	0.009	Neighborliness: Seeks advice from neighbor
General	Parties	-1	0.009	Neighborliness: Attended parties that occur in neighborhood
General	Visits	-1	0.009	Neighborliness: Has visited neighbor's house

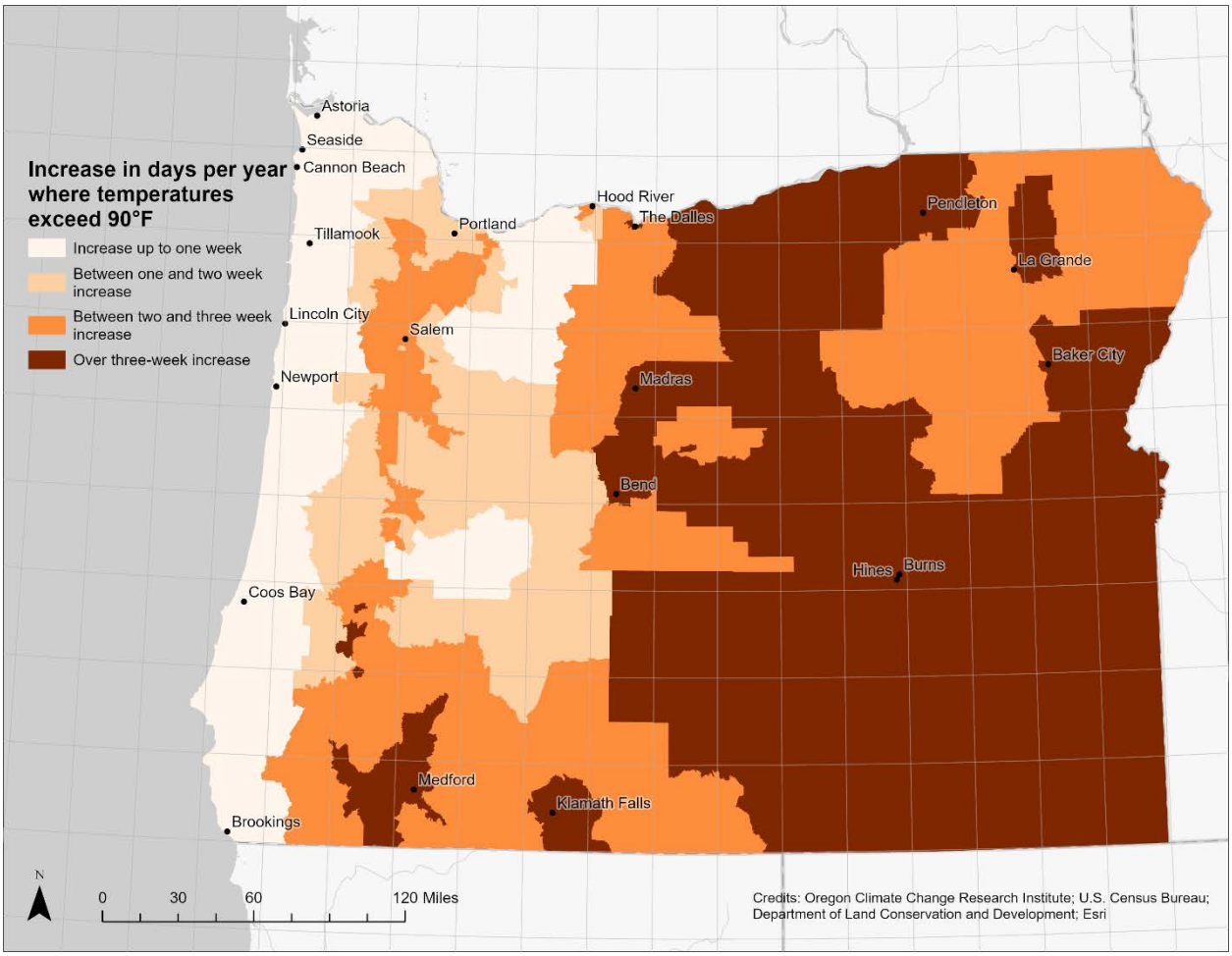
Figure 3.3.4-5: Extreme Heat Results of Oregon Risk Assessment using PROMETHEE Ranking without Socioeconomic Indicators Included.



Indicators used for the hazard

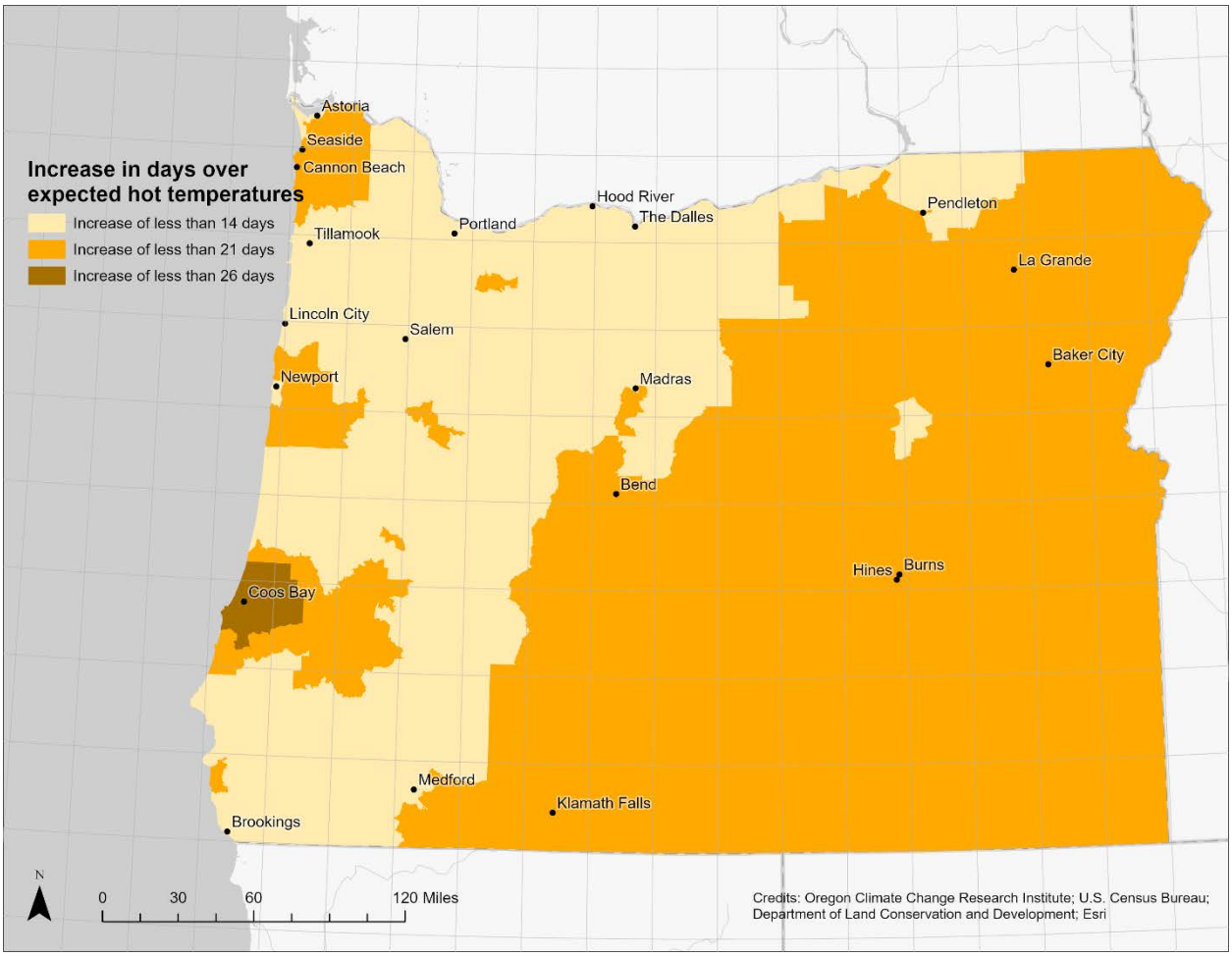
Hazard	Indicator Name	Direction	Weight	Short Description
Heat	Over90th	1	0.143	Mean days that are above the historic 90th percentile temp
Heat	Over90F	1	0.143	Mean days above 90 degrees Fahrenheit
Heat	Heat_Events	1	0.143	Number of heat events.
Heat	Heat_ALAG	1	0.143	Annualized loss to agriculture from heat.
Heat	Heat_ALPOP	1	0.143	Annualized loss to population from heat.
Heat	OutdoorJobs	1	0.143	Rate of jobs that occur outside.
Heat	TreeCan_avg	-1	0.143	Tree canopy density

Figure 3.3.4-6: Change in Days with Temperatures above 90°F: Change from 1981-2010 to 2045-2054 in mean number of days per year that temperatures equal or exceed 90°F.



Source: Derived from 52 ensemble members of 11 LOCA2 downscaled global climate models. Data provided by OCCRI, 2025. Graphic produced by DLCD.

Figure 3.3.4-7: Change in Days with Temperatures above Local 90th Percentile: Change in number of days per year in 2045-2054 that equal or exceed local 1981-2010 90th percentile temperature.



Source: Derived from 52 ensemble members of 11 LOCA2 downscaled global climate models. Data provided by OCCRI, 2025. Graphic produced by DLCD.

3.3.5 Floods

Floods are a common and widespread natural hazard in Oregon; the state has an extensive history of flooding. Across Oregon, flooding typically results from large-scale weather systems that generate prolonged rainfall or rain-on-snow events that result in large amounts of runoff. East of the Cascades, the largest floods are the result of heavy winter rains accompanied by snowmelt on frozen ground (USGS 1983, https://pubs.usgs.gov/wri/1982/4078/report.pdf); however, highly dangerous floods, such as the flash flood that occurred in Heppner in June 1903, can be produced by intense, localized thunderstorms. Other sources of flooding include channel migration, sediment accumulation, high tides, tsunamis, widespread vegetation removal, ice or debris jams, and, much less frequently, dam failures.

The National Flood Insurance Program (NFIP) identifies 260 communities in Oregon as flood-prone including locations in all 36 counties, 222 cities, and two Tribal Nations. Every county and all but two of these flood-

prone cities participates in the NFIP, allowing residents to purchase NFIP flood insurance. Nine additional cities for which FEMA has not mapped Special Flood Hazard Areas also belong to the NFIP, indicating that they believe a flood hazard exists within their jurisdiction and that their residents should have access to NFIP flood insurance.

3.3.5.1 Analysis and Characterization

History of Flooding in Oregon

Oregon has an extensive history of flooding, summarized in Table 3.3.5-2: Historic Damaging Floods in Oregon. The deadliest recorded flood in Oregon's history occurred in Morrow County in June 1903 when a thunderstorm dropped 1.5 inches of rain and hail within a twenty-minute period along Willow Creek, upstream of the town of Heppner. Within minutes, a wall of water five-foot tall and about 500 feet wide, silt, and debris poured through Heppner lifting homes off foundations (Murphy, 1904, https://pubs.usgs.gov/wsp/0096/report.pdf). These floodwaters claimed 247 lives.

The Columbia River floods in May and June of 1948 are best remembered for destroying the entire city of Vanport (now Delta Park) on Memorial Day. Record flow levels on the Columbia River, caused by high winter rainfall and rapid melt of an above average snowpack, triggered the structural failure of a railroad embankment (Rantz 1949, https://pubs.usgs.gov/wsp/1080/report.pdf). Much of Vanport was destroyed in minutes and was never rebuilt. Nearly 19,000 people lost their homes and at least 18 people lost their lives.

The flood of record for many of Oregon's rivers took place in December 1964 and January 1965 during the "Christmas Flood." During this time, there were a series of atmospheric river-driven storms that affected much of the western United States; flooding was caused by snow melt and heavy rainfall on frozen ground (Waananen 1971, https://pubs.usgs.gov/wsp/1866a/report.pdf and USGS 2014, https://www.usgs.gov/news/featured-story/christmas-flood-1964). In Oregon, damages from these floods cost over $157 million and 20 Oregonians lost their lives. The storm that occurred from December 20th through 24th, 1964 produced two-thirds the normal annual rainfall in only five days. The ensuing floods and channel migration destroyed hundreds of homes and businesses, forced the evacuation of thousands of people, destroyed at least 30 bridges, and washed out hundreds of miles of roads and highways.

In February 1996 and January of 1997, another series of devastating floods occurred across the West Coast and in Oregon (NOAA https://www.cnrfc.noaa.gov/storm_summaries/jan1997storms.php). Following an extended period of unseasonably cold weather and heavy snowfall in the Pacific Northwest, warming temperatures and rain began thawing the snowpack and frozen rivers throughout Oregon. On February 6, a strong atmospheric river, called a "Pineapple Express," reached Oregon. This warm, humid air mass brought record rainfall amounts, quickly melting the snowpack. At least twenty-five rivers reached flood stage. Many reached flood levels comparable to those reached in the 1964 flood. Twenty-seven of Oregon's 36 counties were included in the Presidential major disaster declaration due to this event. Statewide, the damage totaled over $280 million. An illustration of the relationship between precipitation and stream flow during the 1996-1997 floods and other flood events can be

found in a Story Map produced by Hoch 2023 for the National Weather Service (https://storymaps.arcgis.com/stories/a633588248144b8d85859c5c14d1916c).

Between February 5th and 9th, 2020, another atmospheric river brought heavy precipitation to eastern Oregon which fell on top of a normal mountain snowpack (15-30+ inches). The heavy rain combined with snowmelt runoff resulted in widespread flooding, record breaking river discharges, heavy flood and channel migration damages, and a federally declared disaster for Umatilla, Union and Wallowa counties. One fatality occurred; Interstate 84 was closed for multiple miles; three bridges were completely washed out; and many homes, businesses, levees, utility systems, and irrigation canals were heavily damaged. The Oregon Office of Emergency Management estimated that Preliminary Damage Assessment public assistance costs were $26.7 million and an additional $17.4 million dollars in emergency relief funding was requested from the Federal Highway Administration (Stoelb, 2020).

Types of Flooding

Riverine Floods: Riverine flooding is the most common flood hazard in Oregon. It is caused by the passage of a larger quantity of water than can be contained within the normal stream channel. The increased stream flow is usually caused by heavy rainfall over a period of several days. Examples of riverine events are the flooding in February 1996, and December 1964 to January 1965. The most severe flooding conditions occur when heavy rainfall is augmented by rapid snowmelt. These rain-on-snow events occur on mountain slopes within the low elevation snow zones of the Pacific Northwest. These events make more water available for runoff than does precipitation alone by melting the snowpack (Van Heeswijk, Kimball, & Marks, 1996). If the ground is frozen, stream flow can be increased even more by the inability of the soil to absorb additional water. Rain falling on snow also is a major cause of mid-winter avalanches, which tend to coincide with flood events. Significant rain-on-snow events occur in years that are colder and wetter than normal because snow accumulates at lower elevations and then is melted off during subsequent rain events (Ferguson, 2000). Rain-on-snow events, including those that occurred in 1861, 1943, 1964, 1977, and 1996 (Table 3.3.5-2), are associated with some of the State's most damaging floods.

Freshet Floods: While riverine flooding in Oregon is typically associated with winter moisture from Atmospheric Rivers on heavy snowpack, Springtime flooding from melting snow also poses a flood thread for some basins in Oregon. A freshet is a flood of a river from large volume of melted snow. For example, every spring, the stored water in the Columbia River snowpack melts and flows downstream and affects Oregon communities. In the Willamette basin, this freshet threat is less because of frequent cycles of melt and accumulation that occurs over the winter months. Some small basins in Eastern Oregon can accumulate enough snow in the winter months to pose a threat of freshet flooding in the spring melt season. On the Columbia, freshet flooding has been most significant during the month of June in 1894, 1933, 1948, and 1956. The USGS gage at Vancouver, WA registered water levels above 26 ft for these years. The last high freshet experienced on the Columbia was in 2017 where the Vancouver gage measured 17.6 ft.

Flash floods: Flash flooding is caused by extremely intense rainfall over a short period of time, commonly within a single drainage. Flash floods usually occur in the summer during the thunderstorm season. The two key contributors to flash flooding are rainfall intensity and duration.

Topography, soil conditions, and ground cover also impact flooding. Flash floods, because of their intensity, often pick up large loads of sediment and other solid materials. In these situations, a flash flood may arrive as a fast-moving wall of debris, mud, and water.

Occasionally, floating debris or ice accumulates at a natural or man-made obstruction and restrict the flow of water. Water held back by the ice jam or debris dam can cause flooding upstream. Subsequent flash flooding can occur downstream if the obstruction suddenly releases. Areas subject to flash floods are not as obvious as a typical riverine floodplain. However, flash floods may be associated with recognizable locations such as canyons or arroyos. There is also always some potential for flash floods associated with dam failure.

The most notorious flash flood in Oregon was the June 1903 flood in Heppner which was previously summarized. More recent flash floods have occurred in Wallowa County in July 2002 and the City of Rufus in August 2003.

Alluvial fan flooding: 44 CFR Part 59.1 defines alluvial fan flooding as flooding occurring on the surface of an alluvial fan. Alluvial fans are fan-shaped deposits of water-transported material (alluvium) that typically form at the base of steep topographic features where there is a marked break in slope. FEMA notes that alluvial fans can make attractive, but dangerous, development sites. Attractive because they provide commanding views and good drainage, but dangerous because flood flows can happen quickly over unpredictable flow paths, at high velocity, and carry large amounts of debris (Federal Emergency Management Agency [FEMA], 1989). The potential for this type of flooding in Oregon is unstudied and past events (if any) have been poorly documented.

Coastal floods: Coastal areas have additional flood hazards. Winds generated by tropical storms or intense offshore low-pressure systems can drive ocean water inland and cause significant flooding. The height of storm surge is dependent on the wind velocity, water depth and the length of open water (the fetch) over which the wind is flowing. Storm surges are also affected by the shape of the coastline and by the height of tides. If King Tides are present during storm surges, there may be a higher likelihood of flooding.

Coastal flooding also may result from tsunamis. A tsunami is a series of traveling ocean waves generated by an earthquake or landslide that occurs below or on the ocean floor. Oregon's seven coastal counties and many coastal cities are susceptible to flood damage associated with tsunamis. Both "distant" tsunamis generated from seismic events in the Pacific basin and "near shore" tsunamis generated from activity associated with the Cascadia Subduction Zone can impact Oregon's coast. For more information, see the Tsunami chapter of this Plan.

Shallow area flooding: Some areas are characterized by FEMA as being subject to shallow flooding. These are areas that are predicted to be inundated by the 100-year flood with flood depths of one to three feet. Flooding events are expected to be low velocity events characterized by "sheet flows" of water.

Urban flooding: As land is converted from fields or woodlands to roads, roofs, and parking lots, it loses its ability to absorb rainfall. This transition from pervious surfaces to impervious surfaces results in more and faster runoff of water. During periods of urban flooding, streets can become

swift moving rivers, and basements can fill with water. Storm drains may back up with yard waste, causing additional nuisance flooding.

Playa flooding: Playa flooding results from greater than normal runoff into a closed basin. Closed basin systems are those areas that have one or more rivers emptying into one or more lakes that have no outlet. In these situations, water can only leave the system through evaporation. Thus, if annual precipitation in the basin increases significantly, evaporation is not enough to reduce water levels. Lake levels rise and inundate the surrounding properties.

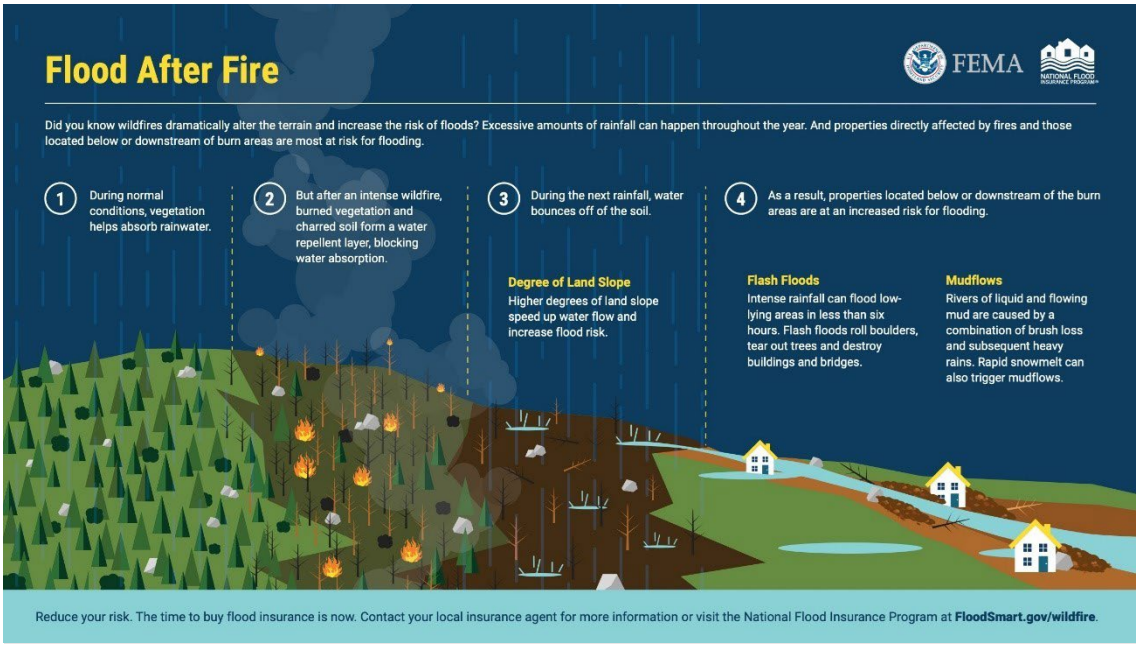
The best-known example of playa basin flooding in Oregon occurs at Malheur and Harney lakes in Harney County. During years with greater than average precipitation, the lakes flood adjacent ranches and public roads. Malheur and Harney lakes flooded during the years 1979 to 1986, and then gradually receded. During the wetter years of 1997 to 1999, these lakes again flooded. By 2005, following several dry years, they had receded significantly. In spring 2011, as a result of a heavy snowpack and persistent rainfall, Harney Lake's water level increased significantly with flooding observed in low-lying areas.

Ice jams: Ice jams happen in colder regions of the State during winter and early spring while rivers are frozen. Sudden warming at higher altitudes melts snow resulting in increased runoff which breaks the ice from reaches of frozen river below. On the way downstream, the floating ice can "jam" in a narrow reach of the drainage or against a road crossing which then dams melting water. As the ice weakens, water breaches the dam releasing a torrent of water.

Dam and levee failure: Dam and levee failures and accidents, though rare, can result in extreme flooding downstream of the dam or in the area behind the levee. Beyond the levee failure previously described in the 1948 Vanport flood, catastrophic dam failures have occurred in other parts of the country and around the world. The South Fork Dam failure (1889 Johnstown flood) resulted in over 2000 fatalities in western Pennsylvania. The Saint Francis Dam in southern California failed in 1928 with a loss of an estimated 600 people. Oregon's dam safety statutes (ORS 540.350 through 400) came into effect shortly after the Saint Francis disaster. Many historical dam failures were triggered by flood events, others by poor dam construction, and some have been triggered by earthquakes. Please review the dam safety chapter and information available through FEMA and the US Army Corps of Engineers for more information.

Flood after Wildfire: Wildfires dramatically change the landscape and ground conditions, which can lead to a higher risk of flooding. When a wildfire burns a portion of a watershed, the resulting burn scar increases the potential for flooding until vegetation is re-established and ecosystems recover. Natural, unburned vegetation and soil normally act as a sponge during a rainfall event. However, the heat from a fire can bake the ground creating a surface that will not absorb water and can increase the speed with which water flows off the slope. When a wildfire compromises or eliminates these normal protective functions, the potential for significant flooding and debris flows increases. FEMA provides this infographic that summarizes this phenomenon (Figure 3.3.5-1):

Figure 3.3.5-1: Wildfires impact flooding in various ways



Source: https://community.fema.gov/PreparednessConnect/s/article/When-Disaster-Strikes-Twice-Flood-after-Fire
Note: FEMA has produced informational graphics to explain some of these (FEMA, 2022).

Because of changed soil conditions and removal of vegetation cover, chances of flash floods increase dramatically on a wildfire impacted basin. Areas of Eastern Oregon, where wildfires and flash floods are common are particularly vulnerable to this hazard.

The likelihood of flooding can depend on the terrain, how much time the ground has had to heal, vegetation regrowth and the severity of the fire on the landscape. These floodwaters typically transport surface debris such as downed trees and gravel, but still behave like water or in some cases mudflow. As water runs downhill through burned areas, it can create major erosion and pick up large amounts of ash, rocks, boulders, and burned trees, generating a debris flow (also commonly termed “mudflow”). Fast-moving, highly destructive debris flows are one of the most dangerous post-fire hazards, since they occur with little warning. High rainfall rates are the trigger for debris flows, rather than the total amount of rain. Their mass and speed make them particularly destructive. Debris flows can strip vegetation, block drainages, damage structures, and endanger human life. The force of the rushing water and debris can threaten life and property miles away from the burned area. Survivors of debris flows describe sounds of cracking, breaking, roaring, or a freight train.

Wildfire recovery is dependent on many factors including soil conditions, vegetation makeup, stability of slopes, weather, and burn severity on the impacted landscape. Ecosystem resilience is highly variable across landscapes and not fully understood. Certainly, the need to know the period of increased impacts caused by wildfires is important, but the variability and lack of data make it difficult to predict. In Oregon, areas of western Cascade burns have seen lingering effects from

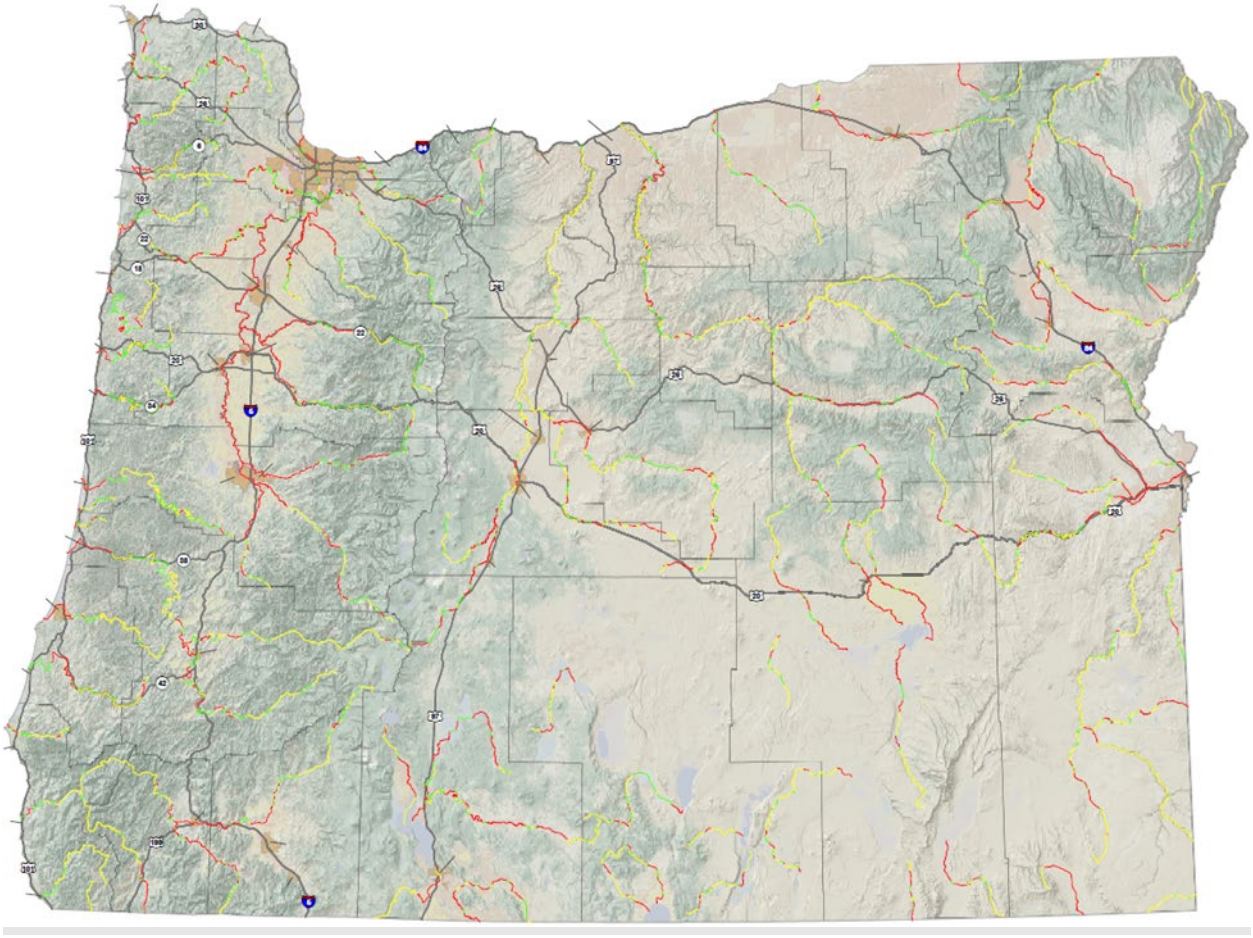
wildfires as trees that died during the wildfire or since are decomposing and destabilizing slopes. Eagle Creek, for example, has seen an uptick in the amount and extent of debris flows in the 5-7 since the Columbia Gorge wildfires. This is a particularly poignant point for those watersheds affected by the devastating 2020 wildfires. In general, Oregon can expect wildfires to affect watersheds for decades following a burn, but the actual recovery is highly dependent site conditions. Based upon floodplain management outreach efforts after the devastating 2020 wildfires in Oregon, approximately 650 structures were reported to be substantially damaged within the Special Flood Hazard Area in Oregon.

Channel Migration in Association with Flooding: Channel migration is the process by which streams move laterally over time. It can be a gradual phenomenon that takes place over many years due to natural processes of erosion and deposition, but in some cases, usually associated with flood events, significant channel migration can happen rapidly. This process is particularly common on rivers with high sediment loads from upstream sources. Depending on the local stream conditions, the river may also avulse—a process in which the river rapidly shifts to occupy a completely new channel. Channel migration susceptibility is determined by the local bed and bank geology, stream discharge and power, available sediment supply, riparian vegetation, presence of large woody debris, channel slope and confinement, human structures and alterations, and other watershed characteristics.

Channel migration can and has created hazardous conditions within Oregon's developed riparian areas. Rapid migration can undercut structure foundations and damage infrastructure. The upper Sandy River in eastern Clackamas County is an example of where high sediment loads, channel migration, and development intersect. A recent January 2011 flood resulted in temporary avulsion that washed out section of Lolo Pass Road and in bank erosion that damaged and destroyed several homes. The flooding in Umatilla County during February 2020 also resulted in widespread erosion damage and caused the river to migrate hundreds of feet very rapidly. Channel migration along the Umatilla River and other streams washed out roads, undermined homes and structures, and destroyed several bridges.

Channel migration is not a standard consideration of the NFIP and has not been mapped systematically in Oregon. DOGAMI has recently completed a statewide channel migration screening for major rivers in Oregon (Roberts & Anthony, 2017). This study classified nearly 7,000 river miles into high, medium, and low potential susceptibility to channel migration based on river and valley characteristics. DOGAMI selected and is currently mapping detailed channel migration zones in four counties in Oregon based on the results of the 2017 screening. The screening will continue to be used to prioritize future detailed channel migration zone mapping as funding becomes available. In 2024, a new group formed through the Northwest Regional Floodplain Management Association which brings together interested city, county, state and federal entities interested in CMZ in Oregon and Washington.

Figure 3.3.5-2: Channel migration screening overview map of Oregon showing major rivers with low (yellow), moderate (green), and high (red) susceptibility.



Source: Roberts & Anthony (2017)

Repetitive Loss and Severe Repetitive Loss:

Oregon currently has 425 repetitive loss (RL) or severe repetitive loss (SRL) structures listed in the state. DOGAMI obtained a combined list of repetitive and severe repetitive loss properties summary report from FEMA. Beginning October 2019, PIVOT became the NFIP's new system of record replacing the BureauNet System. The summary list provided by FEMA does not include addresses or property owner names. However, the list does include data such as community name, county location, zip code, NFIP insured, post or pre firm, dates of losses, occupancy type (single family or non-residential), and many other characteristics that can be used for analysis or to assist in identifying mitigation opportunities at the local level.

Definition: Repetitive loss structure means a structure covered under an NFIP flood insurance policy that (1) has incurred flood-related damage on two occasions, in which the cost of repair, on average, equaled or exceeded 25 percent of the value of the structure at the time of each such

flood event; and (2) at the time of the second incidence of flood-related damage, the contract for flood insurance contains increased cost of compliance coverage (44 CFR § 77.2 Definitions).

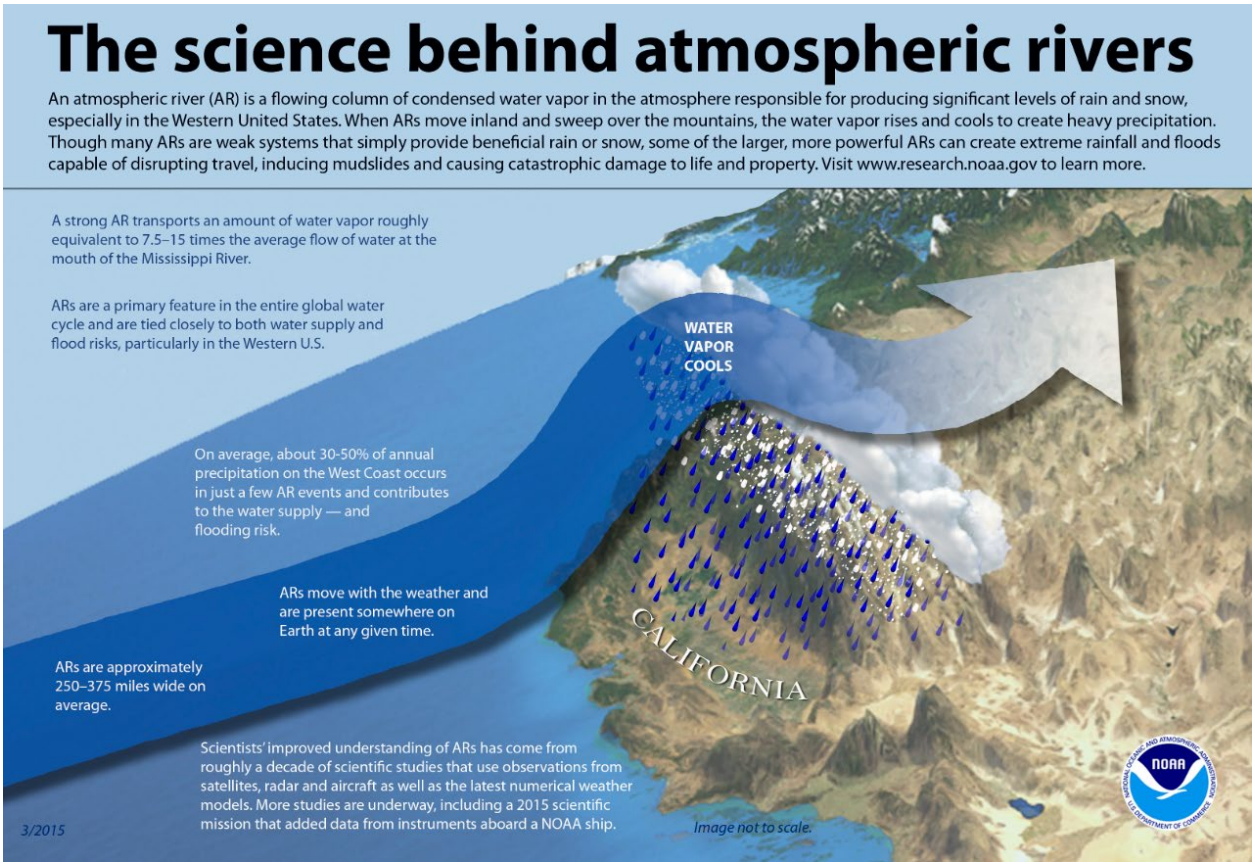
Definition: Severe repetitive loss structure means a structure covered under an NFIP flood insurance policy and has incurred flood-related damage (1) for which four or more separate claims have been made under flood insurance coverage, with the amount of each claim (including building and contents payments) exceeding $5,000 and with the cumulative amount of such claims payments exceeding $20,000; or (2) for which at least two separate flood insurance claims payments (building payments only) have been made, with the cumulative amount of such claims exceeding the value of the insured structure (44 CFR § 77.2 Definitions).

Beyond identifying vulnerable buildings, the RL and SRL list provided by FEMA has value for hazard mitigation planning because the locations of these properties may indicate areas of persistent or repetitive flood or drainage problems. The State will continue to encourage owners of RL and SRL properties to participate in mitigation programs and FEMA's mitigation grants. The following are additional considerations for mitigating these RL/SRL properties:

- Verification of the RL and SRL list should be completed by staff at the local level to ensure its accuracy and whether the subject property is verified as a repetitive loss property or if it has been mitigated or removed (demolished) as a basis for researching and selecting funding for future hazard mitigation projects.
- Local community (city or county) staff are encouraged to work directly with FEMA staff to obtain their local RL/SRL list. FEMA updated their sharing policy on data that includes personally identifiable information in 2023. Additional information on FEMA's policy: Information Sharing Access Agreements | FEMA.gov
- A strategy for mitigating these repetitive properties should include projects that are geographically balanced across the state; communities with approved local hazard mitigation plans; targeted buyouts in regions with high occurrence of repeat damage where critical salmonid habitats are present; and implementing restoration projects that support sustainable land and water use practices benefiting both human communities and salmonid populations.

Atmospheric Rivers: Atmospheric Rivers (ARs) are a key source of flooding in Oregon and are common along the West Coast. During the Winter, long narrow bands of moisture are generated from warm tropical areas of the Pacific. Driven by Pacific Storms, these bands of water vapor release large amounts of rainfall when they interact with coastal topography. (Scripps Oceanography, 2020; https://www.youtube.com/watch?v=NULrvr8pTBg). The Willamette Flood of 1861, Christmas Flood of 1964, and the Great Flood of 1996 (the top three floods in Oregon's recorded history) were all produced by atmospheric rivers. Since these floods are driven by moisture from the Pacific, the threat of Atmospheric River is more pronounced for Western and Southwestern Oregon Communities.

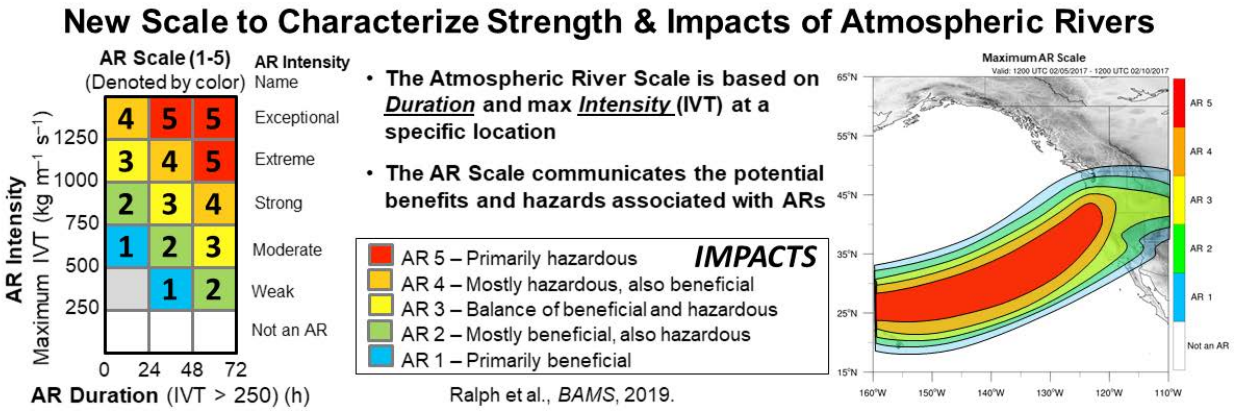
Figure 3.3.5-3: Infographic of the science behind atmospheric rivers



Source: NOAA

Climatological Characteristics of Atmospheric Rivers and Their Inland Penetration over the Western United States https://cw3e.ucsd.edu/wp-content/uploads/2014/05/Rutz_etal_2014_MWR.pdf .The Center for Western Weather and Weather Extremes (CWWWE) (https://cw3e.ucsd.edu/) has been researching Atmospheric Rivers in an effort to enhance existing forecasts for flooding. Using the duration of atmospheric impacts and the intensity of the available water vapor, the CWWWE has developed a categorization model for atmospheric rivers ranging from AR1 to AR5. The following figure summarizes this categorization developed by the CWWWE (Figure 3.3.5-4).

Figure 3.3.5-4: By using a categorization system, forecasts can be enhanced to contextualize the threat of flooding during the Winter Months when ARs are common



Source: Center for Western Weather and Water Extremes (https://cw3e.ucsd.edu/)

Using the grading of ARs (from 1 to 5) in addition to forecasts from the Weather Service, dam safety practitioners and communities can get a better sense of potential flood impacts and the severity of storms approaching the western coast. In addition, because the models used by the CWWWE are linked to water vapor, alerts of advanced warning can be sent ahead of official forecasts. The CWWWE have created automated alert systems that can be useful, during the winter, to stay appraised of weather conditions that might result in flooding.

El Niño and La Niña Events in Oregon and Relationship to Flooding

One of the most prominent aspects of Oregon's weather and climate is its variability. This variability ranges over many time and space scales, from small-scale phenomena such as wind gusts and localized thunderstorms to larger-scale features like fronts and storms, to even more prolonged features such as droughts and periods of flooding. Fluctuations occur on multi-seasonal, multi-year, multi-decade and even multi-century time scales. Examples of these longer time-scale fluctuations include an abnormally hot and dry summer, an abnormally cold and snowy winter, a consecutive series of abnormally mild or exceptionally severe winters, and even a mild winter followed by a severe winter. Human inputs into the geophysical environment are also imposing cumulative impacts with measurable changes to global climate, sea-level and even localized weather. These human inputs along with the normal climate cycles may be working together in unpredictable ways and lead to future climate scenarios that do not resemble past, historic cycles. Under a warming climate, while it is still uncertain exactly how ENSO variability may change, recent research is more confident that the relationships between ENSO and its impacts around the globe will be stronger.

The El Niño Southern Oscillation (ENSO) Cycle

El Niño and La Niña are opposite phases of what is known as the El Niño-Southern Oscillation (ENSO) cycle. The ENSO cycle is a scientific term that describes the fluctuations in temperature between the ocean and atmosphere in the east-central Equatorial Pacific.

La Niña is sometimes referred to as the cold phase of ENSO and El Niño as the warm phase of ENSO. These deviations from normal surface temperatures can have large-scale impacts not only on ocean processes, but also on global weather and climate.

El Niño and La Niña episodes typically last nine to 12 months, but some prolonged events may last for years. They often begin to form between June and August, reach peak strength between December and April, and then decay between May and July of the following year.

While their periodicity can be quite irregular, El Niño and La Niña events occur about every 3 to 5 years. Typically, El Niño occurs more frequently than La Niña.

The terms El Niño and La Niña represent opposite extremes of the ENSO cycle in an otherwise continuum of global climate events, with "average" conditions generally prevailing between those extremes. In the past three decades there have been several El Niños, with the 1982 to 1983 and 1997 to 1998 events having been the strongest on record, while the period between 1990 and 1995 was characterized by persistent El Niño conditions, the longest on record (Trenberth, 1999).

Table 3.3.5-1: Recent ENSO Events in Oregon

El Niño Events	La Niña Events
1982-1983	1988-1989
1994-1995	1995-1996
1997-1998	1999-2000
2002-2003	
2004-2005	
2006-2007	2007-2009
2009-2010	2010-2012
2014-2016	2016-2017
	2017-2018
2018-2019	2020-2023
2023-2024	

Source: NOAA, Multivariate ENSO Index (MEI) http://www.esrl.noaa.gov/psd/enso/mei/ and https://origin.cpc.ncep.noaa.gov/products/analysis_monitoring/ensostuff/ONI_v5.php

In general, the longer time-scale phenomena are associated with changes in oceanic and atmospheric circulation that encompass areas far larger than a particular affected region. At times, these persistent features occur simultaneously over vast, and seemingly unrelated, parts of the hemisphere, or even the globe, resulting in abnormal weather, temperature, and rainfall patterns throughout the world. During the past several decades, scientists have discovered that important

aspects of this interannual variability in global weather patterns are linked to a global-scale, naturally occurring phenomenon known as the El Niño Southern Oscillation (ENSO) cycle. A measure of this cycle is the Southern Oscillation Index (SOI), which is "calculated from the monthly or seasonal fluctuations in the air pressure difference between Tahiti and Darwin, Australia."

Historical El Niño and La Niña events in Oregon

The earliest systematic study of ENSO in the Northwest was by Redmond and Koch (1991). The results were sufficiently strong that the authors suggested a cause-effect relationship between the SOI and Oregon weather. They determined that the Southern Oscillation Index (SOI) can be used as a predictor for weather, especially for winter weather. Greatest correlations between SOI and winter weather patterns occur with about a four-month time lag with summer average SOI correlating well with weather in the Northwest during the following winter. SOI values less than zero represent El Niño conditions, near zero values are average, and positive values represent La Niña conditions.

In Oregon El Niño impacts associated with these climate features generally include warmer winter temperatures and reduced precipitation with drought conditions in extreme events.

What Oregonians should especially plan for and monitor, however, is La Niña. Severe flooding during the winters of 1995-96, 1998-99, and 2007-08 are attributable largely to the combination of heavy snows and warm, intense tropical rains. During La Niña events, heavy rain arrives in Oregon from the western tropical Pacific, where ocean temperatures are well above normal, causing greater evaporation, more extensive clouds, and a greater push of clouds across the Pacific toward Oregon. During February 1996, for example, severe flooding — the worst in the state since 1964 — killed several people and caused widespread property damage. Nearly every river in Oregon reached or exceeded flood stage, some setting all-time records. Debris flows and landslides were also numerous. (Note that debris flow events are typically associated with periods of heavy rainfall or rapid snowmelt on steeply sloping ground. The term "mudslide" is often used interchangeably but is poorly defined as a natural hazard. FEMA uses the terms "mudslide" and "mudflow" in the context of the National Flood Insurance Program, e.g., 44 CFR 59.1 and 206.2(a)(17).)

3.3.5.2 Future Conditions

Across the Pacific Northwest, overall warmer temperatures due to climate change are expected to result in greater winter runoff and streamflow. As more precipitation falls as rain and less as snow, the snow melt is expected to begin earlier in the year, and summer flows are predicted to be lower as a result of less seasonal precipitation (Dalton and others, 2022). Snow-dominated watersheds, those where snowmelt is a primary source of water, will experiencing shifts towards more rain and less snow due to climate change, potentially leading them to become rainfall-dominated systems. Unregulated streams are more likely to display the effects of climate change on discharge, since large dams operated to reduce flood risk often regulate discharges all year long and reduce peak flood flows.

According to Fleishman and the Oregon Climate Change Research Institute (OCCRI) (2023), thus far, Oregon's annual average temperature has increased by approximately 2.2 °F (1.1°C) per century since 1895, and, without significant reductions in greenhouse gas emissions, the annual temperature is projected to increase by 5°F (1.8°C) by the 2050s and 8.2°F (4.5°C) by the 2080s. Although Oregon has seen a statistically

significant increase in temperature, there is no evidence yet of a change in the total precipitation across the state (Fleishman and OCCRI, 2023). However, this may be explained by substantial natural variability and relatively short periods of observation.

A literature review by the USACE (2022) completed in 2015 found strong evidence of decreasing trends in the Pacific Northwest region's annual streamflow, particularly in the spring and summer flows, and a decrease in the region's April 1st snow-water equivalent for the latter half of the 20th century. These patterns were broadly attributed to increasing temperature trends. Similarly, since the mid- to late 1900s, 20 of Oregon's glaciers have disappeared, and nearly all of Oregon has experienced an increased frequency and severity of drought conditions over the last 20 years (Fleishman and OCCRI, 2023).

Historically, atmospheric rivers impact Oregon rivers during winter months, from November to February. In recent years, atmospheric rivers have impacted the west coast later in the season. For example, a particularly strong atmospheric river impacted rivers in Oregon during early April of 2019. In 2021, a strong atmospheric river impacted Oregon as late as June. The system of water management in Oregon is designed based on winter flooding, therefore reservoirs start to fill beginning in March. Loss of this storage volume to meet water conservation needs means that late season atmospheric rivers can have a proportionately greater impact on river levels. These trends are not fully understood but are becoming more common and problematic for traditional flood risk management systems.

3.3.5.3 Historic Flood Events

Table 3.3.5-2 lists historic damaging floods in Oregon.

Table 3.3.5-2: Historic Damaging Floods in Oregon

Date	Location	Notes
Sep. 1861	Klamath, Willamette, and Umpqua	Klamath, Douglas, Lane, Linn, Benton, Marion, Polk, Yamhill, Clackamas, Multnomah Counties
June 1880	Columbia	Clatsop, Columbia, Multnomah, Hood River, Sherman, Gilliam, Morrow
Jan. 1881	Willamette Basin	Lane, Linn, Benton, Marion, Polk, Yamhill, Clackamas, Multnomah Counties
Dec. 1882	Umatilla	Umatilla County
June 1884	John Day	Grant, Wheeler, Wasco, Sherman Gilliam
May-June 1894	Columbia River Basin	Clatsop, Columbia, Multnomah, Hood River, Sherman, Gilliam, Morrow; rain on snowpack; highest flood stage ever recorded at Vancouver, Washington (33.6 ft)
June 1903	Willow Creek	flash flood in Heppner; 247 people killed
Apr. 1904	Silvies and Klamath	Harney, Klamath Counties
Feb. 1907	western Oregon and John Day	Grant, Wheeler, Wasco, Sherman, Gilliam
Nov. 1909	Deschutes, Willamette, Santiam, Umpqua, Coquille, and Rogue	Deschutes, Jefferson, Wasco, Linn, Douglas, Coos, Curry, Josephine, Jackson

Date	Location	Notes
Mar. 1910	Powder and Malheur	Baker, Malheur, Harney
June 1913	Columbia	Clatsop, Columbia, Multnomah, Hood River, Sherman, Gilliam, Morrow
Jan. 1923	Clackamas, Santiam, Sandy, Deschutes, Hood, and McKenzie	Clackamas, Linn, Multnomah, Deschutes, Jefferson, Wasco, Hood River, Lane Counties; record flood levels
Feb. 1925	Malheur	Malheur, Harney
Feb. 1927	Klamath, Willamette, Umpqua, Rogue, and Illinois	major flooding
May 1928	Columbia	Clatsop, Columbia, Multnomah, Hood River, Sherman, Gilliam, Morrow
Mar. 1931	Umatilla, Sandy, Clackamas, and Santiam	Umatilla, Clackamas, Multnomah, Linn
Mar. 1932	Malheur, Grande Ronde, John Day, and Umpqua	Malheur, Harney, Union, Wallowa, Grant, Wheeler, Wasco, Sherman, Gilliam, Douglas
Jan. 1933	Coquille	Coos County
Nov.–Dec. 1942	Willamette Basin	Lane, Linn, Benton, Clackamas, Multnomah; 10 deaths; $34 million damage
Dec. 1945	Coquille, Santiam, Rogue, and McKenzie	Coos, Linn, Jackson, Josephine, Curry and Lane Counties; 9 deaths and homes destroyed in Eugene area
Dec. 1946	Willamette, Clackamas, Luckiamute, and Santiam	
May - June 1948	Columbia River	Multnomah County, Wasco County; rain on snow; destruction of the City of Vanport
Mar. 1952	Malheur, Grand Ronde, and John Day	Malheur, Harney, Union, Wallowa, Grant, Wheeler, Wasco, Sherman, Gilliam counties; highest flood stages on these rivers in 40 years
Dec. 1955	Rogue, Umpqua, Coquille	DR-49. Jackson, Josephine, Curry, Douglas, Coos Counties; 11 deaths; major property damage
July 1956	central Oregon	DR-60. City of Mount Vernon, Grant County and City of Mitchell, Wheeler County; flash floods
Feb. 1957	SE Oregon	DR-69. $ Malheur, Baker, Wallowa Counties; 3.2 million in flood damages
Dec. 1961	Willamette Basin	Lane, Linn, Benton, Clackamas, Multnomah; $3.8 million in flood damages
Dec. 1964–Jan. 1965	Pacific Northwest	DR-184. All 36 counties; rain on snow; record flood on many rivers
Dec. 1967	central Oregon coast	Clatsop, Tillamook, Lincoln Counties; storm surge
Feb 1971	north coast	DR-301. Clatsop and Tillamook counties

Date	Location	Notes
Jan. 1972	western Oregon	DR-319. Clackamas, Clatsop, Coos, Douglas, Lane, Lincoln, Linn, Multnomah, Tillamook, Washington counties; record flows on coastal rivers
Jan. 1974	western Oregon	DR-413. Benton, Clackamas, Columbia, Coos, Curry, Douglas, Gilliam, Hood River, Jackson, Josephine, Lane, Lincoln, Marion, Polk, Tillamook, Wallowa, Wasco, Washington, Yamhill counties; $65 million in damages
Nov. –Dec. 1977	western Oregon	Multnomah, Clackamas counties; rain-on-snow event; $16.5 million in damages
1979 to present	Harney County	cyclical playa flooding on Harney and Malheur lakes
Dec. 1981	Umpqua and Coquille	Douglas and Coos Counties
Jan. 1982	Tillamook County	
Feb. 1982	Malheur and Owyhee Basins	Malheur and Harney Counties
Jan. 1990	Clatsop and Tillamook Counties	DR-853
July 1995	Fifteenmile Creek	DR-1061. Flash flood in Wasco County.
Feb. 1996	nearly statewide	DR-1099. Benton, Clackamas, Clatsop, Columbia, Coos, Deschutes, Douglas, Gilliam, Hood River, Jefferson, Josephine, Lane, Lincoln, Linn, Marion, Morrow, Multnomah, Polk, Sherman, Tillamook, Umatilla, Union, Wallowa, Wasco, Washington, Yamhill counties; damages totaling over $280 million
Nov. 1996	SW Oregon	DR-1149. Flooding, landslides, and debris flows; eight deaths in Douglas, Coos, and Lane Counties
Jan. 1997	SW and NE Oregon	DR-1160. Coos, Jackson, Josephine, Baker, Grant, Wallowa, Gilliam, Morrow, Umatilla, Wheeler, and Lake Counties
May–June 1998	Crook County and Prineville	DR-1221. Ochoco River
Dec. 1998	Lincoln and Tillamook Counties	
Nov. 1999	Coastal rivers in Lincoln and Tillamook Counties	heavy rainfall and high tides
Jan. 2000	Curry, Douglas, and Josephine Counties	A Flood Warning was issued for the South fork of the Coquille River from Myrtle Point to Coquille City, North and South Forks of the Coquille River. Brookings recorded 4.72 inches of rain, a record for the date. Two Small Stream Flood Advisories were issued, the first for Elk Creek, the second for Deer Creek. A Flood Warning was issued for the lower Rogue River from Agness to Gold Beach.
Feb. 2000	Coos County	A Flood Warning was issued for the South Fork of the Coquille River at Myrtle Point
July 2000	Deschutes County	A slow-moving thunderstorm with heavy rain flooded the Becky Johnson Community Center and Health Clinic Campus.
Sept. 2000	Clackamas County	Heavy rain, estimated at 3 inches in places, plus glacial melt associated with abnormally warm temperatures, acted together

Date	Location	Notes
		to trigger floods and rock and mud slides on the western slopes of Mount Hood.
Apr. 2001	Wheeler	A slow-moving thunderstorm produced an estimated 1 inch of rain over mountainous terrain in southeastern Wheeler County.
June 2001	Grant County	The Oregon Dept. of Transportation reported flash flooding on State Highway 26
July 2001	Douglas, Deschutes, and Lake Counties	A Flash Flood Warning was issued for East-Central Douglas county. The Boulder Creek area was of special concern. A heavy slow-moving thunderstorm dumped one inch of rain in one hour over Sunriver. Lakeview Police reported rock and/or mudslides on State Highway 140 at mileposts 22, 23.2, and 25.1. They also reported 0.25-inch hail up to an inch deep and 2 feet of water in spots on the same highway.
June 2002	Baker and Malheur Counties	Slow-moving thunderstorms dropped very heavy rainfall over the Rye Valley area near the Baker-Malheur County line.
July 2002	Wallowa County	flash flood above Wallowa Lake damaged Boy Scout Camp facility
August 2003	City of Rufus, Sherman County	flash flood (Gerking Canyon)
Dec. 2005–Jan. 2006	western and central Oregon,	
Nov. 2006	Clatsop, Hood River, Lincoln, and Tillamook Counties	DR-1672. Heavy precipitation and wind resulted in flooding, landslides, and mudslides (DR-1672)
Feb. 2007	western and central Oregon, and the Confederated Tribes of the Siletz Indians	DR-1683. Benton, Clatsop, Columbia, Lincoln, Polk, Tillamook, Wasco, Wheeler, Yamhill counties; severe winter storm and flooding
Dec. 2007	Northwestern Oregon, Southern Coast	DR-1733. Clatsop, Columbia, Polk, Tillamook, Washington, Yamhill counties; heavy precipitation and wind resulted in flooding, landslides, mudslides, and tree blow down
Dec. 2008	Tillamook County	Flooding caused by convergence of heavy precipitation and high tides
Jan. 2009	Tillamook and Washington Counties	severe winter storm/snow event which included snow, high winds, freezing rain, ice, blizzard conditions, mudslides, and landslide (flooding, post DR-1824)
Jan. 2011	Clackamas, Clatsop, Crook, Douglas, Lincoln, and Tillamook Counties	DR-1956. Severe winter storm, flooding, mudslides, landslides, and debris flows
Apr. 2011	Harney County	widespread basin flooding; Oregon DOT closed and breached U.S. 20 at milepost 132.6 on April 8, 2011, for flood relief; the breach was done at the request of Harney County Emergency Operations Center to avoid damage to nearby residences; larger culverts were later installed
May – June 2011	Union and Grant Counties	melting heavy snowpack caused riverine and playa flooding
June 2011	Heppner	persistent showers with heavy rainfall of 1 to 2 inches produced flooding on Willow and Hinton Creeks; flash flooding on Hinton and Willow Creeks damaged roads, bridges, and the Morrow County Fairgrounds; the Heppner elementary school was evacuated as a precaution

Date	Location	Notes
Jan. 2012	Columbia, Hood River, Tillamook, Polk, Marion, Yamhill, Lincoln, Benton, Linn, Lane, Douglas, Coos, and Curry Counties	heavy rain and wind; ice (DR-4055); flooding in the Willamette Valley; 130 homes and seven businesses were damaged in the City of Turner; 21 streets were closed in the City of Salem; the state Motor Pool lost 150 vehicles and thousands of gallons of fuel; Thomas Creek in the City of Scio overtopped, damaging several buildings
Nov. 2012	Curry, Josephine, and Lane Counties	heavy precipitation; the Curry Coastal Pilot reported over 2 million dollars in infrastructure damage in Brookings and another 2 million in Curry County due to recent heavy rains; sinkholes and overflowing sewage facilities were also reported; according to KVAL news, Eugene Public Works has opened its emergency command center to deal with numerous flooding incidents, including two flooded intersections
Sep. 2013	Multnomah and Tillamook Counties	heavy rain resulted in flooding of the Wilson River near Tillamook as well as urban flooding in the Portland Metro area; KPTV-KPDX Broadcasting reported that heavy rain resulted in flooding and damage to the Legacy Good Samaritan Medical Center and several businesses in Northwest Portland; besides damage to the hospital's emergency and operating room, some elective surgeries were cancelled
Feb. 2014	Lane, Coos, Marion, and Tillamook Counties	A series of fronts resulted in a prolonged period of rain for Northwest Oregon, and minor flooding of several of the area's rivers from February 12th through February 17th. Heavy rains caused the Coquille River to flood at Coquille. The flood was categorized as a moderate flood. The Nehalem River near Foss in Tillamook County exceeded flood stage on February 18th, 2014.
Feb. 2014	Douglas County	In Jackson County heavy rains caused a brief flood on Little Butte Creek at Eagle Point.
March 2014	Tillamook County	Heavy rain resulted in the Nehalem River flooding near Foss. The river reached flood stage around 2 pm March 6, and crested at 14.8 feet at 8 pm
March 2014	Union, Umatilla, and Grant Counties	Heavy rain fell across much of the northern Blue Mountains and Wallowa County throughout the first week of March. March 9th received very heavy rain with snow levels around 6000 ft. This allowed for a significant increase in runoff, which led to a quick rise in rivers for the period
August 2014	Clackamas County	Heavy rain caused the Sandy River to rapidly rise. A footbridge near Ramona Falls broke loose sending a man into the turbulent waters. The man drowned in the river.
Dec. 2014	Tillamook, Lincoln, Lane, Polk Clackamas, Benton, Coos, and Douglas Counties	A slow-moving front produced heavy rain over Northwest Oregon which resulted in the flooding of eight rivers. The rain also caused a couple of landslides/rockslides that both blocked two highways. Heavy rain brought flooding to several rivers in southwest Oregon.
Feb. 2015	Curry, Coos, Douglas, Josephine, and Jackson Counties	Heavy rains caused flooding on the Rogue River at Agness and along the Coquille River at Coquille.
Nov. 2015	Tillamook County	A very moist frontal system produced heavy rain across the region resulting in flooding. Rain rates of 0.3 to 0.5 inches per hour were observed for several hours at many locations. The 5-day rainfall total

Date	Location	Notes
		ending in the morning on November 17th for Lees Camp, OR was 14.60 inches.
Dec. 2015	Tillamook, Lincoln, Washington, Clackamas, Multnomah, Lane, Yamhill, Clatsop, Columbia, Hood River, Polk, Coos, Douglas, Jackson, and Curry Counties	DR-4258. 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. Flooding from the Nehalem River and Rock Creek in Vernonia resulted in evacuation of homes and the implementation of the Vernonia Emergency Command Center. Heavy rain resulted in a landslide that closed OR-47 at mile marker 8. More than $15 million dollars in property damage reported in these counties combined.
Jan. 2016	Jackson, Josephine, Curry, and Coos Counties	Heavy rain brought flooding to some areas of southwest Oregon. Minor flooding on the Rogue at Agness and moderate flooding on the Coquille River at Coquille.
March 2016	Coos County	Heavy rains brought flooding to the Coquille River at Coquille
May 2016	Baker County	A strong thunderstorm dumped up to a quarter of an inch of rain over a 15-minute period over terrain scorched by wildfire in August of 2015 causing flash flooding and debris flows.
Oct. 2016	Tillamook County, Northern Oregon Coast	The combination of heavy rain, large swell, and high tides brought minor tidal overflow flooding during high tides to the North Oregon Coast.
Nov. 2016	Columbia, Tillamook, Lincoln, Benton, Washington, Polk, and Yamhill Counties	A moist Pacific front moving slowly across the area produced heavy rainfall, resulting in flooding of several rivers across Northwest Oregon and at least two landslides.
Dec. 2016	Josephine, Jackson, Douglas, Lane, Coos, and Curry Counties	DR-4296. Heavy rain brought some areal flooding to parts of southwest Oregon.
Jan. 2017	Columbia, Deschutes, Hood River, Josephine, Coos, and Curry Counties	An extended period of heavy rain combined with snowmelt caused flooding of the Coquille River, the South Fork of the Coquille River, and the Rogue River flooded at Agness twice that month.
Feb. 2017	Marion, Polk, Yamhill, Washington, Columbia, Benton, Tillamook, Lane, Coos, Curry, Klamath, Wheeler and Malheur Counties	High river flows combined with high tide to flood some areas near the southern Oregon coast. Heavy rain combined with snowmelt caused flooding along the Coquille River and the Rogue River twice this month in southwest Oregon. Heavy rain combined with snowmelt caused flooding along the Sprague River in south central Oregon. Flows on the John Day River reached flood levels downstream of Monument due to the breaking up of an ice jam.
March 2017	Malheur, Harney, Wallowa, Umatilla, and Wheeler Counties	An extended period of snowmelt, combined with a period of heavy rain, caused an extended period of flooding along portions of the John Day River, the Umatilla, and the Silvies Rivers. Flooding occurred on the Snake River near Ontario.
May 2017	Multnomah County and Wallowa County	Heavy rain from a strong thunderstorm in addition to a log jam caused the rapid rise of Oneonta Creek in the Oneonta Gorge. Two hikers were injured in the flash flood. In Wallowa County the Imnaha River at Imnaha had minor flooding early on May 6th, due to snowmelt.

Date	Location	Notes
June 2017	Umatilla County	In Pendleton, heavy rain caused several small debris flows along Airport Road, and several intersections were flooding with water about 5 to 6 inches deep. Rainfall amounts include 1.54 inches of rain at the NWS office at the Pendleton Airport, with 0.88 inches falling in 30 minutes.
Sept. 2017	Baker County	Thunderstorms producing heavy rain over the 2016 Rail Fire burned area on the Wallowa-Whitman National Forest resulted in flash flooding and debris flows.
Oct. 2017	Tillamook, Benton, and Clackamas Counties	A very potent atmospheric river brought strong winds to the north Oregon Coast and Coast Range on October 21st. What followed was a tremendous amount of rain for some locations along the north Oregon Coast and in the Coast Range, with Lees Camp receiving upwards of 9 inches of rain. All this heavy rain brought the earliest significant Wilson River Flood on record, as well as flooding on several other rivers around the area.
Jan. 2018	Lincoln and Clatsop Counties	A strong stationary low-pressure system off the British Columbia coast brought impressively high seas into the Oregon Coast. Wave heights up to 37 feet were recorded at buoys off the coast, with top one-tenth wave heights up to 45 feet. Damaging surf caused severe beach erosion, damaged a couple buildings right along the beach, injured one person, and killed one person.
Feb. 2018	Umatilla County	Two to three inches of rain fell along the west slopes of the Blue Mountains from February 1st through 4th. The increased runoff caused high water levels and minor flooding along the Umatilla and Walla Walla Rivers.
May 2018	Grant and Wallowa Counties	Heavy rain from slow-moving thunderstorms caused rockslides and water on roadways within an area that includes Mount Vernon, John Day and Canyon City
June 2018	Lane County and Baker County	In Lane County an upper-level trough moved across the area from the southwest, generating strong thunderstorms which produced locally heavy rainfall, lightning, hail, and gusty winds. Thunderstorms with heavy rainfall developed over Southwest Baker County on June 20th, leading to flash flooding and debris flow on the Rail and Cornet-Windy Ridge fires' burn scar areas.
Oct. 2018	Morrow County	Moist upslope flow into the Blue Mountains produced heavy rain with rainfall rates of up to one inch per hour and storm total accumulations between one and three inches. Localized flooding was reported near the town of Heppner where water inside a residence forced an evacuation.
Dec. 2018	Tillamook County	A strong low-pressure system over the Gulf of Alaska brought a strong cold front through. This generated strong winds across northwest Oregon and brought heavy rain which caused flooding on the Tillamook River. Large seas also caused damage in spots along beaches.
Jan. 2019	Coos and Curry Counties	A weekend of very heavy rain led to rivers rising across southern Oregon. The Rogue River at Agness exceeded flood stage and the Coquille River at Coquille flooded as well.

Date	Location	Notes
Feb. 2019	Columbia, Washington and Multnomah Counties	Back-to-back low-pressure systems dropping south along the coast of British Columbia and Washington brought cold air south into NW Oregon as well as plenty of moisture. There was flooding along Fox Creek in Rainier and 40 county roads in Washington County. In Multnomah County, Northwest Rocky Point Road between U.S. 30 and Skyline Boulevard was closed because of a large crack in the road caused by heavy rains and snowmelt.
Feb. 2019	Douglas, Jefferson, Lane, Coos, and Curry Counties	DR-4432. Very heavy rain along with the melting of recent snowfall caused flooding at several locations in southern Oregon in late February. Deer Creek at Roseburg, South Fork of the Coquille at Myrtle Point, North Fork of the Coquille at Myrtle Point, the Coquille River at Coquille and the Rogue River at Agness all exceeded flood stage.
April 2019	Lane, Benton, Marion, Clackamas and Linn Counties	DR-4452. Linn County declared. A particularly strong atmospheric river took aim for the south Willamette Valley, sitting over areas south of Salem for two days, producing anywhere from 2.5 to 5 inches of rain over a 48-hour period. Some areas in the Cascades and Cascade Foothills saw 5 to 7 inches of rain over that 48-hour period. Heavy rain combined with snowmelt from all the snow from a few weeks prior in this same area caused flooding along most rivers in this area as well as along the main-stem Willamette River up to around Oregon City.
April 2019	Douglas, Coos and Curry Counties	DR-4452. Douglas and Curry Counties declared. Two days of very heavy rainfall (compared to April normals) combined with snowmelt led to areal flooding in southwest and south-central Oregon.
April 2019	Union, Grant, Umatilla, Wallowa and Wheeler Counties	DR-4452. Grant, Umatilla, and Wheeler Counties declared. Snow water equivalents near 200 percent of normal in the Blue Mountains coupled with warm temperatures and near record rainfall totals for April produced significant river flooding across eastern Oregon.
April 2019	Wheeler County	Total rainfall of 1.67 inches was recorded just east of Mitchell. This heavy rain over a short period of time triggered a flash flood through Huddleston Heights and Nelson Street, and off High Street and Rosenbaum with mud and debris blocking roads in and around the town of Mitchell.
July 2019	Deschutes County	Slow moving thunderstorms produced localized flooding and minor mud flows around the Tumalo area during the evening of July 1st.
Aug. 2019	Crook and Wasco Counties	A powerful upper storm system combined with modest low- and mid-level moisture to yield scattered, strong to severe storms and flash flooding. Storms developed first across the higher terrain of central Oregon nearer the Cascades and adjacent Ochoco mountains. Storms then built northward with hail and damaging winds along the way.
Feb. 2020	Umatilla County, Confederated Tribes of the Umatilla, Union, and Wallowa Counties	DR-4519: Umatilla County, Confederated Tribes of the Umatilla Indian Reservation, Union, and Wallowa Counties resulting from severe storms, flooding, landslides, and mudslides during period of February 5 to February 9, 2020. Heavy snow, followed by heavy rain and snowmelt led to flooding and major declaration. Record flooding along the Umatilla River.

Date	Location	Notes
Sept. 2020	Clackamas, Douglas, Jackson, Klamath, Lane, Lincoln, Linn, and Marion Counties	DR-4562 Oregon Wildfires. Floodplain management outreach, substantial damage trainings, flood after fire campaign and outreach, support individual assistance, assist with substantial damage determinations per NFIP requirements for properties located in the SFHA. Approximately 651 structures in SFHA were determined to be substantially damaged due to the fires.
May 2021	Benton, Clackamas, Linn, Marion, Polk, Yamhill, Confederated Tribes of Grand Ronde	DR 4599 Ice Storm. Floodplain management outreach, deliver mitigation messages to SFHA properties, ensure NFIP compliance for properties located in SFHA that may have incurred damages.
June 2022	Burns Paiute Indian Reservation	DR-4733: Burns Paiute Tribe Severe Storm, Flooding, Landslides, and Mudslides
Aug. 2023	Ione, Morrow County	Convective showers and thunderstorms over town of Ione with heavy downpour resulted in flash flooding across the town.
Dec. 2023	Tillamook, Clatsop, Lincoln Counties	A strong atmospheric river brought heavy rains on December 5th pushing many streams to flood stage along the north coast. Area of coast range received 12 to 16 inches of rain over a 5-day period.
April 2024	Benton, Clackamas, coos, Hood River, Lane, Lincoln, Multnomah, Sherman, Tillamook, Wasco, Confederated Tribe of Siletz Indians, Yamhill Counties	DR-4768 Winter Storm. Floodplain management outreach, provide information in NFIP, ensure local NFIP regulations are compliant with minimum floodplain regulations, and identify potential projects for RiskMap program.

Source: NOAA Storm Event Database, (http://www.ncdc.noaa.gov/stormevents/), January 2020; Planning for Natural Hazards: Flood TRG (Technical Resource Guide), July 2000, DLCD, Community Planning Workshop https://oregon-oem-geo.hub.arcgis.com/

3.3.5.4 Risk Maps

The maps in this section highlight places where the state might work with communities to develop mitigation projects.

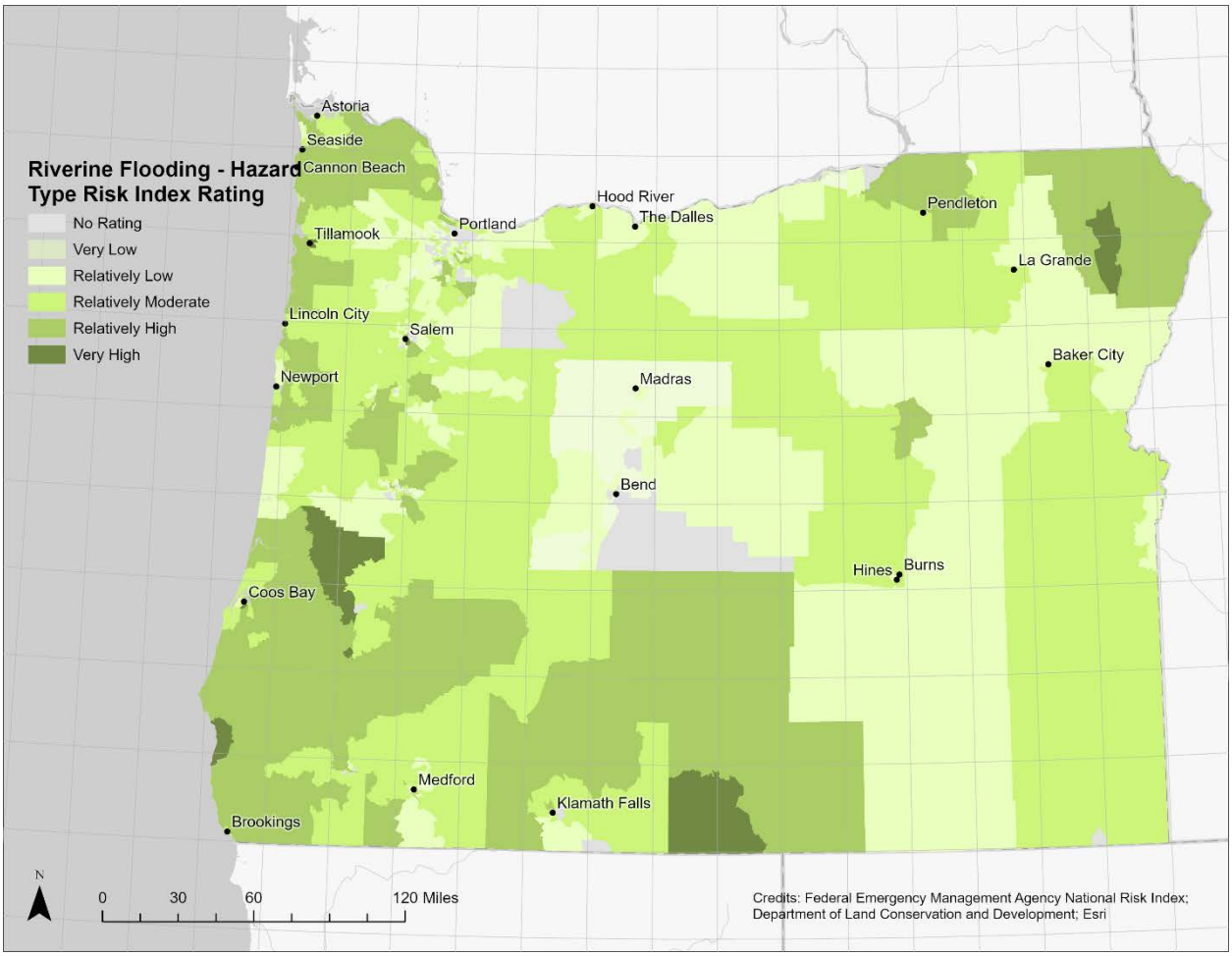
The National Risk Index produces a measure of monetary losses experienced over the period of record. This emphasizes historic costs of harm and would direct mitigation resources to where the costs have been the greatest. Mitigation in these locations would save money over the long term.

In contrast to the National Risk Index, the Oregon Natural Hazards Risk Assessment used indicators of harm based on percentages rather than counts of exposed entities or monetary loss. This captures the potential for disruption within a census tract. The higher the percentage of entities affected, the more disruption to those living or working in the census tract.

The Oregon Natural Hazards Risk Assessment produced two statewide summary maps showing distribution of potential harm. The first map uses both socioeconomic and hazard factors. The second map uses hazard factors alone. The maps show the importance of recognizing the cost of disruption not only to buildings and infrastructure, but also to people, especially vulnerable populations. Both types of losses can be mitigated.

The climate change maps show where risk is projected to increase. Areas with a high risk and a high increase in risk would be especially good places to work with communities to find mitigation projects.

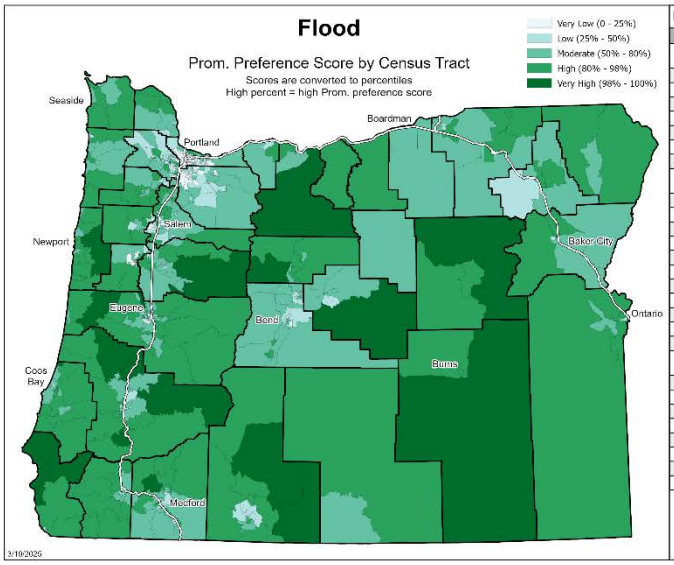
Figure 3.3.5-5: Riverine Flood Risk Rating from the NRI: Risk Index Rating from the Federal Emergency Management Agency, National Risk Index for Riverine Flood.



Federal Emergency Management Agency, National Risk Index for Riverine Flood. Ranking based on national percentiles. Last updated by FEMA in March 2023. Data accessed on February 12, 2025 from National Risk Index | FEMA.gov

Figure 3.3.5-6 and Figure 3.3.5-7 show risk rankings by census tract for flooding from the Oregon Natural Hazards Risk Assessment. Darker colors show census tracts with higher risk. Figure 3.3.5-6 shows census tracts ranked using hazard and socioeconomic vulnerability indicators. Figure 3.3.5-7 shows census tracts ranked using only hazard indicators, without using socioeconomic vulnerability indicators. Cities are included for locational reference only and do not show risk by city. Chapter 9 has additional details and examples of the information available from the risk assessment model.

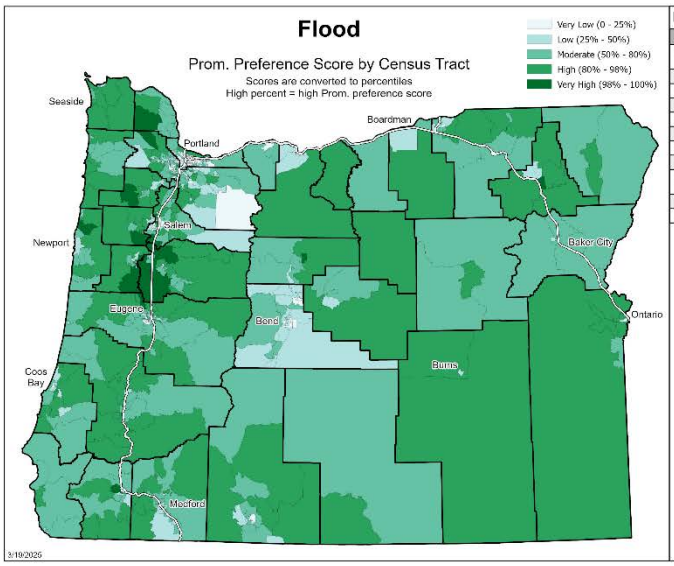
Figure 3.3.5-6: Flood Results of Oregon Risk Assessment using PROMETHEE Ranking with Socioeconomic Indicators Included.



Indicators used for the hazard Hazard indicators are worth 35% of the total weight.

Hazard	Indicator Name	Direction	Weight	Short Description
Flood	Bridge_Scour	1	0.032	Number of bridges that are at risk from scour during a 100-year flood.
Flood	CRS_Rate	1	0.032	Community Rating System (NFIP) score for communities.
Flood	FL_pct_bld	1	0.032	Percentage of SBFO buildings exposed to flooding.
Flood	FL_pct_CF	1	0.032	Percentage of critical facilities buildings exposed to flooding.
Flood	ImpervSurf_Pct	1	0.032	Percentage of impervious surface.
Flood	Hwy_FL_pct	1	0.032	Major roadways number of miles that are exposed to flood hazard.
Flood	Bridge_Scour_pct	1	0.032	Percentage of bridges that are scoured from a 100 year flood.
Flood	Hist_FL_ct	1	0.032	Percentage of historic buildings exposed to flooding.
Flood	FIRM_Diff	1	0.032	Number of years difference between median year built and FIRM date.
Flood	FL_Haz_Area	1	0.032	Area of tract in 100-year flood hazard.
Flood	RepeatLoss	1	0.032	Repetitive loss structures
General	EP_MINRTY	1	0.046	Percentage of Black, Indigenous, and People of Color (2020 Census).
General	HousingTenure	-1	0.046	Housing tenure from the US Census.
General	EP_MOBILE	1	0.046	Percentage of people that live in mobile homes
General	Median_Yrblt	-1	0.046	Median year built of general building stock based on HAZUS default.
General	HospitalDistMile	1	0.046	Distance from tract centroid to nearest hospital.
General	NatResrcJobs	1	0.046	Rate of natural resource jobs.
General	PRED3_PE	1	0.046	Community Resilience Estimate
General	Hosp_Beds	-1	0.046	Estimated number of hospital beds based on square footage .
General	Pct_Adherents	-1	0.046	Percentage of members to a religious group
General	Mitigation	-1	0.046	Number of migitation projects (grouped by zip code and evenly distributed to overlaying tracts)
General	Watch	-1	0.046	Neighborliness: Will watch neighbor's house
General	CountyTax	-1	0.046	County tax rate
General	CityTax	-1	0.046	City tax rate
General	Cultural	-1	0.009	Number of cultural-related buildings
General	Favors	-1	0.009	Neighborliness: Willing to do favors for neighbor
General	Advice	-1	0.009	Neighborliness: Seeks advice from neighbor
General	Parties	-1	0.009	Neighborliness: Attended parties that occur in neighborhood
General	Visits	-1	0.009	Neighborliness: Has visited neighbor's house

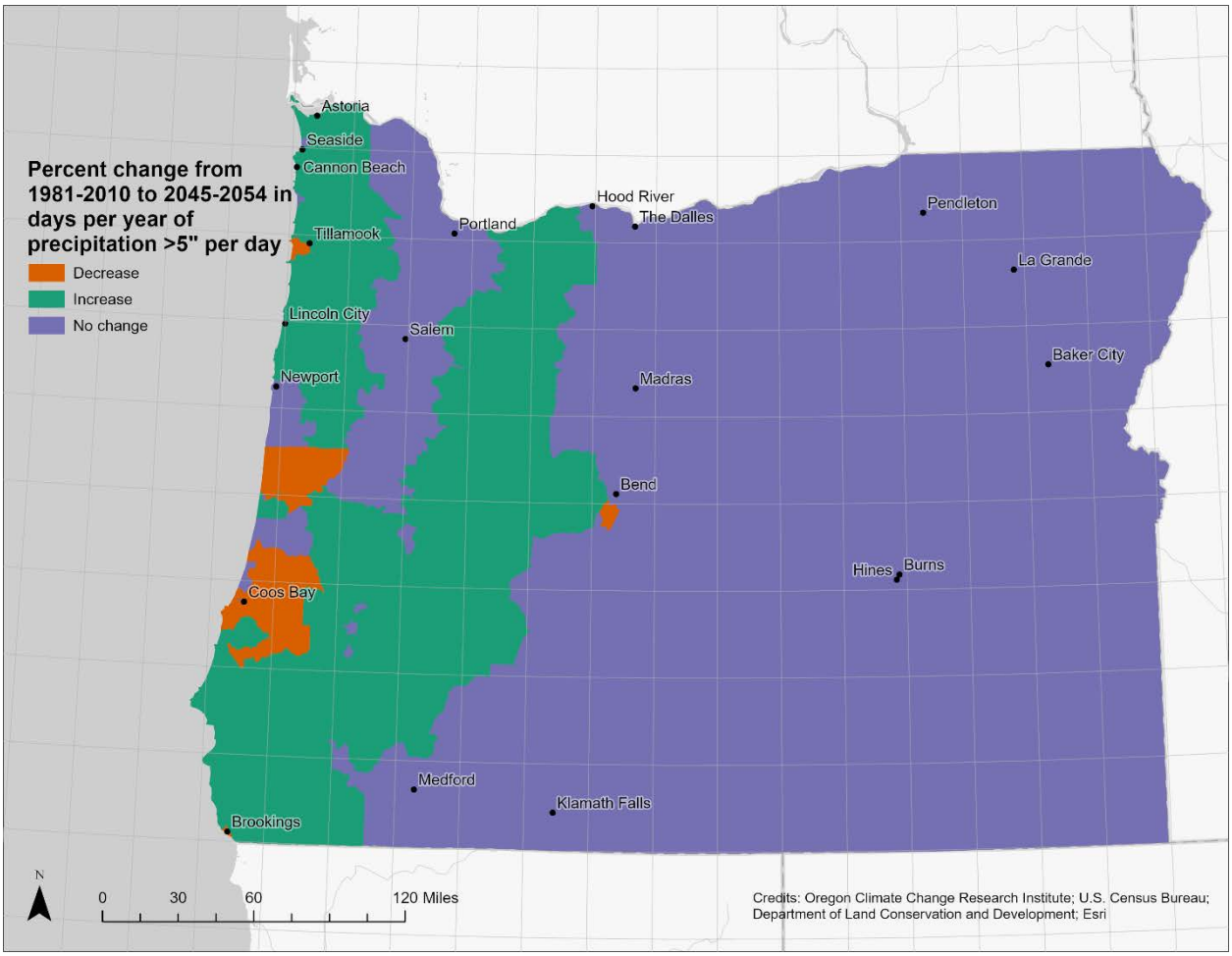
Figure 3.3.5-7: Flood Results of Oregon Risk Assessment using PROMETHEE Ranking without Socioeconomic Indicators Included.



Indicators used for the hazard

Hazard	Indicator Name	Direction	Weight	Short Description
Flood	Bridge_Scour	1	0.091	Number of bridges that are at risk from scour during a 100-year flood.
Flood	CRS_Rate	1	0.091	Community Rating System (NFIP) score for communities.
Flood	FL_pct_bld	1	0.091	Percentage of SBFO buildings exposed to flooding.
Flood	FL_pct_CF	1	0.091	Percentage of critical facilities buildings exposed to flooding.
Flood	ImpervSurf_Pct	1	0.091	Percentage of impervious surface.
Flood	Hwy_FL_pct	1	0.091	Major roadways number of miles that are exposed to flood hazard.
Flood	Bridge_Scour_pct	1	0.091	Percentage of bridges that are scoured from a 100 year flood.
Flood	Hist_FL_ct	1	0.091	Percentage of historic buildings exposed to flooding.
Flood	FIRM_Diff	1	0.091	Number of years difference between median year built and FIRM date.
Flood	FL_Haz_Area	1	0.091	Area of tract in 100-year flood hazard.
Flood	RepeatLoss	1	0.091	Repetitive loss structures

Figure 3.3.5-8: Change in Average Number of Heavy Precipitation Days: Change from 1981-2010 to 2045-2054 in days per year of precipitation that equals or exceeds 5 inches per day.



Source: Derived from 52 ensemble members of 11 LOCA2 downscaled global climate models. Data provided by Oregon Climate Change Research Institute, 2025. Graphic produced by DLCD.

3.3.6 Dam Failure

3.3.6.1 Dams in Oregon

Dams can fail and create flooding downstream. Although rare, a dam failure flood is usually much more severe than a natural flood and can cause severe flooding well above mapped floodplains. The greatest risk from dam failure is loss of life, though property and environmental damage from dam failures can also be severe. The priority emphasis for mitigation actions in this NHMP are non-federal dams with highest loss of life risk, as consistent the FEMA High Hazard Potential Dam (HHPD) program. The state dam safety program is part of the Oregon Water Resources Department and hereafter referred to as dam safety. Dam safety program staff reviewed existing data including dam inspections, risk analyses, design and construction records, dam breach inundation analyses, and determinations of populations at risk, buildings, roads and

critical infrastructure downstream of dams to write this chapter of the Oregon Natural Hazards Mitigation Plan.

As of January 2024, there were 941 dams exceeding state jurisdictional size regulated by dam safety program. Dam safety program actions to address safety of these dams include:

a. Reviewing analysis, designs, specifications and associated reports for new dam construction and modification of existing dams;
b. Approving designs when shown to be safe and accepting as-built documents when construction or modification is complete and consistent with the approved design;
c. Reviewing plans for removal of significant hazard and high hazard dams and determining if changes to these plans are needed for safety;
d. Conducting routine inspections and notifying dam owners of outcomes with recommendations for maintenance and repair;
e. Cooperating with dam owners on dam safety issues;
f. Determining if maintenance actions, corrective actions, or any other actions are necessary to protect life, property, or public infrastructure. Communicating this information to dam owners, and issuing formal orders and enforcing if necessary cooperative actions are not taken;
g. Communicating, coordinating, and collaborating with dam owners, other agencies, and the public to improve dam safety in Oregon; and
h. Planning for and responding for potential and actual emergencies at dams.

There are another 240 dams exceeding National Inventory of Dams size thresholds owned or regulated by the federal government. The largest dams (height and water storage volume) in Oregon are under federal ownership or regulation.

Oregon dam safety law exempts very small dams (those that are under 10 feet in height or that store less than 3 million gallons). There are very roughly 20,000 such dams in Oregon, based on water right permit information.

3.3.6.2 Hazard Potential and Dam Safety

Oregon law (ORS 540.443 (3)) states “Dam failure” means a rapid, sudden and uncontrolled release of water or wastewater due to loss of dam integrity. The dam safety program follows national guidance for assigning hazard potential to dams and for the contents of Emergency Action Plans (EAPs). Dams are rated according to the anticipated impacts of potential failure. Oregon has adopted the following definitions of hazard potential for state-regulated dams. These definitions are essentially the same as federal/FEMA definitions:

- **High Hazard** means loss of life is expected if the dam fails.
- **Significant Hazard** means loss of life is not expected if the dam fails, but extensive damage to property or public infrastructure is likely.
- **Low Hazard** is assigned to all other state-regulated dams.

Maintaining correct hazard ratings is a dam safety priority, and therefore hazard ratings can and do change. Ratings may change for a number of reasons. For example, a dam’s original rating may not have been based on current inundation analysis methodologies, or new development may have changed potential

downstream impacts. Also, very importantly, hazard is not risk. Risk depends on the probability of, and consequences of failure as described in the section titled Risk Analysis.

3.3.6.3 Emergency Action Plans

An "**Emergency Action Plan**" is defined by Oregon law as a plan that assists a dam owner or operator, and local emergency management personnel, to perform actions to ensure human safety in the event of a potential or actual dam failure. The content required in EAP's follows national guidance. State law (ORS 540.482) requires the owner of a dam that has a high hazard rating to develop an emergency action plan for the dam. Consistent with Federal criteria, an emergency action plan required under this section must include, but need not be limited to:

a) Means for emergency condition detection
b) Means for emergency level determination
c) Identification of, and information necessary for, notifications and communications to be made at each level of emergency condition
d) A description of actions expected to be undertaken to prevent dam failure or reduce the effects of dam failure
e) A map of dam failure inundation zones for varying conditions, including, but not limited to, dry weather conditions and high flood conditions
f) Procedures to be followed at the termination of an emergency.

Oregon dam safety requires an EAP for all dams confirmed to be high hazard potential. Dam safety works with owners to develop an EAP for dams which based on new dam breach inundation analysis have a change in hazard potential rating to high. All confirmed state regulated high hazard dams (with that rating prior to 2023) have an emergency action plan. Many of these EAPs do need updating and exercising, and the program is working with owners to accomplish the updates, often during the exercise of their EAP.

3.3.6.4 Historical Dam Failures

Failures of some dams can result in loss of life, damage to property, infrastructure, and the natural environment. The impacts of dam failures range from local impacts to waters below the dam and the owners' property to community destruction with mass fatalities. The 1889 Johnston Flood in Pennsylvania was caused by a dam failure that resulted in over 2000 lives lost. Oregon's first dam safety laws were developed in response to the St. Francis dam failure in California in 1928. That failure was due to unsafe design practice and caused about 500 people to die.

Oregon has records of at least 55 dam failures in the State. Many of these failures had very little or no impact on people, structures or properties. The 21 dams with more serious to tragic effects are listed in Table 3.3.6-1.

Table 3.3.6-1: Oregon dam failures with damage (potential)

Year	Location	Description
1896	Goodrich dam west of Baker City in Baker Co.	Flood wave killed entire family of 7
1917	Killamacue dam west of Haines in Baker Co.	Property damaged
1920	Bonneyview dam east of Prineville in Crook Co.	Property damaged
1925	Bully Creek dam west of Vale in Malheur Co.	Multiple homes badly damaged, loss of livestock
1927	Cottonwood creek dam northwest of Lakeview in Lake Co.	Property damaged
1937	Spaulding Vaughn dam in Baker Co.	Property damaged
1941	Willow Creek (Malheur) dam west of Vale in Malheur Co.	Potential failure situation with more than 100 persons at risk, failure prevented
1949	Kern Brothers dam south of Burns in Harney Co.	Property damaged
1951	N. Indian Creek dam in northern Malheur Co.	Property damaged
1952	Rock Creek dam east of Burns in Harney Co.	Property damaged
1956	Goodrich dam west of Baker City in Baker Co.	Property damaged in the second failure of a dam at this site
1956	Sams Valley dam east of Gold Hill in Jackson Co.	Landslide related to reservoir filling threatened homes
1958	Vaughn Reservoir in rural Malheur Co.	Property damaged
1959	Currant Creek dam east of Antelope in Wasco Co.	Property damaged
1961	Woodrat Knob dam near Lake Creek in Jackson Co.	Major landslide on dam with persons evacuated, flooding prevented
1978	Kern Brothers dam south of Burns in Harney Co.	Property damaged including failure of Krumbo dam, second failure at this dam site
1982	Mann creek dam near Sweet Home in Linn Co.	Washed out multiple forest roads
1983	Star Mountain dam near Riverside in Malheur Co.	Washed out railroad and roads, damaged homes
1996	Powers Log Pond in Powers in south Coos Co.	Damaged road and limited damage to dwellings
2005	Simplot Lagoon south of Hermiston in Umatilla Co.	Washed out State Highway, major irrigation ditch and made 1 home unrepairable
2016	Heater Reservoir near Sublimity in Marion Co.	Flooded area occupied by Christmas tree packers, flooded paved road

Source: Oregon Water Resources Department Dam Safety Program records 2025

3.3.6.5 Laws and Rules

The Oregon Water Resources Department (OWRD) is the state authority for dam safety with specific authorizing laws and implementing regulations. Oregon's first dam safety laws were adopted in 1929. The 1929 laws were repealed in 2019, replaced by a new law contained in ORS 540. 443 to 491, ORS 540.990, and ORS 540.995. New dam safety rules authorized by this law have been in effect since 2020. Oregon dam safety law exempts very small dams (those that are under 10 feet in height or that store less than 3 million gallons). Oregon's new dam safety laws and rules were developed considering the joint Association of State Dam Safety Officials (ASDSO) and FEMA Model State Dam Safety Program.

3.3.6.6 Coordination

OWRD dam safety drafted this Section of the NHMP in coordination with Oregon Department of Land Conservation and Development staff responsible for most other elements of the Oregon NHMP. Dam safety also coordinates with the Oregon Department of Emergency Management and with dam owners, federal dam regulators, county and city emergency managers, and first responders. Dam safety program staff also develop language for state and local natural hazard mitigation plan sections on high hazard potential dams, and assist with sections related to floods and extreme events.

Dam safety has specifically coordinated with the federal owners and regulators on preparations for a Cascadia earthquake and extreme flood, events where multiple dams may have impacts and need rapid situational awareness. Additional work is needed to ensure the Oregon Department of Emergency Management understands the risks associated with high hazard dams and is prepared to rapidly use information from the state and federal dam safety programs.

3.3.6.7 General Information Sharing

Information available from the OWRD dam safety program includes:

- Original design drawings and specifications;
- OWRD dam inspections;
- Safety and risk analyses completed for certain dams
- Status of maintenance and correction actions on dams
- Emergency Action Plans; and
- Inundation Maps for those dams with Emergency Action Plans.

Almost all this information is considered public information and provided upon specific request. The Dam Safety Program provides accurate and timely information on its role in the safety of Oregon dams to other agencies, dam owners and the public. Dam safety uses many modes of communication including in person, phone, e-mail, postal mail, web information, and workshops. Well informed agency staff, dam owners, engineers, emergency managers, stakeholders, media and the public are all essential to an effective dam safety program. A core message is that dam safety is the responsibility of the dam owner. One dam safety program's role is to assist dam owners in understanding this responsibility.

3.3.6.8 High Hazard Potential Dams in Oregon

The following table (Table 3.3.6-2) shows high hazard potential dams in Oregon. The National Inventory of dams was the information source for the federal dams, while the state dam safety database was the source for state regulated dams.

Table 3.3.6-2: High Hazard Potential Dams in Oregon

	Name	County	Rating	Regulator	Identification #
1.	Brownlee Dam	Baker	High	Federal	ID00056
2.	Mason Dam	Baker	High	Federal	OR00577
3.	Oxbow Hydro Dam	Baker	High	Federal	OR00258
4.	Thief Valley Reservoir	Baker	High	Federal	OR00592
5.	Unity Reservoir	Baker	High	Federal	OR00593
6.	Bull Run Dam 2 (Lower)	Clackamas	High	Federal	OR00317
7.	Faraday Diversion Dam	Clackamas	High	Federal	OR00551
8.	Faraday Forebay	Clackamas	High	Federal	OR00245
9.	North Fork Dam (Clackamas)	Clackamas	High	Federal	OR00550
10.	River Mill Dam	Clackamas	High	Federal	OR00552
11.	Timothy Lake	Clackamas	High	Federal	OR00545
12.	Willamette Falls	Clackamas	High	Federal	OR00596
13.	Ochoco Reservoir	Crook	High	Federal	OR00098
14.	Prineville Reservoir (Bowman)	Crook	High	Federal	OR00579
15.	Crane Prairie	Deschutes	High	Federal	OR00279
16.	Wickiup Reservoir (USBR)	Deschutes	High	Federal	OR00136
17.	Creekside Dam #1	Douglas	High	Federal	OR03902
18.	Creekside IWR	Douglas	High	Federal	OR03903
19.	Galesville Reservoir	Douglas	High	Federal	OR00748
20.	Lemolo Lake Dam	Douglas	High	Federal	OR00556
21.	Soda Springs Dam	Douglas	High	Federal	OR00555
22.	Olive Lake	Grant	High	Federal	OR00341
23.	Clear Branch Creek Dam	Hood River	High	Federal	OR00451
24.	Agate Dam	Jackson	High	Federal	OR00422
25.	Applegate Lake	Jackson	High	Federal	OR00624
26.	Emigrant	Jackson	High	Federal	OR00581
27.	Fish Lake (Jackson-USBR)	Jackson	High	Federal	OR00021
28.	Howard Prairie	Jackson	High	Federal	OR00580
29.	Hyatt Reservoir	Jackson	High	Federal	OR00591
30.	Lost Creek Reservoir (COE)	Jackson	High	Federal	OR00612
31.	Reeder Gulch Reservoir	Jackson	High	Federal	OR00110
32.	Haystack Equalizing Pond	Jefferson	High	Federal	OR00287
33.	Pelton Dam	Jefferson	High	Federal	OR00548
34.	Pelton Regulating Dam	Jefferson	High	Federal	OR00547
35.	Round Butte Dam	Jefferson	High	Federal	OR00549
36.	Gerber Reservoir	Klamath	High	Federal	OR00584
37.	Upper Klamath Lake	Klamath	High	Federal	OR00557

	Name	County	Rating	Regulator	Identification #
38.	Blue River Dam	Lane	High	Federal	OR00013
39.	Cottage Grove	Lane	High	Federal	OR00005
40.	Cougar Reservoir	Lane	High	Federal	OR00015
41.	Dexter	Lane	High	Federal	OR00006
42.	Dorena	Lane	High	Federal	OR00008
43.	Fall Creek Reservoir	Lane	High	Federal	OR00007
44.	Fern Ridge	Lane	High	Federal	OR00016
45.	Hills Creek Reservoir	Lane	High	Federal	OR00014
46.	Hult Log Storage Pond	Lane	High	Federal	OR00183
47.	Leaburg Dam	Lane	High	Federal	OR00553
48.	Lookout	Lane	High	Federal	OR00009
49.	Walterville Power Intake	Lane	High	Federal	OR00600
50.	Walterville Pumped S. Pond	Lane	High	Federal	OR00267
51.	Big Cliff Dam	Linn	High	Federal	OR00003
52.	Detroit Reservoir	Linn	High	Federal	OR00004
53.	Foster Reservoir	Linn	High	Federal	OR00012
54.	Green Peter Reservoir	Linn	High	Federal	OR00010
55.	Smith River	Linn	High	Federal	OR00541
56.	Trail Bridge Reg. Reservoir	Linn	High	Federal	OR00540
57.	Agency Valley Dam	Malheur	High	Federal	OR00589
58.	Bully Creek Dam	Malheur	High	Federal	OR00578
59.	Owyhee	Malheur	High	Federal	OR00582
60.	Rock Creek (Malheur)	Malheur	High	Federal	OR00623
61.	Warm Springs Reservoir (USBR)	Malheur	High	Federal	OR00082
62.	Willow Creek (Morrow)	Morrow	High	Federal	OR00212
63.	Bonneville Dam	Multnomah	High	Federal	OR00001
64.	Bull Run Dam 1 (Upper)	Multnomah	High	Federal	OR00327
65.	John Day Dam	Sherman	High	Federal	OR00011
66.	Cold Springs Reservoir (USBR)	Umatilla	High	Federal	OR00590
67.	Indian Lake Dam	Umatilla	High	Federal	OR00601
68.	McKay Reservoir (USBR)	Umatilla	High	Federal	OR00583
69.	McNary Dam	Umatilla	High	Federal	OR00616
70.	Hells Canyon Dam	Wallowa	High	Federal	OR00250
71.	Happy Canyon	Wasco	High	Federal	OR00694
72.	The Dalles Dam	Wasco	High	Federal	OR00002
73.	Wasco Dam	Wasco	High	Federal	OR00326
74.	Scoggins	Washington	High	Federal	OR00685
75.	North Fork	Benton	High	State	OR00348
76.	Buche (Clackamas)	Clackamas	High	State	OR00766
77.	Mompano	Clackamas	High	State	OR00500
78.	Bear Creek	Clatsop	High	State	OR00689
79.	Middle	Clatsop	High	State	OR00135
80.	Seaside City	Clatsop	High	State	OR01387
81.	Wickiup Lake (Astoria)	Clatsop	High	State	OR00136
82.	Pony Creek - Lower	Coos	High	State	OR00070

	Name	County	Rating	Regulator	Identification #
83.	Pony Creek - Upper	Coos	High	State	OR00200
84.	Barnes Butte	Crook	High	State	OR00284
85.	Joe Fisher	Crook	High	State	OR00248
86.	Johnson Creek (Crook)	Crook	High	State	OR00232
87.	Ferry Creek	Curry	High	State	OR00437
88.	North Canal Diversion	Deschutes	High	State	OR00566
89.	Sunriver Effluent	Deschutes	High	State	OR03790
90.	Bear Creek 3	Douglas	High	State	OR00614
91.	Berry Creek	Douglas	High	State	OR00640
92.	Cooper Creek (Sutherlin)	Douglas	High	State	OR00463
93.	Hayhurst Road	Douglas	High	State	OR01892
94.	Paris	Douglas	High	State	OR00320
95.	Plat I	Douglas	High	State	OR00443
96.	Updegrave	Douglas	High	State	OR00491
97.	Wageman	Douglas	High	State	OR00496
98.	Winchester	Douglas	High	State	OR00263
99.	Duggan	Jackson	High	State	OR00475
100.	Lake Creek	Jackson	High	State	OR00395
101.	Osborne Creek	Jackson	High	State	OR00401
102.	Sams Valley	Jackson	High	State	OR00400
103.	Wade	Jackson	High	State	OR00379
104.	Walch Dam	Jackson	High	State	OR00246
105.	Willow Creek	Jackson	High	State	OR00356
106.	Woodrat Knob	Jackson	High	State	OR00357
107.	Yankee	Jackson	High	State	OR00222
108.	Mays	Jefferson	High	State	OR00355
109.	McMullen Creek	Josephine	High	State	OR00513
110.	Strong	Josephine	High	State	OR00142
111.	Crescent Lake	Klamath	High	State	OR00381
112.	Bullard Creek F.R.S. (Lake)	Lake	High	State	OR03780
113.	Cottonwood	Lake	High	State	OR00373
114.	Drews	Lake	High	State	OR00049
115.	Santa Clara	Lane	High	State	OR00743
116.	Big Creek #1 (Lower)	Lincoln	High	State	OR00225
117.	Big Creek #2 (Upper)	Lincoln	High	State	OR00473
118.	Mill Creek	Lincoln	High	State	OR00472
119.	Olalla	Lincoln	High	State	OR00470
120.	Spring Lake	Lincoln	High	State	OR00532
121.	Foster Log Pond	Linn	High	State	OR00159
122.	Antelope	Malheur	High	State	OR00378
123.	Crowley	Malheur	Significant	State	OR00132
124.	Lonesome Lake	Malheur	High	State	OR03792
125.	Pole Creek	Malheur	High	State	OR00239
126.	Willow Creek 3 (Malheur)	Malheur	High	State	OR00390
127.	Franzen	Marion	High	State	OR00613

	Name	County	Rating	Regulator	Identification #
128.	Silver Creek	Marion	High	State	OR00622
129.	Portland #1 (Mt. Tabor)	Multnomah	High	State	OR00667
130.	Portland #5 (Mt. Tabor)	Multnomah	High	State	OR00670
131.	Portland #6 (Mt. Tabor)	Multnomah	High	State	OR00671
132.	Van Raden	Multnomah	High	State	OR00105
133.	Croft	Polk	High	State	OR00415
134.	Mercer	Polk	High	State	OR00524
135.	Jubilee Lake	Union	High	State	OR00453
136.	Morgan Lake	Union	High	State	OR00653
137.	Pilcher Creek	Union	High	State	OR00688
138.	Wolf Creek	Union	High	State	OR00220
139.	Wallowa Lake	Wallowa	High	State	OR00465
140.	Crow Creek	Wasco	High	State	OR00464
141.	Currant Creek	Wasco	High	State	OR00696
142.	Pine Hollow	Wasco	High	State	OR00480
143.	Rock Creek (Wasco)	Wasco	High	State	OR00147
144.	Younglife Waste A (Lower)	Wasco	High	State	OR00697
145.	Younglife Waste B (Middle)	Wasco	High	State	OR04030
146.	Younglife Waste C (Upper)	Wasco	High	State	OR04031
147.	Barney	Washington	High	State	OR00525
148.	Kay Lake	Washington	High	State	OR00394
149.	Rock Creek	Wheeler	High	State	OR00265
150.	Baker ER	Yamhill	High	State	OR00507
151.	McGuire	Yamhill	High	State	OR00514

Source: Oregon Water Resources Department, 2025

Figure 3.3.6-1: Federally Regulated Dam Locations in Oregon

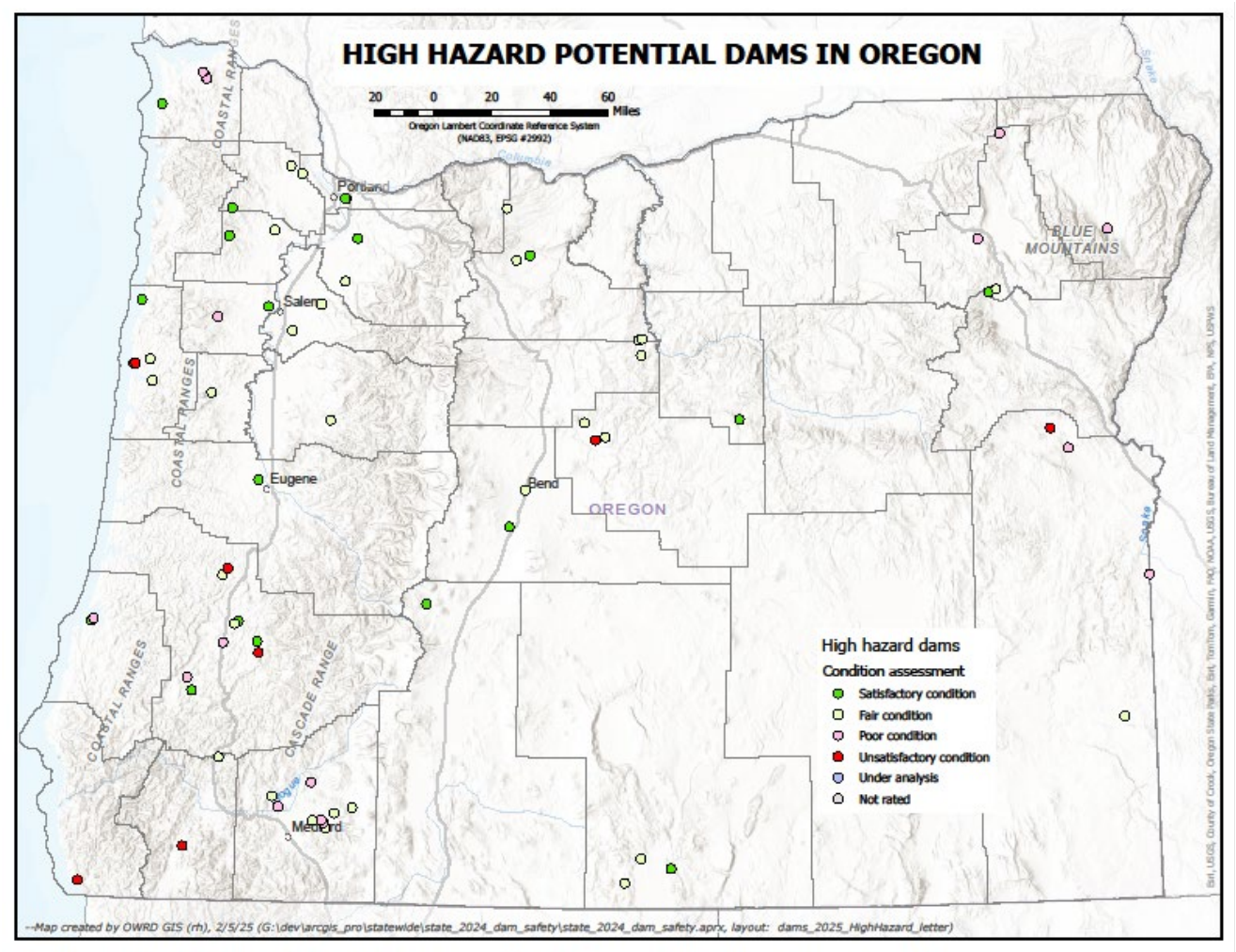
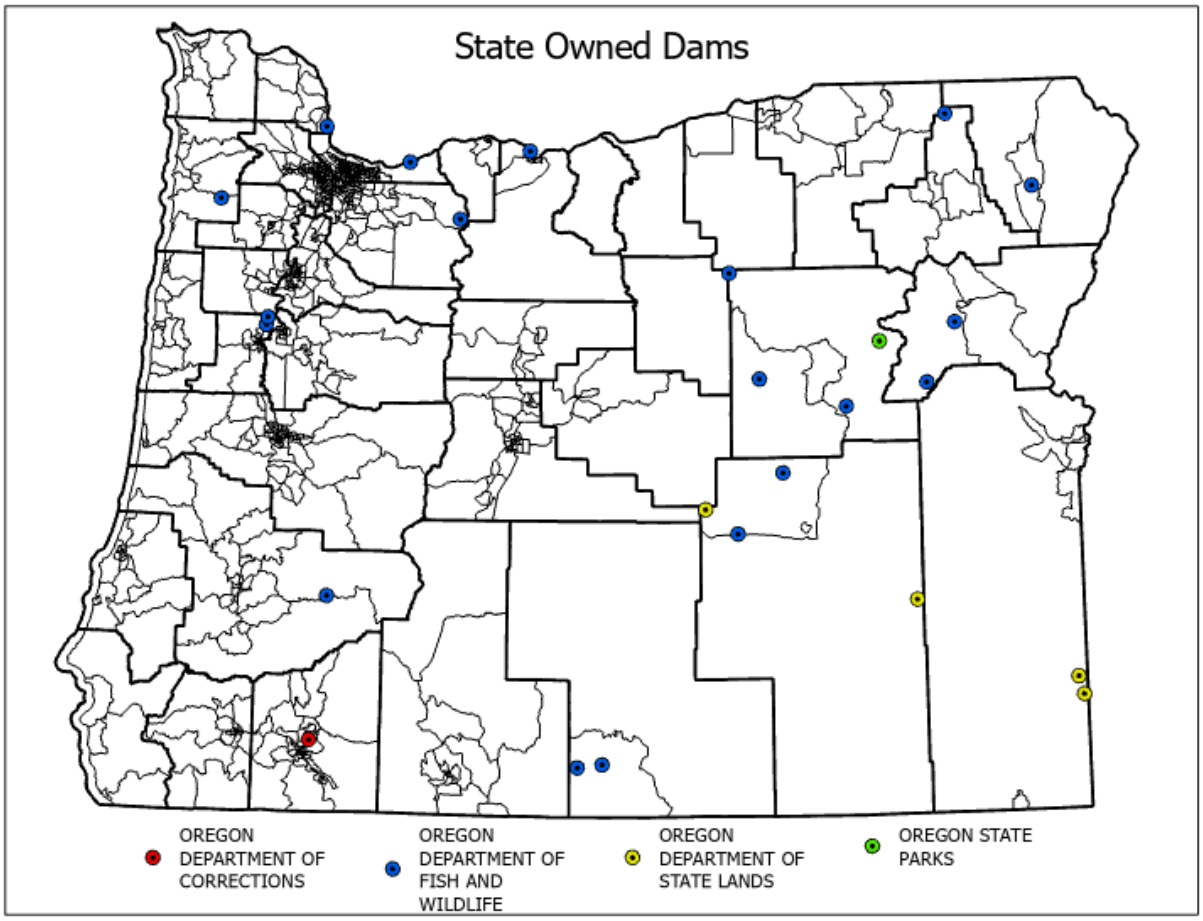


Figure 3.3.6-2: State Regulated Dams in Oregon



Oregon uses FEMA's condition classifications as a preliminary screen for risk of failure and for HHPD grant eligibility. These classifications can be very subjective, and for state regulated dams typically based on routine inspections results and visually apparent deficiencies. Condition classifications are not equivalent to risk as they do not consider expected loss of life, or fiscal effects from a dam failure. Oregon law contains specific definitions for unsafe and potentially unsafe conditions at dams, and these conditions, rather than condition classifications, trigger actions by the dam safety program. FEMA's condition classifications that were used initially to determine dams not meeting safe thresholds are as follows:

"Satisfactory" means no existing or potential dam safety deficiencies are recognized. Acceptable performance is expected under all loading conditions (static, hydrologic, seismic) in accordance with the applicable regulatory criteria or tolerable risk guidelines.

"Fair" means no existing dam safety deficiencies are recognized for normal loading conditions. Rare or extreme hydrologic and/or seismic events may result in a dam safety deficiency. Risk may be in the range to take further action.

"Poor" means a dam safety deficiency is recognized for loading conditions that may realistically occur. Remedial action is necessary. A poor rating may also be used when uncertainties exist as to critical analysis

parameters that identify a potential dam safety deficiency. Further investigations and studies are necessary.

“Unsatisfactory” means a dam safety deficiency is recognized that requires immediate or emergency remedial action for problem resolution.

“Not Rated” means the dam has not been inspected, is not under state jurisdiction, or has been inspected but, for whatever reason, has not been rated.

As of January 2025, 24 state-regulated high hazard dams in Oregon are currently assessed to be below accepted safety standards (in Poor or Unsatisfactory Condition, or in Fair condition with a suspected but unconfirmed potentially unsafe condition). The state only maintains non-federal conditions. Some federal agencies do not release this information. As the dam safety program conducts risk analysis over time, the number of dams determined to be unsafe or potentially unsafe may change.

Table 3.3.6-3: Condition classification of state regulated high hazard dams

Dam ID	Dam Name	File	County	District	Condition Assessment
OR00122	ANTELOPE	A-2	MALH	9	FAI
OR00507	BAKER, ER	B-49	YAMH	22	FAI
OR00284	BARNES BUTTE	B-38	CROO	24	UNS
OR00525	BARNEY	H-29	WASH	1	SAT
OR00449	BEAR CREEK	B-47	CLAT	1	POR
OR00614	BEAR CREEK 3	B-51	DOUG	15	FAI
OR00640	BERRY CREEK	B-52	DOUG	15	FAI
OR00225	BIG CREEK #1 (LOWER)	B-28A	LINC	1	UNS
OR00473	BIG CREEK #2 (UPPER)	B-28B	LINC	1	UNS
OR00766	BUCHE (CLACKAMAS)	B-64	CLAC	16	FAI
OR03780	BULLARD CREEK F.R.S. (LAKE)	B-9	LAKE	12	SAT
OR00463	COOPER CREEK (SUTHERLIN)	C-61	DOUG	15	FAI
OR00535	COTTONWOOD	C-6	LAKE	12	FAI
OR00381	CRESCENT LAKE	C-9	KLAM	11	SAT
OR00415	CROFT	C-59	POLK	22	SAT
OR00464	CROW CREEK	C-62	WASC	3	FAI
OR00696	CURRANT CREEK	C-64	WASC	21	FAI
OR00049	DREWS	D-3	LAKE	12	FAI

Dam ID	Dam Name	File	County	District	Condition Assessment
OR00475	DUGGAN	D-48	JACK	13	POR
OR00437	FERRY CREEK	F-25	CURR	14	UNS
OR00159	FOSTER LOG POND	LP-41	LINN	16	FAI
OR00613	FRANZEN	T-14	MARI	16	FAI
OR01892	HAYHURST ROAD	D-39	DOUG	15	UNS
OR00248	JOE FISHER	F-11	CROO	24	FAI
OR00232	JOHNSON CREEK (CROOK)	J-5	CROO	24	FAI
OR00453	JUBILEE LAKE	J-16	UNIO	6	POR
OR00394	KAY LAKE	C-57	WASH	18	FAI
OR00395	LAKE CREEK	L-24	JACK	13	FAI
OR03792	LONESOME LAKE	L-15	MALH	9	POR
OR00355	MAYS	M-37	JEFF	21	FAI
OR00514	MCGUIRE	M-43	YAMH	1	SAT
OR00513	MCMULLEN CREEK	M-46	JOSE	14	UNS
OR00524	MERCER	D-35	POLK	22	POR
OR00135	MIDDLE	M-10A	CLAT	1	POR
OR00472	MILL CREEK	M-9	LINC	1	FAI
OR00500	MOMPANO	M-53	CLAC	20	SAT
OR00653	MORGAN LAKE	M-64	UNIO	6	POR
OR00566	NORTH CANAL DIVERSION	N-12	DESC	11	FAI
OR00348	NORTH FORK	N-9	BENT	22	FAI
OR00470	OLALLA	O-10	LINC	1	FAI
OR00401	OSBORNE CREEK	O-15	JACK	13	POR
OR00320	PARIS	P-31	DOUG	15	UNS
OR00688	PILCHER CREEK	P-42	UNIO	8	SAT
OR00480	PINE HOLLOW	P-39	WASC	3	SAT
OR00443	PLAT I	P-38	DOUG	15	SAT
OR00239	POLE CREEK	P-9	MALH	9	POR

Dam ID	Dam Name	File	County	District	Condition Assessment
OR00070	PONY CREEK - LOWER	P-6	COOS	15	POR
OR00200	PONY CREEK - UPPER	P-14	COOS	15	SAT
OR00667	PORTLAND #1 (MT. TABOR)	P-50A	MULT	20	SAT
OR00670	PORTLAND #5 (MT. TABOR)	P-50B	MULT	20	SAT
OR00671	PORTLAND #6 (MT. TABOR)	P-50C	MULT	20	SAT
OR00147	ROCK CREEK (WASCO)	R-4	WASC	3	FAI
OR00265	ROCK CREEK LAKE (WHEELER)	R-7	WHEE	4	SAT
OR00400	SAMS VALLEY	S-39	JACK	13	FAI
OR00743	SANTA CLARA	S-68	LANE	2	FAI
OR01387	SEASIDE CITY	S-113	CLAT	1	FAI
OR00622	SILVER CREEK	S-66	MARI	16	FAI
OR03811	SPRING LAKE	S-77	LINC	1	SAT
OR00142	STRONG	S-101	JOSE	14	FAI
OR03790	SUNRIVER EFFLUENT LAGOON	LG-73	DESC	11	SAT
OR00491	UPDEGRAVE	U-8	DOUG	15	SAT
OR00105	VAN RADEN	V-9	MULT	18	FAI
OR00379	WADE	W-45	JACK	13	FAI
OR00496	WAGEMAN	W-79	DOUG	15	POR
OR00246	WALCH DAM	W-34	JACK	13	POR
OR00465	WALLOWA LAKE	W-2	WALL	7	POR
OR00136	WICKIUP LAKE (ASTORIA)	M-10B	CLAT	1	POR
OR00212	WILLOW CREEK	W-29	JACK	13	FAI
OR00390	WILLOW CREEK 3 (MALHEUR)	W-6	MALH	9	UNS
OR00263	WINCHESTER	W-1A	DOUG	15	POR
OR00220	WOLF CREEK	W-62	UNIO	8	FAI
OR00357	WOODRAT KNOB	W-43	JACK	13	POR
OR00222	YANKEE	Y-6	JACK	13	FAI
OR00697	YOUNGLIFE WASTE A (LOWER)	R-24A	WASC	21	FAI

3.3.6.9 Risk Assessment and Analysis

The FEMA High Hazard Potential Dam (HHPD) grant program and the new Model State Dam Safety Program both recognize the need for risk assessments, especially for deficient high hazard potential dams. The 2015 FEMA publication Federal Guidelines for Dam Safety Risk Management provides definitions and conceptual guidance for risk analysis by dam safety programs and was used to develop methods. *Risk* in the simplest terms for dam safety applications, and for this work, is the product of the likelihood (probability) of a sudden dam failure and the consequences of that dam failure or uncontrolled release of water.

For HHPD grant eligibility and for current state of the practice dam safety program management, a consistent evaluation of the risks posed by regulated dams is needed. Oregon dam safety staff developed an assessment protocol for use on state regulated dams to support FEMA grant processes. Seventeen high hazard dams with known or suspected major safety deficiencies have been assessed, including quantitative evaluation of events associated with failures, loadings in those events, and loss of life from catastrophic failure.

3.3.6.10 Events and general risks to dams

Under normal loading conditions dams are generally at very low risk of failure. Specific events are associated with most dam failures. The events most likely to result in failure vulnerability in Oregon include:

- An extreme flood that exceeds spillway capacity and causes an earthen dam to fail;
- Record high water levels in a dam that has no protection against internal erosion;
- Movement of the dam in an earthquake; and
- A large rapidly moving landslide impacting the dam or reservoir.

Floods: Oregon's two largest historical floods occurred in 1861 and 1903. There is very little data on the precipitation leading up to these flood events, or on specific peak flood flows. The 1861 storm occurred up and down the west coast. This storm was a long duration atmospheric river event (very different mechanism and moisture source from the eastern 2/3 of the country). The 1903 event was an extreme intermountain (arid region thunderstorm). Given the short period of record and the lack of extreme floods in Oregon there has been low confidence in estimates of the size of extreme floods in much of the state using existing methods. Hydrometeorological Report No. 57 (HMR 57 for the Pacific Northwest) does not well represent the meteorological physics of atmospheric rivers. Dam safety has two projects underway to address this issue as described later in the chapter.

High Reservoir Levels: While internal erosion observations can occur at typical reservoir levels, (Fell et al., 2015) provide evidence that most internal erosion failures occur at the highest reservoir level experienced by that dam. Based on stream gage data and other information, it is unlikely any of the dams in the project have experienced greater than a 0.2 percent annual exceedance probability (500-year) flood. Therefore, it is reasonable to use a reservoir level calculated at the 0.2 percent AEP inflow to make a consistent comparison of risk for these dams as described later in this chapter.

Earthquakes: The western part of the state is subject to a very large Cascadia Subduction Zone earthquake, the last one occurring in 1700. There is no record of a very large earthquake in Oregon since that time (two

earthquakes near magnitude 6 occurred in 1991). Almost all existing dams in Oregon were designed before there was an understanding of the Cascadia Subduction Zone hazard. Most Oregon dams were designed before there was any awareness of the occurrences of subduction zone earthquakes in the Pacific Northwest. Phase 1 studies were completed by the Corps of Engineers and the Water Resources Department from 1971 to 1982 and used an acceleration of 0.05 standard gravitational acceleration (g) for analysis of these dams. The 2500-year return earthquake accelerations are now 0.6 to 1 g at coastal Oregon dams.

The full Cascadia rupture earthquake has a 14-20 percent occurrence probability every 50 years, with at least one paper indicating an even higher risk. This is equivalent to about a 0.3 percent annual chance of occurrence. The eastern Oregon faults closest to some of the HHPD analysis dams are believed to have been last active in the past up to 16,000 years ago.

Landslides in Oregon have occurred in high precipitation events, and during large earthquakes. Oregon's geologic units closer to the coast tend to have weaker rocks and very steep slopes, further increasing seismic and landslide risk. A number of Oregon dams are located on or near landslide deposits, and one dam is under formal reservoir level restriction because higher reservoir levels trigger movement at the toe of the existing landslide (the reservoir is in the large graben formed when the landslide moved in the distant past).

Wildfire Intense wildfire in the watershed above dams can increase peak stream flows and increase debris loading that could block spillways. Oregon has experienced an increase in large wildfire occurrences and severity over the last decade or so. The years 2020 and 2024 were especially serious. In 2024 wildfires in 2024 burned significant portions of watersheds above several high hazard dams, including two that were in Unsatisfactory or Poor condition.

Cascading Effects Cascading effects are also possible, although there are not many large state-regulated high hazard dams upstream from other large dams. An exception is some of the coastal municipal water supply dams, especially some of the dams for the Cities of Astoria, Newport, and Coos Bay/North Bend. These are also the dams with some of the higher vulnerabilities to a Cascade Subduction Zone earthquake.

Climate Change Flood producing storms can be made more severe by climate change and locally by wildfire. Oregon has experienced higher temperatures and less rainfall and now officially significantly drier and hotter summers that contribute to the increased wildfire occurrence. Oregon has not yet experienced increased flooding precipitation, but that could be expected anytime.

3.3.6.11 Potential Impacts from dam failures

Life loss is by far the most critical effect of some dam failures and is the basis of the high hazard potential designation. The *Population at Risk* (PAR) for a dam is the number of people or households that could be affected by a dam failure. It is normally higher than expected life loss since it assumes people are in homes, and because it usually includes all areas that are likely to be inundated, not the depth or velocity of inundation. Life loss depends on the depth and velocity of flood flows, the resilience of the structure, and very importantly, if there was sufficient warning and people were able to move to safer locations. Homelessness poses a challenge in that population in potential inundation areas may not be identified. Dam safety has evaluated PAR below dams mostly for the HHPD grant eligibility dams.

Dam failures can damage or destroy homes, businesses, roads, water treatment and other infrastructure. Several municipal water supply reservoirs are directly above the treatment plants for that water and would be destroyed by a failure of those dams. This is most critical for Oregon coastal communities, with the greatest apparent risk from a Cascadia event. Lack of water would reduce firefighting and essential water supplies at a time that the need is greatest.

Environmental risk is not directly regulated by dam safety, however most of the dams on streams with essential anadromous salmonid habitat are rated high or significant hazard, so receive higher levels of inspections and safety actions due to the hazard rating. If there are structures or infrastructure downstream but loss of life is unlikely, dams are rated as a significant hazard.

3.3.6.12 Vulnerabilities to and from HHPD eligible dams

Initial risk detail is found in the summary of 17 Oregon 2021 HHPD eligible dams risks follows. Where applicable this includes: the location and size of population at risk; potential impacts to institutions and critical infrastructure/facilities/community lifelines; and economic, environmental, social impacts, and potential multi-jurisdictional impacts from dam failure:

Dam Name	Barnes Butte	NID OR00284	File B-38	
Type	Embankment	Year Constructed	1956	
Height	32.5 ft	Normal Storage	340 ac-ft	
Owner (private)	Individual	County Crook	Uses	Recreation
PAR daytime	1,787 people	PAR nighttime	1,648 people	

Initial information on dam vulnerabilities: The US Army Corps of Engineers (USACE) Phase 1 report for this dam indicated the spillway is significantly undersized for a PMF. The OWRD dam safety files contain a letter from the owner stating that the spillway was widened. This was not correct, and the spillway remains in roughly the same condition as it was when the Phase 1 report was completed about 40 or so years ago. A team of consultants are finalizing a report on alternatives for addressing the spillway of this dam.

Condition Classification: POOR

PAR detail: The dam is 1.5 miles from downtown Prineville, a town with a current population of 11,227 people. Over 10 percent of the population is in the area that would be flooded by a catastrophic dam breach. The dam owner is an individual ranch owner, and other than the owner there is no dam operator. Water is used mostly for recreation. The owner has a house on the reservoir, but at times is in another state. The critical infrastructure most at risk is US Highway 26. The average PAR of 1,718 was used for the risk analysis since flooding in this location is equally likely in day or night conditions.

Notices and Enforcement: The prior dam owner was notified that the spillway was undersized after the Phase 1 report. The most recent dam safety program formal notice was dated March 12, 2024, and stated in part: “The spillway capacity analysis is near complete, and the results indicate that the current spillway cannot pass the Probable Maximum Flood (PMF), the largest flood theoretically possible for the dam’s

drainage basin. In addition, the analysis indicates that even if the spillway is returned to the as-designed condition, it would not have sufficient capacity to pass the PMF. Inability of the dam to pass the PMF in the current or as-designed condition results in a Potentially Unsafe condition with Barnes Butte Dam as defined by ORS 540.443 (7)."

Dam Name	Big Creek 1	NID OR00225	File B-28A
Type	Embankment	Year Constructed	1951
Height	21 ft	Normal Storage	200 ac-ft
Owner (public)	City of Newport	County Lincoln	Uses Municipal supply
PAR daytime	16 people	PAR nighttime	35 people

Initial information on dam vulnerabilities: This dam is one of the closest dams to the Cascadia subduction zone, which based on geomorphic evidence has produced long duration earthquakes, up to around magnitude of 9.0. During geotechnical exploration for a modification to the inlet structure, SPT blow counts of 0 were found in the dam, and in the 60 feet of soft alluvial material forming the dam's foundation. This dam is immediately downstream from the larger Big Creek 2 dam.

Both dams are to be replaced by one dam. Analysis for this project is underway. Due to the high estimated cost, the city is still working on funding.

Condition Classification: POOR

PAR detail: The homes at risk and the Cities water treatment plant are all within ¼ mile of this dam. The average PAR of 26 is appropriate for this dam.

Notices and Enforcement: The dam safety program sent a formal notice dated January 22, 2021. This analysis indicated that both dams would deform significantly during a Cascadia Subduction Zone (CSZ) earthquake. For both dams, the deformation could cause the dam crest to drop below the water line which could lead to overtopping of the dam crest and subsequent catastrophic failure of the dam. The dam is determined to be Potentially Unsafe.

Dam Name	Big Creek 2	NID OR00473	File B-28B
Type	Embankment	Year Constructed	1968/1977
Height	26 ft	Normal Storage	970 ac-ft
Owner (public)	City of Newport	County Lincoln	Uses Municipal supply
PAR daytime	26 people	PAR nighttime	52 people

Initial information on dam vulnerabilities: This dam is one of the closest dams to the Cascadia subduction zone, which based on geomorphic evidence has produced long duration earthquakes, up to around magnitude of 9.0. During geotechnical exploration for a modification to the inlet structure for the lower

dam, SPT blow counts of 0 were found in the dam and in the 40-60 feet of soft alluvial material forming the dam's foundation. This dam is immediately upstream from the smaller Big Creek 1 dam. Investigations for replacing both dams with a single dam that can withstand a Cascadia earthquake are underway.

During preliminary review of all design documents, inconsistencies were found with the design documentation and actual on the ground conditions. A recent OWRD dam safety inspection identified water under pressure squirting into a large-corrugated metal culvert that was constructed as the interior (glory hole) spillway for the dam. A subsequent investigation by a consulting engineer occurred after OWRD sent a notice of an unsafe dam. These investigations confirmed discontinuous internal erosion at the base of large diameter spillway pipe. Leakage into the low-level conduit (control outlet) has also been observed during video scoping. Part of the short-term repairs for this issue have been completed.

Condition Classification: UNSATISFACTORY

PAR detail: The dam is about one mile from the population at risk. The dam owner maintains personnel (operators) at the water treatment plan (very critical and essential infrastructure) below the dam. Failure of the dam would destroy this water treatment plant, and Newport does not have an alternate treatment source. This would eliminate water supply for this City of 10,500 people. This City will be cut off from outside ground transport after a major earthquake, so for a significant time would need air dropped water and other supplies. The average PAR of 39 is appropriate for this dam.

Notices and Enforcement: The dam safety program sent a formal notice dated January 22, 2021.

The notice stated department conducted a routine dam inspection on October 15th, 2018, during which inspectors observed corrosion of, and leakage through, the corrugated metal pipe (CMP) portion of the overflow spillway for Big Creek Dam #2. The leakage occurs at locations throughout the length of the CMP portion of the spillway. This is determined to be an Unsafe Condition.

This analysis also indicated that both Big Creek dams will deform significantly during a Cascadia Subduction Zone (CSZ) earthquake. For both dams, the deformation could cause the dam crest to drop below the water line which could lead to overtopping of the dam crest and subsequent catastrophic failure of the dam. The condition is determined to be Potentially Unsafe.

Dam Name	Bear	NID OR00449	File B-47
Type	Concrete gravity	Year Constructed	1912/1950
Height	90 ft	Normal Storage	700 ac-ft
Owner (public)	City of Astoria	County Clatsop	Uses Municipal supply
PAR daytime	20 people	PAR nighttime	57 people

Initial information on dam vulnerabilities: This dam is one of the closest dams to the Cascadia subduction zone, which based on geomorphic evidence has produced long duration earthquakes, up to around magnitude of 9.0. A consultant's analysis indicated this dam is likely to survive this earthquake will little deformation. However, the spillway for the dam is undersized, and since the dam is concrete, the main

vulnerability is high flow erosion of the abutments and toe of the dam. Engineering consultant analysis of abutment and toe scour protection is underway.

Condition Classification: POOR

PAR detail: The dam is 2-7 miles from a mostly semi-rural population. The dam owner maintains a dam operator on site, as water is used for the municipal water supply for the City of Astoria. There will likely be warning prior to major overtopping of this dam. This dam is most vulnerable in a winter flood event, so the nighttime PAR of 57 will be used for risk analysis.

Notices and Enforcement: The dam safety program sent the most recent formal notice dated September 16, 2025, stating:

> "In every dam safety inspection conducted by the department, since at least 2011, the control mechanism for the low-level conduit valve has not been cycled and the conduit controls cannot be safely operated. A properly functioning low-level conduit is a key safety feature of a dam. It allows the reservoir to be drained in the event of an emergency and lowered prior to a major flood event. It is particularly important for Bear Creek dam since the spillway is not capable of safely passing a large flood event. Because it has not been operated our inspectors have been unable to determine the condition of the conduit controls. The dam was built around 1912, so the conduit and controls are well over 100 years old. The non-functional low-level control is a Potentially Unsafe condition at Bear Creek Dam.
>
> The other Potentially Unsafe condition is the spillway that is significantly undersized to pass the Probable Maximum Flood. The City and the dam safety program have cooperated on an analysis of necessary spillway capacity and alternatives for safely passing this flood. Several engineering consultants have been working on this project. Specific findings and alternatives are in the *Bear Creek Spillway Modifications 30 percent design report from Cornforth Consultants dated March 27, 2024*. The current lack of capacity makes this a Potentially Unsafe condition. This is the most complex of the three Potentially Unsafe Conditions, and this condition drives the need for the other Corrective Actions".

Dam Name	Duggan	NID OR00475	File D-48
Type	Embankment	Year Constructed	1963
Height	23 ft	Normal Storage	50 ac-ft
Owner (private)	Individual	County Jackson	Uses Recreation
PAR daytime	6 people	PAR nighttime	11 people

Initial information on dam vulnerabilities: There was no USACE Phase 1 report for this dam. OWRD dam safety inspections have found the spillway mostly filled in by the owner to make use of their ATV easier. The valve for the low-level conduit is inoperable, the dam is covered by medium sized trees, and the outlet is obscured by dense blackberry growth and cannot be inspected until this is cleared.

Condition Classification: POOR

PAR detail – The dam is 1/4 mile from semi-rural population. The dam owner had been out of the country for several years, and the property renter has avoided OWRD attempts at contacts. Other than for yearly OWRD inspections the dam is unwatched, though can be seen from a public road. The average PAR of 9 is appropriate for this dam. No critical infrastructure would be affected by failure.

Notices and Enforcement: The dam safety program sent a formal notice dated August 22, 2016. From past inspections, inspectors have determined that the controls for the low-level conduit of this dam are inoperable. As a result, it is not possible to drain this reservoir in the event of an emergency. From the most recent inspection, there has been no substantial progress clearing trees from the dam or clearing around the conduit inlet and outlet. As a result, it is not possible for Department staff to conduct a complete safety inspection of this dam. Consequently, Duggan dam has been determined to be UNSAFE.

Dam Name	Ferry	NID OR00437	File F-25
Type	Embankment	Year Constructed	1914/1966
Height	65 ft	Normal Storage	167 ac-ft
Owner (public)	City of Brookings	County Curry	Uses Former Municipal Supply
PAR daytime	84 people	PAR nighttime	25 people

Initial information on dam vulnerabilities: This dam is the closest Oregon dam to the Cascadia subduction zone, which based on geomorphic evidence has produced long duration earthquakes, up to around magnitude of 9.0. The dam was not designed for any seismic loading.

This dam was reclassified from low hazard to high hazard in 2014. There had been no review of hazard rating since construction of the dam. The dam is in an area with the highest intensity rainfalls in Oregon and has overtopped by a small amount in the past (in less than a 1 percent AEP flood). The dam has three penetrating conduits, none of which are functional, and some may be pressurized. OWRD dam safety inspections have found a large landslide moving slowly into the spillway. Engineering consultant analysis for removal of the dam is in progress, and the city tentatively plans to remove the dam if funding support is available.

Condition Classification: UNSATISFACTORY

PAR detail: The dam is 1 mile from several houses, and 2-3 miles from a small commercial and recreational port. The dam owner is the Coty of Brookings, with a small public works staff and does not have dam safety expertise. There is no dam operator, as water is no longer used as part of the municipal supply. Use of an average PAR (daytime and nighttime) of 55 is reasonable for this dam.

Notices and Enforcement: The dam safety program sent a formal notice dated April 12, 2021. The following safety issues result in a Potentially Unsafe condition with Ferry Creek Dam:

- none of the conduits are functional and the condition of the conduits is unknown
- seismic risk
- insufficient spillway capacity

Dam Name	McMullen	NID OR00513	File M-46
Type	Embankment	Year Constructed	1960
Height	45ft	Normal Storage	1675 ac-ft
Owner (public)	County	County Josephine	Uses Recreation
PAR daytime	85 people	PAR nighttime	243 people

Initial information on dam vulnerabilities: Unti1 2014 this dam had been classified as a significant hazard dam. A dam breach inundation analysis was conducted for the dam, and as a result it was reclassified to a high hazard dam. The dam has had a history of issues beginning with a greatly undersized spillway causing the dam to nearly overtop the year after construction. An overflow was constructed, and the concrete surface for that spillway is failing.

This dam is also close to the Cascadia subduction zone, which based on geomorphic evidence has produced long duration earthquakes, up to around magnitude of 9.0.

Engineering consultant analysis has confirmed the spillway is significantly undersized and the dam is vulnerable to high seismic deformation. OWRD dam safety inspections have found significant wave erosion, spillway issues, and a non-functional outlet.

Condition Classification: UNSATISFACTORY

PAR detail: The dam is 1-2 miles from the unincorporated community of Selma and there is a main highway downstream. The County Parks Department manages the reservoir and is the dam owner. The dam has a real time reservoir level gage that is monitored by the County and has reservoir level warnings set that are delivered to OWRD Dam Safety. The average PAR of 164 is appropriate for this dam.

Notices and Enforcement: The dam safety program sent a formal notice dated February 2, 2021, the lack of an operating control structure and deterioration of the conduit result in an Unsafe condition at McMullen Dam. In addition, a potentially Unsafe condition exists with the insufficient spillway capacity and seismic stability of McMullen Dam.

Dam Name	Morgan	NID OR00653	File M-64
Type	Embankment	Year Constructed	c 1900
Height	22 ft	Normal Storage	780 ac-ft
Owner (public)	City of LaGrande	County Union	Uses Recreation
PAR daytime	11,128 people	PAR nighttime	6,362 people

Initial information on dam vulnerabilities: A USACE Phase 1 report exists for this dam, but this report did not investigate the conduit condition and had no evaluation of internal erosion risk. The dam, built in around 1900 for hydro power. The dam may be a puddle core fill. OWRD dam safety inspections have found the conduit may be made of clay and tin, and it is pressurized and not operable. Engineering consultant analysis is in progress.

Condition Classification: POOR

PAR detail: The City of LaGrande is directly downstream from this dam in a very high-risk setting. The dam is 1-3 miles from a dense population. The breach flow would travel down a very steep canyon (1400 elevation drop over 1 mile) to the edge of the city. It is very possible that the flow will remove all debris from the canyon and have unusually high velocity. There is no dam operator or operation, as the valve is inoperable (and the conduit appears to be pressurized). During the winter and early spring when highest water levels occur the very steep road to the dam has deep snow, is unplowed and is not accessed. The regional hospital is at the base of this canyon. The average PAR of 8,745 is appropriate for this dam.

Notices and Enforcement: The dam safety program sent the most recent formal notice on September 16, 2024. This stated "In every dam safety inspection conducted by the department, since at least 2011, the control mechanism for the low-level conduit valve has not been functional and the conduit outlet has been buried. On August 21st, 2021, the outlet to the conduit was unburied. Inspectors were unable to determine if the conduit was pressurized and it was not clear what material the conduit was made of; it did not appear to be any type of material any of the engineers on site were familiar with. The conduit outlet was reburied to prevent vandalism.

A properly functioning and durable low-level conduit is a key safety feature of a dam. It allows the reservoir to be drained in the event of an emergency. Inspectors have been unable to determine the condition of the low-level conduit. The dam was built around 1900, so the conduit is well over 100 years old, past the design life of most conduit materials. A failing conduit may lead to internal erosion and then to complete dam failure. The unknown conduit condition results in the determination of a Potentially Unsafe condition at Morgan Lake Dam."

Dam Name	Osborne	NID OR00401	File O-15
Type	Embankment	Year Constructed	1964
Height	60 ft	Normal Storage	438 ac-ft
Owner (private)	Ranch	County Jackson	Uses Irrigation
PAR daytime	123 people	PAR nighttime	229 people

Initial information on dam vulnerabilities: There was no Phase 1 report for this dam. OWRD dam safety inspections have found that corrugated metal culverts were used for the low-level conduits in all the dams on this ranch. The pipes are severely deteriorated, and it was unclear whether they were encased on concrete. Engineering consultant inspection for the owner has not yet provided sufficient information for a safety determination on the condition of the conduit.

Condition Classification: POOR

PAR detail: The main population is in Eagle Point 15 miles below the dam, with some structures within 3 miles of the dam. A State Highway would also be affected by a dam breach. The dam owner is a large private ranch, with no specified dam operator.

The average PAR of 176 is appropriate for this dam.

Notices and Enforcement: The dam safety program sent a formal notice dated November 1, 2018. The Department notice stated that the condition of the conduit was a serious safety concern and the conduits either needed to be relined, replaced, or grouted shut if an alternate location was selected for new pipes.

Dam Name	Pole	NID OR00239	File P-9
Type	Embankment	Year Constructed	1909
Height	58 ft	Normal Storage	1525 ac-ft
Owner (private)	Farmer Association	County Malheur	Uses Irrigation
PAR daytime	37 people	PAR nighttime	103 people

Initial information on dam vulnerabilities: The USACE Phase 1 report for this dam indicated the dam did not have a spillway and was the primary safety concern. The dam still does not have a spillway. It is filled mostly by diversion from a creek but is also located on a small channel. The Engineering consultant analysis for spillway alternatives is in progress.

Condition Classification: POOR

PAR detail: The dam is about 2 miles from the very small town of Brogan. The dam owner is a private company made up of local farmers. One of their employees manages dam operations but does not live on site. Dam breach will flood one US highway. Population and critical infrastructure at risk. The average PAR of 70 is appropriate for this dam.

Notices and Enforcement: The prior dam owner was notified that the spillway was undersized after the Phase 1 report. The dam safety program sent the latest formal notice dated April 14, 2021, notifying the owner of a Potentially Unsafe Condition - There is no spillway at this dam.

Analysis for spillway alternatives is complete.

Dam Name	Lower Pony	NID OR0070	File P-6
Type	Embankment	Year Constructed	1986
Height	32 ft	Normal Storage	380 ac-ft
Owner (public)	Coos Bay North Bend	County Coos	Uses Municipal supply
PAR daytime	687 people	PAR nighttime	408 people

Initial information on dam vulnerabilities: This dam is one of the closest dams to the Cascadia subduction zone, which based on geomorphic evidence has produced long duration earthquakes, up to around magnitude of 9.0.

OWRD file review and a preliminary geotechnical investigation indicate there is loose sand in the dams' foundation, and if confirmed could have a high potential for liquefaction in the Cascadia earthquake. Engineering consultant analysis will be in progress shortly.

Condition Classification: POOR

PAR detail – The dam is 0.5 to 3 miles from to population in the City of North Bend. The dam owner is the public water supply entity for over 25,000 people. Loss of the dam would destroy the water treatment system and eliminate water supply for this entire population. There are dam operators on site most of the time. The average PAR of 548 is appropriate for this dam.

Notices and Enforcement: The dam safety program sent a formal notice dated April 6, 2021. The notice stated that initial analysis indicates a layer of loose sand below the dam. This indicates likely significant deformation of the dam in a Subduction Zone type very large earthquake. As a result, this dam was determined to be in Potentially Unsafe condition.

Dam Name	Wageman	NID OR00496	File W-79
Type	Embankment	Year Constructed	1971
Height	40 ft	Normal Storage	50 ac-ft
Owner (private)	Individual	County Douglas	Uses Recreation/irrigation
PAR daytime	6 people	PAR nighttime	12 people

Initial information on dam vulnerabilities: There is no USACE Phase 1 report for this dam. OWRD dam safety inspections have found indicators of holes and leakage though these holes in the CMP low level conduit, which is only 8 inches in diameter so cannot be scoped. Inspections have also found the spillway choked with debris and trees, and uneven. Engineering consultant analysis has developed repair alternatives for this dam.

Condition Classification: POOR

PAR detail: The dam is about 2000 feet from the owners' house, with several homes within 2 miles of the dam. The dam owner is an individual that lives below the dam, with no dam operator. The owner would like to resume using the water for crop irrigation and recreation/wildlife. The average PAR of 9 is appropriate for this dam.

Notices and Enforcement: The dam safety program sent a formal notice dated February 2, 2021. The notice stated that seepage indicates that there are holes in the conduit and when the conduit is pressurized during operation, water is seeping into the dam from the conduit. This is a Potentially Unsafe condition because the holes in the conduit are a potential route for internal erosion.

Dam Name	Wallowa	NID OR00465	File W-2
Type	Concrete	Year Constructed	1920, 1927
Height	35 ft	Normal Storage	42,750 ac-ft
Owner (public)	Irrigation District	County Wallowa	Uses Irrigation

PAR daytime	1,131 people	PAR nighttime	1,334 people

Initial information on dam vulnerabilities: The USACE Phase 1 report for this dam indicated the dam could not quite pass a probable maximum flood, and that at a water level near the crest the dam might slide due to uplift at the base of the dam. A replacement dam or major rehabilitation is being designed at this time. This risk analysis relied on the Phase 1 report, since the Corps conducted the Phase 1 analysis, and had structural engineering expertise on the team.

Condition Classification: POOR

PAR detail: The dam is about 5 miles from the City of Enterprise. The dam owner employs a dam operator that lives on site. In addition, there is real time monitoring of reservoir levels that is monitored by the owner and OWRD. The average PAR of 1,233 is appropriate for this dam. There is no atypical critical infrastructure at high risk.

Notices and Enforcement: The dam safety program and the dam owner agreed to a water level restriction for this dam. The restriction was developed in the early 1980's.

Dam Name	Willow Ck 3 (Malheur)	NID OR00390	File W-6
Type	Embankment	Year Constructed	1911
Height	125 ft	Normal Storage	49,000 ac-ft
Owner (private)	Farmer Company	County Malheur	Uses Irrigation
PAR daytime	3,426 people	PAR nighttime	3,518 People

Initial information on dam vulnerabilities: Since 1942 this dam has been under a formal restriction due to leakage above elevation 3386 (about 30 feet below the dam crest). The USACE Phase 1 report for this dam investigated this situation in detail, and at that time it was not clear if the restriction was sufficiently safe in an extreme flood event. OWRD dam safety inspections and monitoring of reservoir levels have found this restriction was exceeded once in the last 12 years. There have also been issues with valve operability at the dam.

Condition Classification: POOR

PAR detail – The City of Vale is about 35 miles downstream, while the City of Ontario is about 50 miles downstream from this dam. The dam owner has one employee for two dams and its ditches, and there is remote monitoring of reservoir level. The average PAR 3,472 is appropriate for this dam. Failure of the dam would also close a major US highway.

Notices and Enforcement: The original restriction is in place, so the dam is considered unsafe if its level exceeds the restricted level. The dam safety program most recently sent a formal notice dated April 19, 2021, that stated an extreme flood will cause the dam to rise much above the restricted level and trigger leakage and movement and possible dam failure - Potentially Unsafe Condition.

Dam Name	Woodrat Knob	NID OR00357	File W-43
Type	Embankment	Year Constructed	1956
Height	90 ft	Normal Storage	1320 ac-ft
Owner (private)	Ranch	County Jackson	Uses Irrigation
PAR daytime	227 people	PAR nighttime	500 people

Initial information on dam vulnerabilities: There was no Phase 1 report for this dam. This dam experienced a nearly catastrophic landslide that extended from the toe of the dam to the upstream edge of the crest in 1961. OWRD Dam Safety inspections have found deterioration of all corrugated metal pipes (for the mid-level conduit and drains in the toe berm. The original low-level conduit is strongly believed to remain in the dam. Engineering consultant investigation has not yet identified this pipe and has not yet confirmed the other pipe is fully encased in concrete with that concrete intact.

Condition Classification: POOR

PAR detail: The main population is in Eagle Point, 15 miles below the dam, with some structures within 3 miles of the dam. A State Highway would also be affected by a dam breach. The dam owner is a large private ranch, with no specified dam operator.

The average PAR of 364 is appropriate for this dam.

Notices and Enforcement: The dam safety program sent a formal notice dated November 1, 2018, stating that the condition of the conduit was a serious safety concern and the conduits either needed to be relined, replaced, or grouted shut if an alternate location was selected for new pipes.

3.3.6.13 Semi Quantitative Risk Assessment of HHPD eligible dams

An HHPD grant funded semi quantitative risk analysis of the 17 Oregon dams eligible was completed for the FY19 and FY 20 eligible dams. Another major dam risk evaluation project used multiple funding sources to conduct deterministic engineering assessments of many dams. Analyzed dams included both eligible high hazard dams and municipal water supply dams, with priorities based in part on the semi-quantitative risk analysis. In addition, projects to advance the state of the practice for determination of probable maximum precipitation and precipitation recurrence frequency in Oregon are underway.

OWRD Dam Safety staff developed dam-specific risks due to dam failure for each of the 17 dams. Modes of failure most likely to cause dam failures were evaluated for each dam, as was a dam-specific mode if there were unusual conditions at that dam. The modes of failure analyzed were as follows:

a. Overtopping in flood exceeding spillway capacity
b. Spillway blockage or erosion
c. General internal erosion
d. Internal erosion conduit
e. Seismic deformation - Cascadia subduction zone

f. Landslide into dam or reservoir
g. Dam specific vulnerabilities

Methodology and assumptions for risk data and inundation modeling are best described in the project HHPD Grant #EMW-2020-GR-00204 report to FEMA. This semi-quantitative risk analysis methodology was completed and applied to the 17 eligible dams in accordance with the scope of work contained in the Oregon FEMA HHPD FY19 and FY 20 grant applications. Existing file information was comprehensively reviewed with inspection elements based in information and gaps in the dam safety program files for those dams.

The product is a consistent procedure and includes a rating of confidence in the information. Results are calculated in terms of expected loss of life on an annualized basis. The probability of failure for each potential failure mode (PFM), the combined probability of failure, the PAR, and the annualized per capita life loss risk were determined for each dam, and the information was then entered into tables at the end of this document. The combined risk of failure is determined to an order of magnitude only. The combined failure risk (across all PFMs) only considers the highest risk modes of failure, and for convenience was additive.

Risks that are at least one order of magnitude less than the highest risk PFM for that dam are not included in the risk summary and are not listed or considered a principal failure mode. All risks may be one or two orders of magnitude off, depending on the confidence in the data behind the estimates, as indicated in the last row of the analysis table under each PFM. A summary table showing the dam's name and the annualized per capita life loss risk is provided in Table 3.3.6-4. The table is arranged from highest to lowest risk.

Table 3.3.6-4: Highest Apparent Risk Dams and Affected Communities

Rank/Dam Name	Annual life loss risk	Affected Community
1 Morgan	3.5E-01	La Grande in Union County
2 Barnes Butte	3.4E-01	Prineville in Crook County
3 Willow 3 Malheur	1.7E-01	Vale and Ontario in Malheur County
4 Lower Pony	1.6E-01	Coos Bay and North Bend in Coos Co.
5 Ferry	1.3E-01	Brookings in Curry County
6 Big # 2	8.8E-02	Newport in Lincoln County
7 McMullen	6.6E-02	Rural Josephine County
8 Pole	2.5E-02	Brogan and Vale in Malheur County
9 Wallowa	6.2E-03	Joseph Enterprise and Wallowa
10 Walch	5.6E-03	Shady Cove in Jackson County
11 Big # 1	5.0E-03	Newport in Lincoln County

Rank/Dam Name	Annual life loss risk	Affected Community
12 Jubilee	4.0 E-03	Rural Union County
13 Osborne	3.5E-03	Eagle Point in Jackson County
14 Bear	3.0E-03	Rural Clatsop County
15 Woodrat	2.2E-03	Eagle Point in Jackson County
16 Wageman	6.0E-04	Rural Douglas County
17 Duggan	2.0E-04	Rural Jackson County

The analysis resulted in a risk-based ranked list of dams that is being used to prioritize HHPD eligible dams for further dam safety actions and for future HHPD funding. In addition, the analysis indicated that the most significant safety issue affecting Oregon dams is overtopping during flood events, with internal erosion and seismic risk being close second and third. Many of the dams evaluated under this risk analysis have an apparent risk of failure higher than the accepted tolerance level outlined in the document Federal Guidelines for Dam Safety Risk Management (FEMA P-1025).

Given the high risk of life loss from some of these dams, in the short term the Oregon dam safety priority must be on protecting life for determinations of dams needing funding support for rehabilitation or removal.

Limitations of analysis

Limitations to this analysis and means to address them are as follows:

Precipitation Event Duration: The analysis is limited to one event duration, the 24-hour precipitation event. A more thorough analysis would take into consideration other event durations. Oregon does not have up-to-date precipitation estimates that provide spatial and temporal distributions. Lack of this information is a major limitation in determining risk accurately. The probable maximum and frequency precipitation analysis projects described later should address this situation.

Peak Discharge Estimates: For eastern Oregon, some of the peak discharge estimates produced from the regional regression model (OWRD Peak Discharge Calculator) for eastern Oregon are likely incorrect; the regression model underestimates the peak discharge. Since peak discharge estimates were used to calibrate HEC-HMS models, inaccurate values led to inaccurate inputs into some of the hydraulic models which in turn led to inaccurate reservoir level determination for some dams in eastern Oregon. A precipitation frequency analysis for Oregon which could be used to determine more accurate peak discharge estimates in the future is now underway.

Dam Construction practices: Many Oregon dams were constructed under different design standards than applied to new dams. Designs did not usually include geotechnical investigation, and hydrologic calculations are minimal and were designed without zoning or filters. Most of the dams were constructed without an engineer on site to verify the construction followed design. As a result, recent investigations have found dams to be less that homogenous. The semi-quantitative analysis

therefore needed to make significant assumptions about the dams, which are described in the formal reports on file.

3.3.6.14 Deterministic Assessments and Analyses

Rehabilitation or removal of dams requires specific engineering and analysis to verify the risk identified in the risk assessment, and to develop the specific actions to correct the deficiencies at the dam. As described later in the funding section, the OWRD dam safety program was provided funding for dam safety analysis by the Oregon legislature in 2021 and 2023. Staff used results of the risk analysis and inspection history to determine the priority analysis types and the specific dams needing that analysis. Dam Safety then drafted contract language and is managing the contracts with consultants conducting the analyses. This analysis work was focused on the following issues:

- Extreme Precipitation Determination
- Precipitation Frequency Analysis
- Dam Breach Inundation Analyses
- Seismic Assessments and Analyses
- Spillway Capacity Analyses and Spillway Design
- Conduit Condition Assessments
- Structural Repair/Protection Assessments
- Dam Removal Design Plan

All analyses will be complete by 2026. More detail is provided for each analysis type below.

Extreme Precipitation Determination

The purpose of this project is to develop a current understanding of the extreme precipitation possible in Oregon, and how this would change with specific climate-related and measurable factors. This project is critical for safety of Oregonians, not just below dams, but in any location that could be affected by changes in extreme flooding. The analysis and report will improve understanding of the mechanics of precipitation in an extreme atmospheric river event. The project results will be used to determine the accuracy of and potential need to update the National Weather Service's HMR 57, a document used to determine extreme precipitation in Pacific Northwest States. It is the document used to begin analysis for the safety of a high hazard from overtopping in an extreme flood.

This project produced a final Phase 1 report. Phase 2 is underway. The goal of Phase 2 is to develop statewide Atmospheric River ("AR")-based Probable Maximum Precipitation ("PMP"). This includes a procedure for determining PMP in Oregon. The document will provide the appropriate amount of information for an engineer to determine the PMP for any given watershed area above a dam, and then to calculate the flood flow and volume caused by that extreme precipitation (including potential snowmelt). The document will also contain guidance on determining the PMF. The expert engineering hydrology contractor assembled a technical review team of experts to develop and review methods to identify the most extreme potential conditions that could result in the greatest reasonable possible depths, areas and durations in Oregon. As of January 1, 2025, that project is 50 percent complete.

Precipitation Frequency Analysis

Oregon is one of the few states without a NOAA Atlas 14 precipitation frequency analysis and map. Atlas 14 documents are developed by NOAA technical staff and this development is normally funded by State Transportation Agencies. The Oregon Department of Transportation had a less detailed precipitation analysis developed in 2008 and generally does not design highways for extreme precipitation events as dams are designed for, so did not support funding a NOAA Atlas 14 for Oregon. Dam safety has been provided resources and has contracted for an Oregon statewide precipitation frequency analysis.

Risk-informed design for dams requires hydrological loads since they are one of the main hazards for dams and levees. Due to the high consequences, extremely rare events (e.g., return periods over 100,000-year recurrence) must be considered. Methods for hydrologic loading estimation include flow frequency analysis and stochastic flood modeling. Flow frequency analysis presents limited applicability due to limited periods of gauge record and non-stationary streamflow data. Stochastic flood modeling is usually the recommended approach and involves using probabilistic methods to simulate and analyze the occurrence, magnitude, and impacts of flood. Precipitation frequency estimates are one of the primary inputs for stochastic flood modeling. The goal of this project is to generate areal and point precipitation frequency analysis for Oregon for multiple seasons, durations, and return periods. As of January 1, 2025, that project is 50 percent complete.

Dam Breach Inundation Analyses

Dam Breach Inundation Analyses is the means by which hazard potential (rating) is determined. It is an essential dam safety program function, as limited resources can be focused on dams where the effects of dam failure are serious. This type of analysis required by Oregon Administrative rule 690-020-0100 and 0120, both to determine hazard rating changes, and as part of an emergency action plan for a high hazard dam. Dam safety funding has been awarded for a total of 23 dams.

Seismic Assessments and Analyses

The potential for a massive earthquake generated by the Cascadia subduction zone movement was not recognized when most Oregon dams were constructed. The subduction zone is offshore, so the dams closer to the coast will experience the most severe shaking, and projects were prioritized in large part by proximity to the coastline and by use for municipal water supply.

Dam safety contracts have been awarded for a total of 9 dams. A full seismic investigation is being conducted for Lower Pony Creek dam with funds other than HHPD funds. The other eight projects are seismic assessments using original design information, which in many cases is quite limited.

Spillway Capacity Analyses and Spillway Design

Inadequate spillway capacity is the second most common mode of dam failure. Dam safety funding has been awarded for a total of 10 dams. This includes more detailed analysis and design alternatives for five HHPD eligible dams: Willow 3, Pole, Barnes Bute, Bear and Walsh.

Conduit Condition Assessments and Repair/Replacement Alternative

Many Oregon dams were constructed using corrugated metal pipes for the low-level conduit. Corrugated metal pipes have a life span of 20 to 50 years, and most of these pipes have been in the dams for between 50 and 70 years. Most are badly corroded, and some have no remaining material at the base of the pipe. Corroded conduits can be a path for internal erosion, the most common cause of dam failure. One HHPD eligible dam (Upper Big Creek) has experienced an internal erosion event that was identified during a dam safety inspection and subsequently.

Dam safety funding has been awarded for a total of 6 conduit evaluations.

Dam Removal Design Plan

The owner of one HHPD eligible dam is fully supportive of dam removal. Ferry Creek dam in Curry County is no longer used for municipal water supply. Based on the semi-quantitative risk assessment this dam has the highest combined risk of failure of the Oregon eligible dams (but not highest PAR). The dam is almost shovel-ready for removal, with a removal design and permits in progress.

3.3.6.15 Dam Safety Mitigation Strategy

Dam Safety Mitigation Goal

Leverage Federal HHPD funds with other funds and resources to improve the safety of high hazard dams in Poor or Unsatisfactory Condition and to ensure effective response to protect people, property and infrastructure below dams after an earthquake, flood, internal erosion situation or other emergency.

Dam Safety Mitigation Actions and Funding

1. Continue assessing risk for state-regulated HHPDs.

   Semi-quantitative risk assessment work is a very important means of prioritization for dam safety projects. The most significant dam vulnerabilities must be identified to direct subsequent deterministic analysis consistent with current dam safety community design practice.

   Dam safety has been able to use limited funds available to the dam safety program, but this work continues at a slow rate with the given funding.

2. Support an initiative to develop funding for rehabilitation efforts.

   To remove or rehabilitate a deficient dam requires funding for:

   - deterministic analysis
   - development of drawings and specifications
   - obtaining permits to assure safety and environmental protection
   - construction to modify or remove the dam

Oregon has no specific state fund for this work. This would be a new funding source, as such dependent on Executive and Legislative Branch direction as to how it would work. A few dams have received legislative earmarks for major rehabilitation, though this funding was not directly based on dam safety prioritization. This project would consider criteria that would be cost- effective, environmentally sound and technically feasible. Any such project would need to meet state fish passage and other state environmental requirements.

3. Complete floodplain management plans for inundation areas below priority High Hazard dams. Floodplain Management Plans are required for a dam to be eligible for HHPD funding and may also be the best source of information about dam and other flood risk for local governments and persons in potential inundation areas. They may help local governments better make decisions about actions before and during flood and dam breach events. OWRD has been leading exercises with dam owners, the local government emergency manager and first responders. Dam safety communicates the need for additional actions including evacuation maps to prepare residents for potential flooding. This action is low cost, cost- effective, environmentally sound, and technically feasible to reduce risks so jurisdictions are better prepared for dam related and other flooding. OWRD has been allocating resources for this, depending on the level of dam safety funding.

4. Re-evaluate extreme precipitation potential.

   Current guidance for dam safety determinations of extreme flood potential uses technically out of date procedures and neglects recent climate information. Technically correct spillway capacity and loading decisions cannot be made for dams with a hydrologic deficiency without this information. This information is needed to evaluate use of Probable Maximum Flood, or a rare Annual Exceedance Food is more cost effective and still safe and environmentally protective.

   Overtopping in an extreme flood is the second most common cause of dam failure, preventing dam failure is environmentally sound, and technically feasible. Properly designed spillways that can pass outflows from a Probable Maximum Flood would eliminate failure risk during an extreme flood. This action directly contributes to the dam safety mitigation goal. It is already funded by state general fund and ARPA funds.

Local Coordination and Capabilities

Regulation of dams in Oregon is at the State level. Local governments have actively participated and contributed to EAP exercises and updates, and at exercises have been advised to use inundation maps to develop evacuation maps. In general, current local policies, programs, and capabilities do not include mitigation actions for dams, except for selected dams that were eligible for HHPD funding. The issue is mostly new to past developments below dams. Oregon land use effective at limiting new development to Cities. Dam owners are responsible for the safety of their dams, not downstream residents.

Currently, the main safety challenge is that residents are usually not aware of the relatively much higher risk from deficient dams, and how this is very different than for dams up to current safety standards. Inundation maps for state regulated dams in Oregon are public information.

Inundation maps are only required for dams rated high hazard. Oregon dam safety law does not provide a mechanism to get this information to persons at risk from high hazard dams in Unsatisfactory or Poor Condition.

The biggest opportunity for implementing mitigation actions to reduce risks to and from high hazard potential dams through local capabilities is to develop a process to share information on those high hazard dams with much elevated risk with persons and property owners that are affected by this risk. This information has been included in floodplain management plans as part of local natural hazard mitigation plans. For local jurisdictions with HHPD eligible dams, Oregon dam safety has drafted sections on local mitigation for dams with those DLCD staff. If Oregon land use planning Goal 7 rules were updated or interpreted to include actions around dams with verified deficiencies and with people, property or infrastructure at risk, local capabilities would be improved.

Emergency Planning Exercises

Dam Safety has engaged local jurisdictions that have been identified as having high- hazard potential dams, dam owners/operators, and the Oregon Department of Emergency in the exercising and updating of Emergency Action Plans for dams.

Dam safety has developed a standard template for Emergency Action Plans and for Exercises. The objectives listed in the exercise include the following:

- Ensure all responsible parties understand their role and the roles of others during a dam safety emergency
- Understand dam specific vulnerabilities including the importance of freeboard and rate of change of water level
- Demonstrate ability to determine emergency level through technical evaluation
- Learn how to communicate dam safety related conditions so that accurate information flows from the dam owner to emergency managers to persons at risk
- Ensure contact information, the EAP, and inundation maps are up to date
- Understand how to use inundation maps and that they are not an evacuation plan map
- Coordinate communication and public information needs across state and local agencies

Exercises facilitated by dam safety staff include the following HHPD dams: Bear, Big 1 and 2, McMullen, Pole, Willow 3, Lower Pony Creek, and Barnes Butte. Dam safety identifies the most significant vulnerabilities to and from high hazard potential dams and tailors the exercise to address actions to protect persons and reduce risk of dam failure.

Local Natural Hazards Mitigation Plans

Dam safety and DLCD staff have assisted local governments in HHPD dam mitigation for the following jurisdictions:

- Newport for the two Big Creek dams
- Wallowa County for Wallowa Lake dam
- LaGrande for Morgan Lake dam
- Malheur County for Willow Creek 3 and Pole Creek dams

- Curry County for Ferry Creek dam
- Crook county for Barnes Butte dam.

Funding Sources and Staffing for Dam Safety Actions

The Oregon dam safety program relies on several funding sources to mitigate vulnerabilities to and from high hazard potential dams. Funding has been increasing since the new dam safety law was adopted in 2019, including a one-time funding for dam safety analysis, and ARPA funding dedicated to eligible water supply dams.

Current dam safety funding sources include the following:

1. Dam Safety annual fee charged to state regulated dam owners based on the hazard rating of the dam
2. Dam Safety design review fee
3. The state General Fund for dam safety program supports three positions and vehicles
4. A one-time state General Fund for dam safety analysis contracts
5. State Authorized ARPA funds for analysis of water supply dams
6. FEMA HHPD for rehabilitation of high hazard potential dams.
7. FEMA National Dam Safety Program grant for all eligible dam safety program activities.

As of January 1, 2025, there are 4 engineering positions in dam safety. This level of staffing is an increase from the single engineer covering the State prior to 2016. Engineers now conduct inspections of significant hazard dams and determine risk and eligibility for FEMA grant funding, in particular to address high hazard dams that are unsafe or potentially unsafe. Dam Safety is authorized to work cooperatively to address safety issues before a dam becomes dangerous.

Staff also developed and managed contracts for the extra 1-million dollars in state general fund, and 4-million dollars in ARPA funds, and the FEMA HHPD funds awarded to Oregon since 2019.

Funds for Rehabilitation/Removal

The dam safety program has been effective in applications for HHPD funds for risk analysis, design alternatives and designs for eligible dams. Dam safety is allowed by law to utilize funds from any source, including dam owners and local government to support its dam safety actions.

There is currently no state fund for rehabilitation or removal of deficient dams. The 2020 Oregon NHMP included a specific Mitigation Action to address this situation, and a task force was proposed in state legislation. No action was taken on this legislation. A dam safety rehabilitation and removal fund was also included in the state's formal Integrated Water Resource Strategy from 2017. Oregon still needs a statewide funding source and funding policy to assist dam owners in addressing dams with safety deficiencies.

Funding Prioritization

Funding actions for dams are prioritized differently than mitigation actions for other hazards in part because the HHPD requirements are very different and the costs are much higher. Oregon uses the

risk methodology developed by the Oregon Water Resources dam safety program to assess projects based on failure modes, potential consequences resulting from a dam incident, and considers the expected risk reduction and other benefits of the project. The Oregon dam safety program also assesses the loss of the resource and benefits of the dam.

More specifically, for each dam the dam safety program will evaluate as applicable:

- Is semi-quantitative or other risk assessment that meets FEMA criteria complete
- Is deterministic analysis of work needed to rehabilitate or remove the dam completed
- Are the designs and permits ready
- Is the dam public or private
- Is the dam needed for municipal supply or for livelihood/employment
- Can the dam owner(s) provide significant funding and implement the project

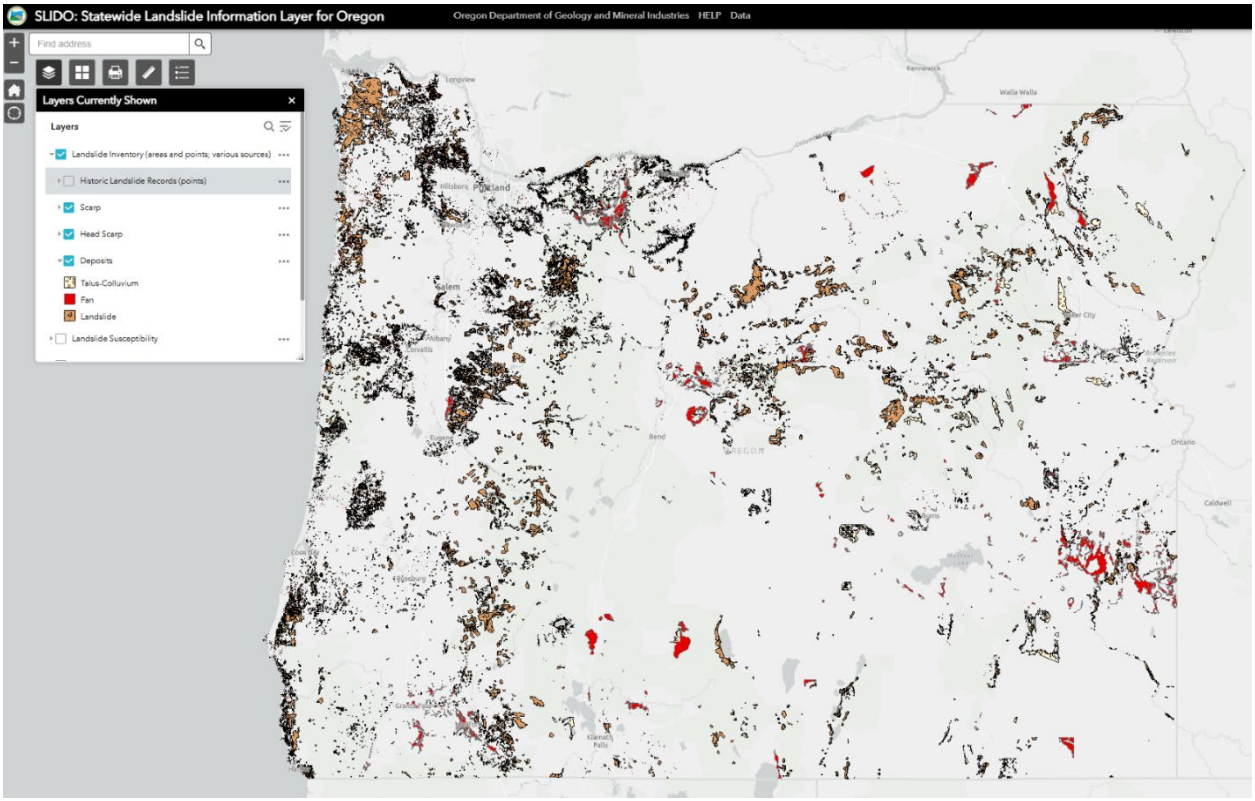
Limitation

The lack of formal mechanism other than the HHPD grant for providing owners funding for essential dam safety work is the main limitation. Dam safety will continue to work with agency management to address this deficiency through the state's normal legislative process.

3.3.7 Landslides

One of the most common and devastating geologic hazards in Oregon is landslides. Landslides can be found throughout the state of Oregon, as seen in the current statewide landslide inventory database, SLIDO R4.4, in Figure 3.3.7-1 and Table 3.3.7-1. Systematic lidar (light detection and ranging)-based landslide mapping has not been performed statewide; however, in general, the areas of the state with more relief and steeper slopes, such as the Oregon Coast Range Mountains and the Cascade Range Mountains, tend to have more landslides. In general counties in Oregon have 10-80 percent high-very high landslide susceptibility as shown in Table 3.3.7-1 derived from the Landslide Susceptibility Overview Map of Oregon.

Figure 3.3.7-1: Statewide Landslide Inventory SLIDO R4.4



Source: Franczyk, J.J., Burns, W.J., Calhoun, N.C., 2019. Statewide Landslide Information Database for Oregon, release 4 (SLIDO-4.0), Oregon Department of Geology and Mineral Industries, Digital Data Series

Table 3.3.7-1: Landslide susceptibility exposure area and percent of Oregon Counties

			Landslide Susceptibility Exposure, ft²				Landslide Susceptibility Exposure, %				
	County	Area, ft²	Low	Moderate	High	Very High	Low	Moderate	High	Very High	High + Very High
1	Baker	85,745,041,556	18,427,313,309	28,591,102,078	36,652,548,721	2,074,077,447	21.5%	33.3%	42.7%	2.4%	45.2%
2	Benton	18,898,991,855	4,992,678,348	6,847,896,474	6,304,116,636	754,300,397	26.4%	36.2%	33.4%	4.0%	37.3%
3	Clackamas	52,482,820,515	12,355,700,886	16,302,031,666	18,117,009,949	5,708,078,013	23.5%	31.1%	34.5%	10.9%	45.4%
4	Clatsop	22,700,260,108	2,057,579,309	2,998,727,490	8,227,272,218	9,416,681,090	9.1%	13.2%	36.2%	41.5%	77.7%
5	Columbia	18,493,573,546	3,374,518,239	4,776,747,887	8,769,151,149	1,573,156,271	18.2%	25.8%	47.4%	8.5%	55.9%
6	Coos	45,354,938,031	5,041,191,570	9,481,330,213	27,924,790,190	2,907,626,058	11.1%	20.9%	61.6%	6.4%	68.0%
7	Crook	83,235,830,831	31,141,381,608	32,866,611,254	15,526,337,997	3,701,499,972	37.4%	39.5%	18.7%	4.4%	23.1%
8	Curry	45,638,104,103	2,650,164,204	9,240,540,460	29,689,033,857	4,058,365,582	5.8%	20.2%	65.1%	8.9%	73.9%
9	Deschutes	85,109,220,479	56,546,695,507	21,081,050,738	7,454,901,368	26,572,866	66.4%	24.8%	8.8%	0.0%	8.8%
10	Douglas	141,317,397,747	12,133,858,652	34,455,769,154	86,836,593,291	7,891,176,650	8.6%	24.4%	61.4%	5.6%	67.0%
11	Gilliam	33,662,136,614	12,523,087,774	10,703,927,449	10,212,038,271	223,083,120	37.2%	31.8%	30.3%	0.7%	31.0%
12	Grant	126,193,657,306	21,247,595,262	47,465,778,299	49,675,296,954	7,804,986,790	16.8%	37.6%	39.4%	6.2%	45.5%
13	Harney	285,145,843,006	179,502,123,490	70,358,116,375	33,801,473,019	1,484,130,121	63.0%	24.7%	11.9%	0.5%	12.4%
14	Hood River	14,582,414,844	1,451,272,957	4,745,622,963	7,427,134,785	958,384,139	10.0%	32.5%	50.9%	6.6%	57.5%
15	Jackson	78,133,339,144	13,872,632,498	24,452,787,551	34,772,529,510	5,035,389,585	17.8%	31.3%	44.5%	6.4%	50.9%
16	Jefferson	49,946,523,725	16,986,526,937	16,904,142,211	14,442,672,705	1,613,181,872	34.0%	33.8%	28.9%	3.2%	32.1%
17	Josephine	45,768,477,096	5,686,920,023	8,136,650,857	31,328,675,574	616,230,642	12.4%	17.8%	68.5%	1.3%	69.8%
18	Klamath	171,143,448,274	102,628,506,245	48,063,317,411	19,450,752,096	1,000,872,523	60.0%	28.1%	11.4%	0.6%	11.9%
19	Lake	233,060,448,824	158,329,067,591	51,170,622,619	20,371,153,624	3,189,604,990	67.9%	22.0%	8.7%	1.4%	10.1%
20	Lane	128,802,991,658	16,755,013,466	38,682,477,990	64,663,344,708	8,702,155,495	13.0%	30.0%	50.2%	6.8%	57.0%
21	Lincoln	27,673,176,599	1,939,016,555	5,560,163,586	17,098,652,531	3,075,343,928	7.0%	20.1%	61.8%	11.1%	72.9%
22	Linn	64,272,873,796	18,507,907,440	13,731,267,567	23,983,676,960	8,050,021,829	28.8%	21.4%	37.3%	12.5%	49.8%
23	Malheur	276,601,766,018	141,882,833,248	85,058,608,415	45,456,525,427	4,203,798,928	51.3%	30.8%	16.4%	1.5%	18.0%
24	Marion	33,185,295,063	14,072,342,462	7,642,297,819	9,550,677,782	1,919,977,000	42.4%	23.0%	28.8%	5.8%	34.6%
25	Morrow	56,628,190,492	24,805,570,909	20,356,455,504	11,380,627,588	85,536,491	43.8%	35.9%	20.1%	0.2%	20.2%
26	Multnomah	12,223,672,777	4,712,992,825	3,638,767,903	3,250,418,931	621,493,118	38.6%	29.8%	26.6%	5.1%	31.7%
27	Polk	20,738,900,872	6,469,153,617	4,251,225,794	9,539,951,545	478,569,915	31.2%	20.5%	46.0%	2.3%	48.3%
28	Sherman	23,057,239,569	11,360,531,905	6,323,824,280	5,342,690,616	30,192,769	49.3%	27.4%	23.2%	0.1%	23.3%
29	Tillamook	31,340,756,476	2,581,502,742	2,662,963,451	19,610,618,770	6,485,671,513	8.2%	8.5%	62.6%	20.7%	83.3%
30	Umatilla	89,769,773,294	31,779,595,578	31,033,819,776	26,074,546,107	881,811,833	35.4%	34.6%	29.0%	1.0%	30.0%
31	Union	56,832,962,984	13,721,146,622	21,385,787,806	18,471,463,366	3,254,565,190	24.1%	37.6%	32.5%	5.7%	38.2%
32	Wallowa	87,790,890,515	14,105,102,624	22,837,879,148	49,487,844,531	1,360,064,213	16.1%	26.0%	56.4%	1.5%	57.9%
33	Wasco	66,503,203,674	18,224,397,082	27,164,026,064	17,382,971,537	3,731,808,991	27.4%	40.8%	26.1%	5.6%	31.8%
34	Washington	20,258,824,921	6,371,254,612	5,934,460,272	7,147,799,469	805,310,569	31.4%	29.3%	35.3%	4.0%	39.3%
35	Wheeler	47,835,198,973	4,792,578,409	17,939,448,483	19,167,910,975	5,935,261,107	10.0%	37.5%	40.1%	12.4%	52.5%
36	Yamhill	20,024,032,738	5,285,461,212	4,235,189,720	9,399,065,951	1,104,315,854	26.4%	21.2%	46.9%	5.5%	52.5%

Source: Burns, W.J., Mickelson, K.A., Madin, I.P., 2016. Statewide landslides susceptibility overview map of Oregon: Oregon Department of Geology and Mineral Industries, Open-File Report O-16-02.

DOGAMI found that to truly understand the landslide hazard in Oregon, lidar (light detection and ranging) topographic data must be collected and used during the mapping of existing landslides and modeling of future susceptibility. Completing this type of mapping and modeling is one of DOGAMI's long-term goals.

Average annual repair costs for landslides in Oregon exceed $10 million and individual severe winter storm losses can exceed $100 million (Wang, Summers, & Hofmeister, 2002). As population growth continues to expand and development occurs in landslide susceptible terrain, greater losses are likely to result.

Landslides in Oregon are typically triggered by periods of heavy rainfall and/or rapid snowmelt. Earthquakes, volcanoes, and human activities also trigger landslides.

Three main factors influence an area's susceptibility to landslides: geometry of the slope, geologic material, and water. Certain geologic formations are more susceptible to landslides than others. In general, locations with steep slopes are most susceptible to landslides, and the landslides occurring on steep slopes tend to move more rapidly and therefore may pose life safety risks.

3.3.7.1 Analysis and Characterization

El Niño Southern Oscillation and Effects on Landslides

The strongest impacts of intra-seasonal variability on the U.S. occur during the winter months over the western U.S. During the winter this region receives the bulk of its annual precipitation. Storms in this region can last for several days or more and are often accompanied by persistent atmospheric circulation features. Of particular concern are the extreme precipitation events which are linked to flooding and landslide. There is strong evidence for a linkage between weather and climate in this region from studies that have related the El Niño-Southern Oscillation (ENSO) to regional precipitation variability. From these studies it is known that extreme precipitation events can occur at all phases of the El Niño-Southern Oscillation (ENSO) cycle, but the largest fraction of these events occur during La Niña episodes and during ENSO-neutral winters. During La Niña episodes much of the Pacific Northwest experiences increased storminess, increased precipitation and more overall days with measurable precipitation. The risk of flooding and rain-induced landslides (and debris flows) in this region can be related to La Niña episodes.

Source: NOAA/Climate Prediction Center, http://www.cpc.noaa.gov/products/intraseasonal/intraseasonal_faq.html#usimpactsSource: NOAA/Climate Prediction Center, http://www.cpc.noaa.gov/products/intraseasonal/intraseasonal_faq.html#usimpacts

The term "landslide" encompasses a wide range of geologic processes and a variety of nomenclatures that can lend itself to confusion. The general term landslide refers to a range of mass movement including rock falls, debris flows, earth slides, and other mass movements. One very important thing to understand is the fact that all landslides have different frequencies of movements, triggering conditions, and very different resulting hazards.

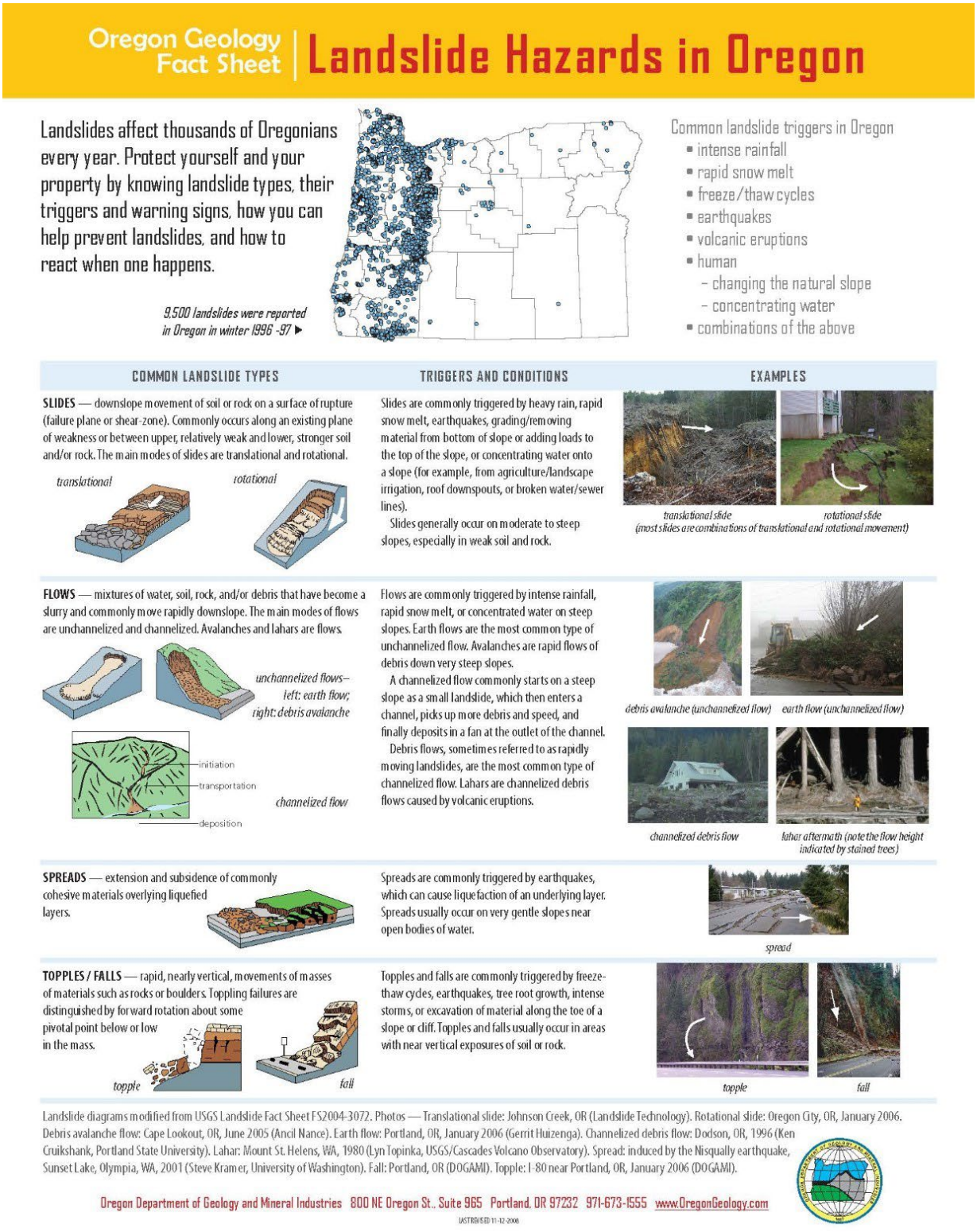
All landslides can be classified into one the following six types of movements: (a) slides, (b) flows, (c) spreads, (c) topples, (d) falls, and (f) complex (Figure 3.3.7-2). Most slope failures are complex combinations of these distinct types, but the generalized groupings provide a useful means for framing discussion of the type of hazard associated with the landslide, the landslide characteristics, identification methods, and potential mitigation alternatives.

These types of movements can be combined with other aspects of the landslide such as type of material, rate of movement, depth of failure, and water content for a better understanding of the type of landslide.

One potentially life-threatening type of landslide is the channelized debris flow or "rapidly moving landslide," which initiates upslope, moves into and down a steep channel (or drainage) and deposits material, usually at the mouth of the channel. Debris flows are also commonly initiated by other types of landslides that occur on slopes near a channel. They can also initiate within the channel in areas of accelerated erosion during heavy rainfall or snowmelt. Rapidly moving landslides have caused most of the recent landslide related injuries and deaths in Oregon. Debris flows or rapidly moving landslides following storms caused eight deaths in Oregon in 1996, a La Niña year.

Areas that have failed in the past often remain in a weakened state, and many of these areas tend to fail repeatedly over time. This commonly leads to distinctive geomorphology that can be used to identify landslide areas, although over time the geomorphic expression may become subtle, making the landslide difficult to identify. Other types of landslides tend to occur in the same locations and produce distinctive geomorphology, such as channelized debris flows, which form a fan at the mouth of the channel after repeated events. This is also true for the talus slopes, which form after repeated rock fall has taken place in an area.

Figure 3.3.7-2: Common Types of Landslides in Oregon.



Source: DOGAMI, Landslide Hazards in Oregon fact sheet (http://www.oregongeology.org/pubs/fs/landslide-factsheet.pdf)

Previously impacted areas are particularly important to identify, as they may pose a substantial hazard for future instability and help identify areas that are susceptible to future events. Large, slow-moving landslides frequently cause significant property damage but are far less likely to result in serious injuries. The 1997 Tillamook County, and the 2005 Oregon City slides are examples.

The velocity of landslides varies from imperceptible to tens of miles per hour. Some volcanic induced landslides have been known to travel between 50 to 150 miles per hour. On less steep slopes, landslides tend to move slowly and cause damage gradually. Debris flows typically start on steep hillsides as shallow landslides, enter a channel, then liquefy and accelerate. Canyon bottoms, stream channels, and outlets of canyons can be particularly hazardous. Landslides can move long distances, sometimes as much as several miles. The Dodson debris flows in 1996 started high on Columbia River Gorge cliffs and traveled down steep canyons to form debris fans in the Dodson-Warrendale area.

Post-fire debris flows are also a threat in areas of Oregon burned by wildfires. In 2017, the Eagle Creek Fire occurred in the Columbia River Gorge, then in 2021 and 2022 hundreds of post-fire debris flows were triggered during atmospheric river type storms. One of these resulted in a fatality.

Landslide recurrence interval is highly variable. Some large landslides move continuously at very slow rates. Others move periodically during wet periods. Very steeply sloped areas can have relatively high landslide recurrence intervals (10 to 500 years on an initiation site basis).

Because debris flows can be initiated at many sites over a watershed, in some cases recurrence intervals can be less than 10 years. Slope alterations can greatly affect recurrence intervals for all types of landslides, and cause landslides in areas otherwise not susceptible. Most slopes in Western Oregon steeper than 30 degrees (about 60 percent) have a risk of rapidly moving landslide activity regardless of geologic unit. Areas directly below these slopes in the paths of potential landslides are at risk as well.

Based on the Oregon Department of Forestry Storm Impacts Study, the highest debris flow hazard occurs in western Lane County, western Douglas County, and Coos County. The combination of steep slopes and geologic formation (sedimentary rock units) contributes to the increased hazard. The debris flow hazard is also high in much of the Oregon Coast Range and Cascade Range Mountains and in the Columbia River Gorge.

Deep landslides are generally defined as having a failure plane within the regional bedrock unit (generally greater than 15 feet deep), whereas the failure plane of shallow landslides is commonly between the thin soil mantle and the top of the bedrock. Deep landslide hazard is high in parts of the Coast Range. Deep landslides are fairly common in pyroclastic rock units of the Western Cascade Range Mountains, and in fine-grained sedimentary rock units of the Oregon Coast Range. Deep landslides also occur in semi-consolidated sedimentary rocks at or near the Oregon coast and in the Troutdale Formation in the northern portions of the Willamette Valley.

Infrequent very large landslides and debris flows may occur in any of the larger mountain ranges or in deep gorges throughout Oregon.

During 1996 and 1997, heavier than normal rains caused over 700 landslides within the Portland Metropolitan region, which totaled over $40 million for mitigation (Burns, Burns, James, & Hinkle, 1998). In the City of Portland, 17 homes were completely destroyed and 64 were badly damaged. There were no

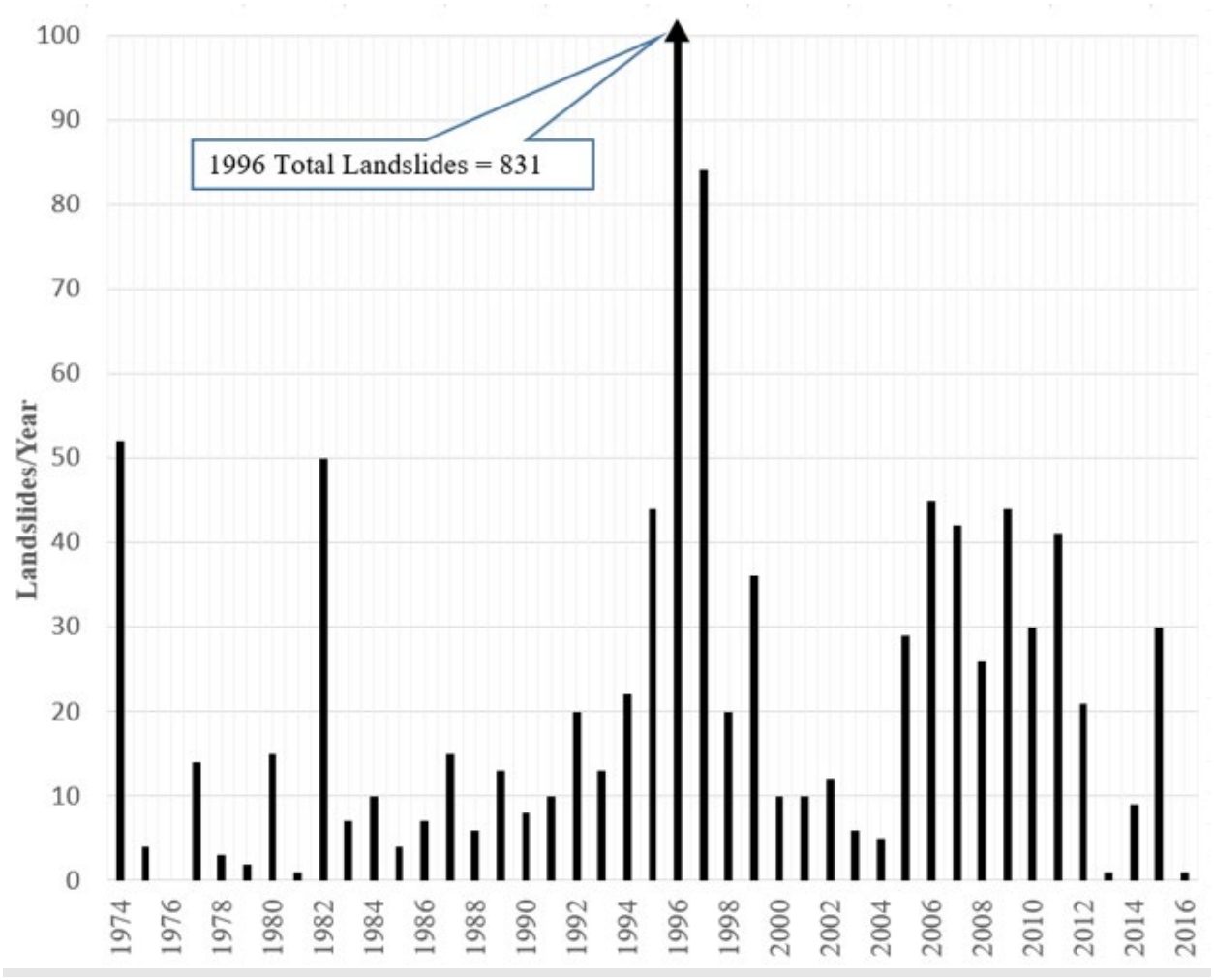
serious injuries associated with the landslides in Portland or in other urban areas within Oregon during the 1996 storms.

The Oregon Department of Forestry Storm Impacts Study estimated that tens of thousands of landslides occurred on steep slopes in the forests of Western Oregon during 1996. Areas with recent logging, especially clear cutting, and areas near forest roads had a higher likelihood of landslides. The Oregon Department of Geology and Mineral Industries Slope Failures in Oregon inventoried thousands of reports of landslides across the state resulting from the 1996-1997 storms. There are a significant number of locations in Oregon that are impacted frequently (every 10 to 100 years) by dangerous landslides. The number of injuries and deaths in the future will be directly related to vulnerability: the more people in these areas, the greater the risk of injury or death.

3.3.7.2 Historic Landslide Events

Oregon has declared 41 major disaster declarations from 1955 through 2024. Thirty-seven of these are related to storm events causing flooding and landslides. One of the most significant of these disasters is the 1996 and 1997 storms, which caused thousands of landslides in Oregon. The City of Portland has some of the best landslide records in Oregon. When examining these records of 1,806 landslides, 831 of these occurred during February 1996 storm. Further examination of the data found incomplete records or lack of data collection from 1928 to 1973. Excluding the year 1996, there is an average of 20 landslides per year, from 1974 to 2016. This highlights the fact that large storm events like the February 1996 storm can cause the majority of landslides in Oregon and result in large disasters from damage and losses. However, landslides are still an annual chronic hazard.

Figure 3.3.7-3: Portland landslide events

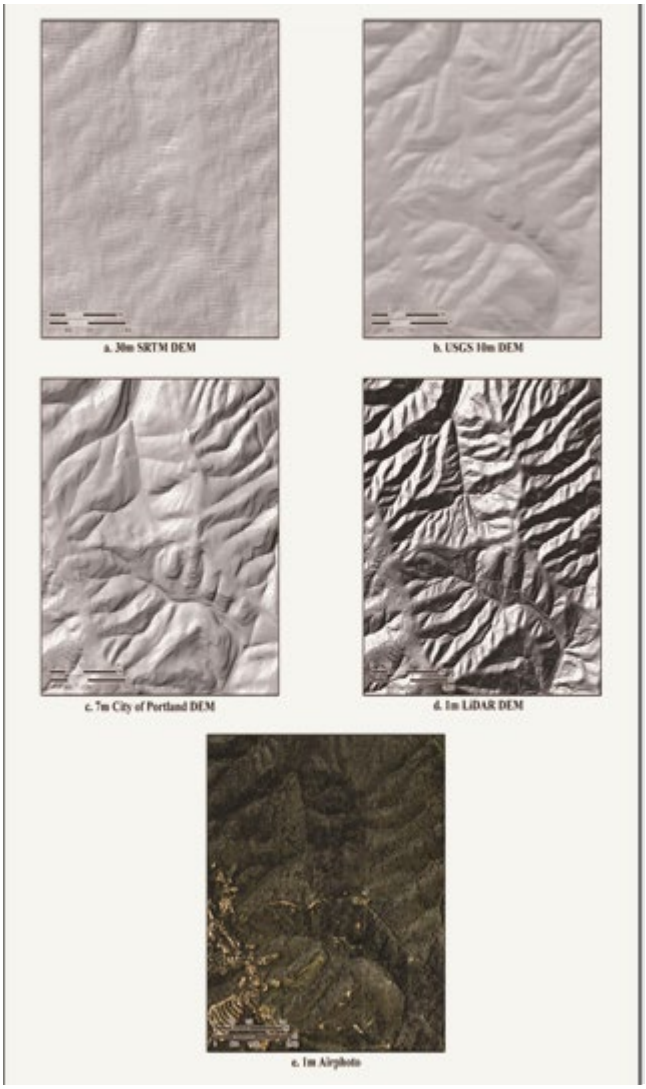


Source: Burns, W.J., Calhoun, N.C., Franczyk, J.J., Koss, R.J., Bordal, M.G., 2017. Estimating Losses from Landslides in Oregon, In De Graff, J.V. and Shakoor, A. (eds.), Landslides: Putting Experience, Knowledge and Emerging Technologies into Practice, AEG Special Publication No. 27, p. 473-482.

Landslides are found in every county in Oregon as shown in Table 3.3.7-1. There is a 100 percent probability of landslides occurring in Oregon in the future. Although DOGAMI does not know exactly where and when they will occur, they are more likely to happen in the general areas where landslides have occurred in the past. Also, they will likely occur during intense rainfall events like atmospheric river type storms which are projected to increase in frequency under future climate change, or during a future earthquake or volcanic eruption.

To reduce losses from landslides, areas of landslide hazard must first be identified. The first step in landslide hazard identification is to create an inventory of past landslides. Once this inventory is created, it can be used to create susceptibility maps which display areas that are likely to have landslides in the future. Once the landslide hazards are identified on inventory and susceptibility maps, the risk can be quantified, mitigation projects prioritized and implemented.

Figure 3.3.7-4: Visual Comparison of five remote sensing data sets



Note: The air photo is draped over a DEM so that it appears to have the 3-dimensional view provided by a stereo-pair
Source: Burns, W. J., 2007, Comparison of remote sensing datasets for the establishment of a landslide mapping protocol in Oregon. AEG Special Publication 23: Vail, Colo., Conference Presentations, 1st North American Landslide Conference.

In 2005, DOGAMI began a collaborative landslide research program with the U.S. Geological Survey (USGS) Landslide Hazards Program to identify and understand landslides in Oregon. To begin the extensive undertaking of mapping existing landslides throughout Oregon, a pilot project area was selected to compare remote sensing data/images for effectiveness. The remote sensing data sets compared included (Burns W. J., 2007) (Figure 3.3.7-4)

1. 30-m (98 ft) digital elevation model (DEM) from the Shuttle Radar Topography Mission;
2. 10-m (33 ft) DEM derived from USGS topographic quadrangles;
3. Photogrammetric and ground-based 1.5-m (5 ft) interval contour data;
4. Stereo aerial photographs from 1936 to 2000; and

5. Lidar imagery with an average of 1 data point per square meter (3.2 ft) and with a vertical accuracy of about 5 cm (6 in).

Two key findings of the pilot project were: (a) the use of the lidar data resulted in the identification of between 3 to 200 times the number of landslides identified using the other data sets, and (b) the ease and accuracy of mapping the spatial extent of the landslides identified from lidar data were greatly improved compared to other mapping methods.

When examining the results of the comparison of remote sensing data, several debris flow fans at the mouths of channels or potential channelized debris flow deposits were identified with serial stereo-pair aerial photos, which did not get identified on the lidar-derived DEMs (Digital Elevation Model). Dense development has taken place in Oregon in the last 40 years, which can mask landslide features, especially if major earthwork has taken place. In most of the populated areas of Oregon, if historic air photos are available, at least one review of (greater than 40 years old) photos should be performed.

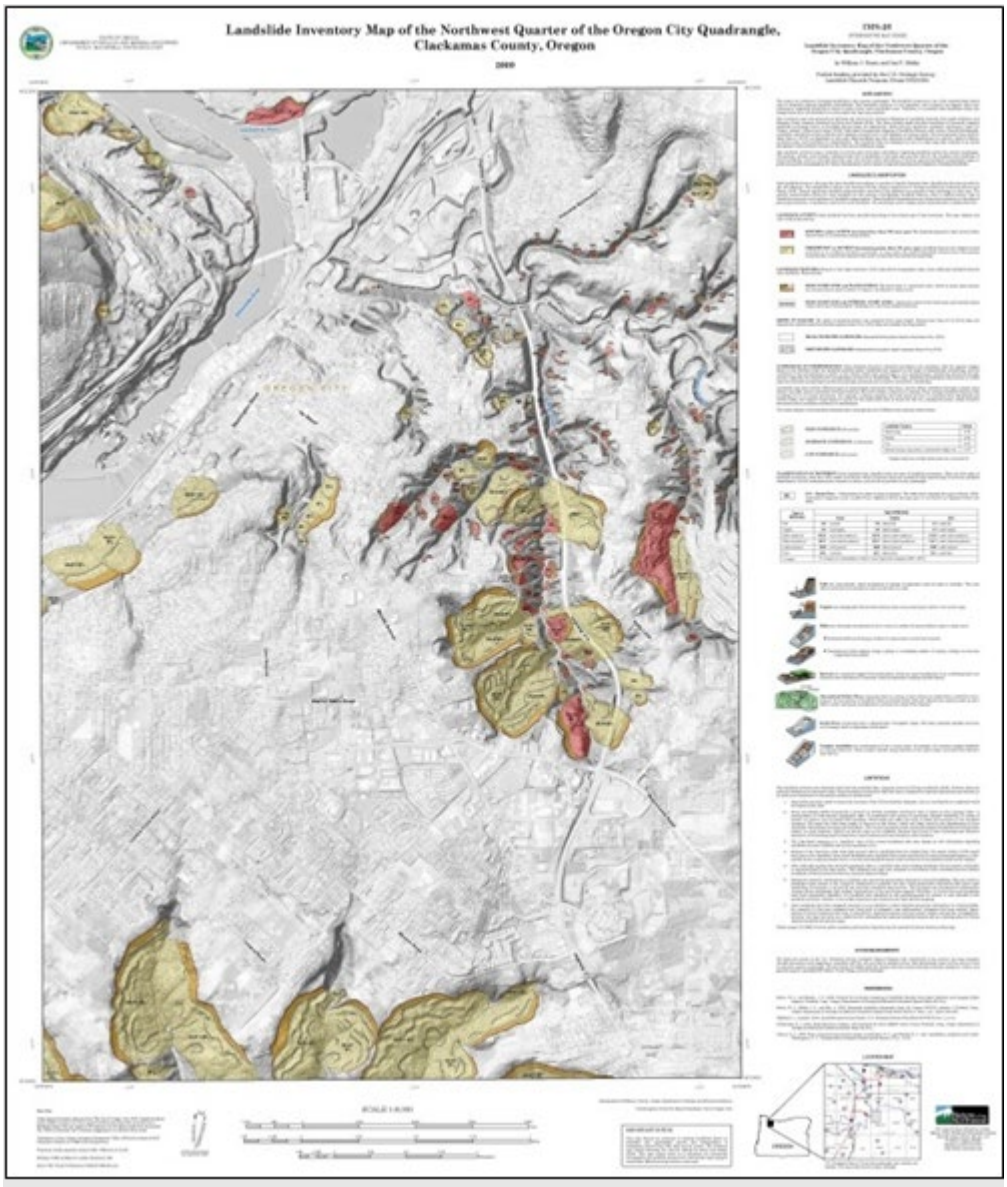
To develop accurate large-scale landslide inventory maps, DOGAMI recommends the following minimal requirements:

1. All previously identified landslides from geologic maps, previous landslide studies, and other local sources should be compiled.
2. The mapper should have experience identifying all types and ages of landslides within the area being studied.
3. Lidar data should be used to identify landslides and accurately locate the extents of previously mapped landslides (from step 1).
4. An orthophoto of similar age to the lidar data should be used to minimize the misidentification of man-made cuts and fills as landslides.
5. The mapper should use at least one set of historical stereo-pair aerial photography to locate landslides in the area being studied.

Non-spatial data should also be collected at the time of the mapping so that a comprehensive database can be formed. Non-spatial data should generally include confidence of interpretation, movement class, direction of movement, etc. and are described in detail in section 6.0 of this paper. A comprehensive check of spatial (map) and non-spatial data should be developed and implemented including technical review of mapped landslides and field checks where possible.

A protocol was developed by DOGAMI so that analysts can produce consistent lidar-based landslide inventory maps at an accelerated rate without having to describe how the mapping was done every time a new area is mapped (Burns & Madin, 2009). The results of following this protocol in any particular area include a very detailed database and map of the landslide inventory (Figure 3.3.7-5).

Figure 3.3.7-5: Example of a Lidar-Based Landslide Inventory (Oregon City, Oregon)

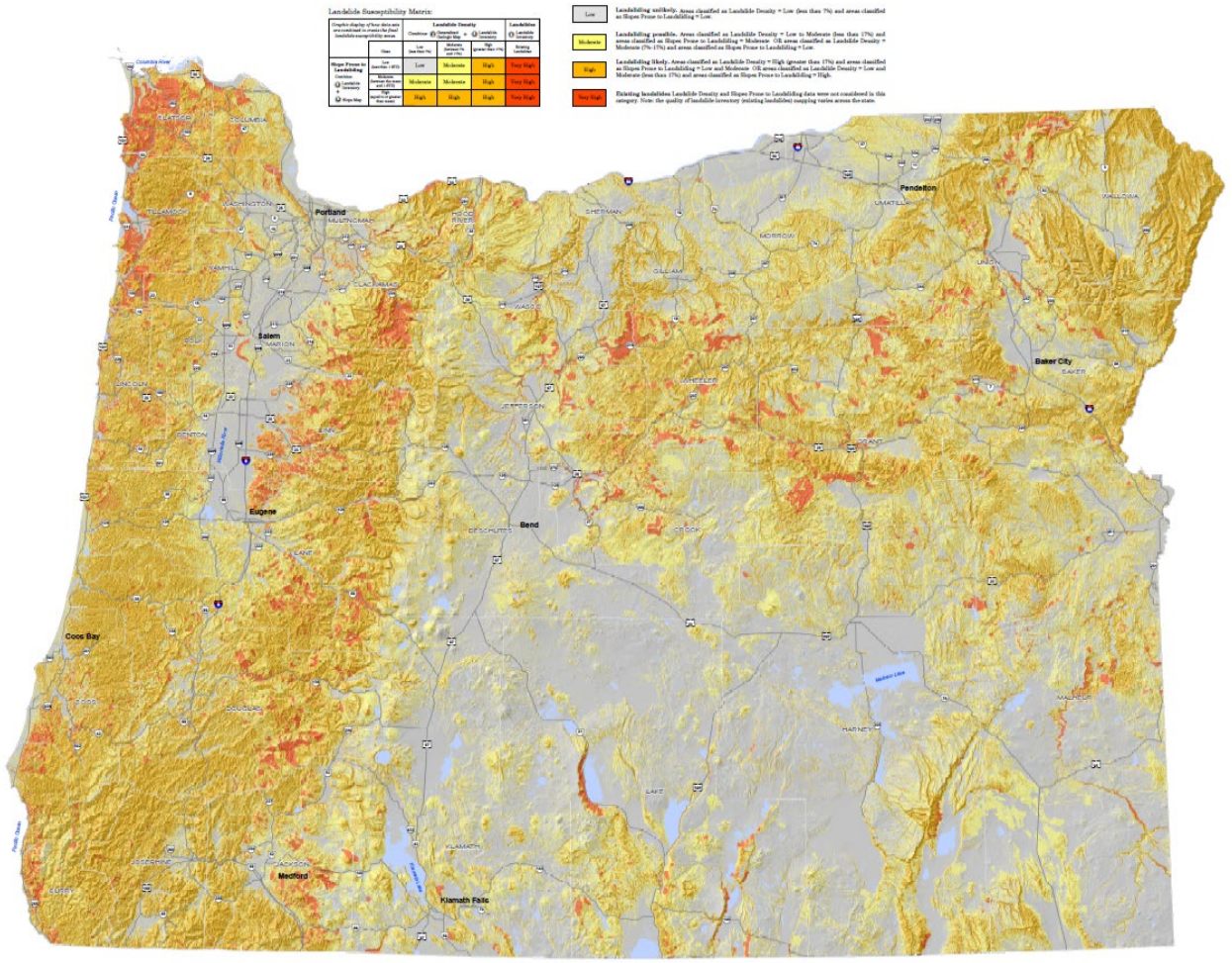


Source: Burns & Mickelson (2010)

With an accurate landslide inventory in hand, the next step in a complete landslide hazard mapping program is developing susceptibility. DOGAMI has completed a shallow landslide, deep landslide, and channelized debris flow susceptibility mapping protocols, which are being implemented in regions of

Oregon as needed and when funding is available. Because implementing these methods will take some time, a generalized landslide susceptibility map was created in 2016 (Figure 3.3.7-6).

Figure 3.3.7-6: Statewide Landslide Susceptibility Overview Map.



Source: Burns, W.J., Mickelson, K.A., Madin, I.P., 2016. Statewide landslides susceptibility overview map of Oregon: Oregon Department of Geology and Mineral Industries, Open-File Report O-16-02.

There are many details which can affect the landslide risk. Some are related to the hazard and some are related to the assets. Below are lists of some of these details. This list is not comprehensive but does provide insight into the overall landslide risk in Oregon.

Landslide Hazard:

- Spatial extent - Location of previous landslides and locations of future landslides can have a dramatic impact on landslide risk. For example, a landslide in a wilderness can have minimal risk versus a landslide in a dense urban area can result in significant damage and losses.
- Type of landslide – Different types of landslides have different sizes and rates of movement. Some types move very fast and present life safety concerns. Some are very large and can damage entire

neighborhoods. Some damage infrastructure (roads, electricity, water) which can affect large regions of Oregon.
- Magnitude – The size of the landslide can have a very large range from 10 ft to 10 miles. The size of the events can have a large effect on the damage and losses.
- Frequency – How often landslides occur can increase or decrease the level of risk. For example, as previously noted, during large storm events the number of landslides can increase dramatically which can change how much damage and losses occur.

Assets:

- Built environment – Some buildings and infrastructure are more or less vulnerable to landslides depending on the construction type and geotechnical analysis and stabilization during construction. For example, a flexible conduit can withstand ground movement while a stiff conduit may fail.
- People – Every single person is unique which results in variable vulnerability to landslides. For example, one person may be aware of the life-safety concern with debris flow and able to evacuate before an event while others may be unaware or unable to evacuate.
- Economy – Every community has different levels of economic resources. A community with a lot of economic resources may be able to mitigate landslide hazards and thus reduce risk, however the opposite can also be a reality.
- Environment – The environment can benefit or hinder from landslide impacts. For example, debris flow can deposit coarse grained material which can become salmon eggs in gravel nests.
- Culture (archaeology, historic sites, traditional activities) – Cultural sites can be vulnerable to landslides because they were generally constructed before scientists understood where landslides hazards may happen in the future. These sites can also be very dependent on stable ground, such as cemeteries, which can be easily severely damaged by landslides.
- Governance – Every community has different priorities and willingness to perform risk reduction within their community. If landslide risk reduction is not a priority or if the community lacks willingness to reduce landslide risk, the landslide risk may remain higher than it would in a proactive willing community.

3.3.7.3 Risk Maps

The maps in this section highlight places where the state might work with communities to develop mitigation projects.

The National Risk Index produces a measure of monetary losses experienced over the period of record. This emphasizes historic costs of harm and would direct mitigation resources to where the costs have been the greatest. Mitigation in these locations would save money over the long term.

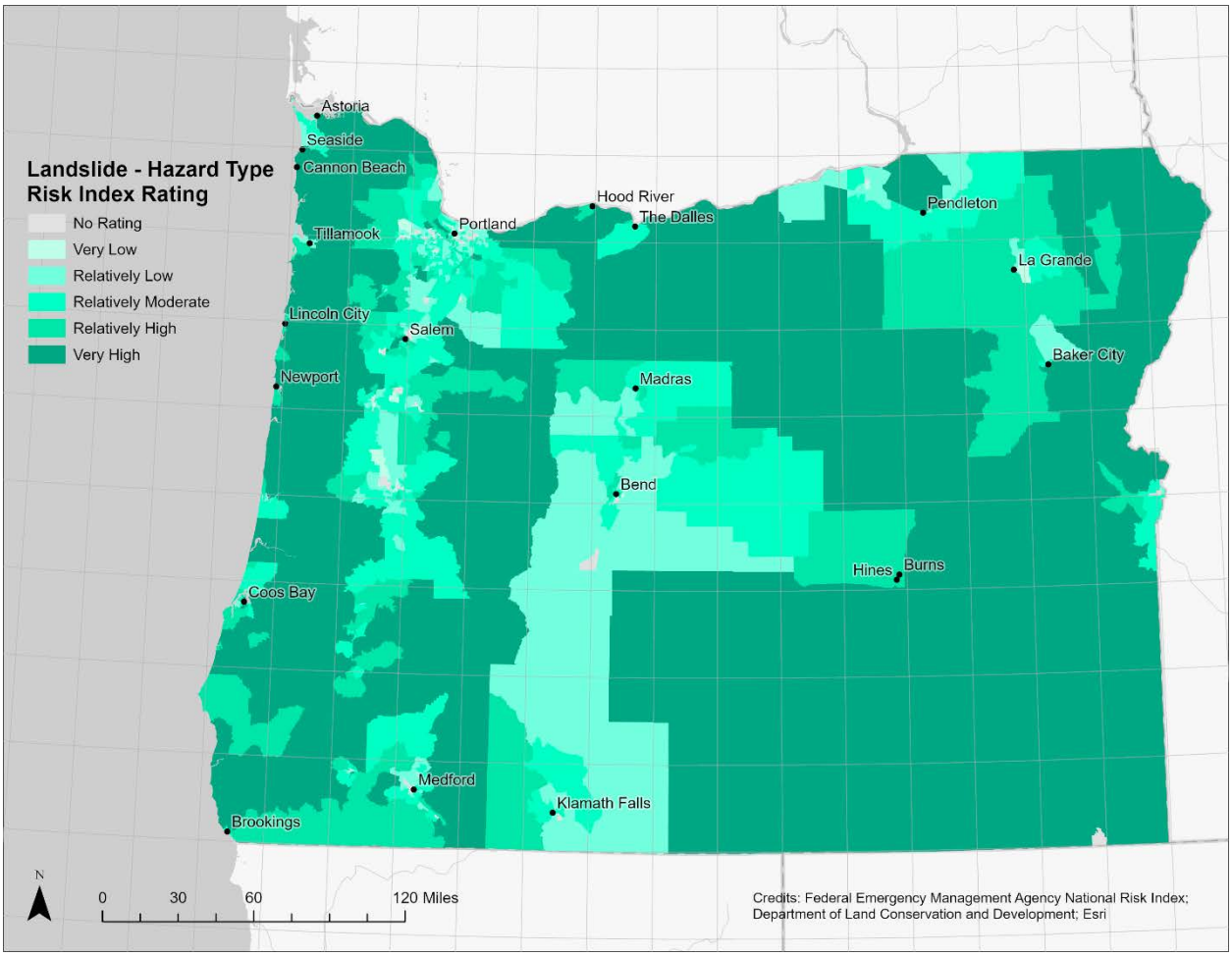
In contrast to the National Risk Index, the Oregon Natural Hazards Risk Assessment used indicators of harm based on percentages rather than counts of exposed entities or monetary loss. This captures the potential for disruption within a census tract. The higher the percentage of entities affected, the more disruption to those living or working in the census tract.

The Oregon Natural Hazards Risk Assessment produced two statewide summary maps showing distribution of potential harm. The first map uses both socioeconomic and hazard factors. The second map uses hazard

factors alone. The maps show the importance of recognizing the cost of disruption not only to buildings and infrastructure, but also to people, especially vulnerable populations. Both types of losses can be mitigated.

The climate change maps show where risk is projected to increase. Areas with a high risk and a high increase in risk would be especially good places to work with communities to find mitigation projects.

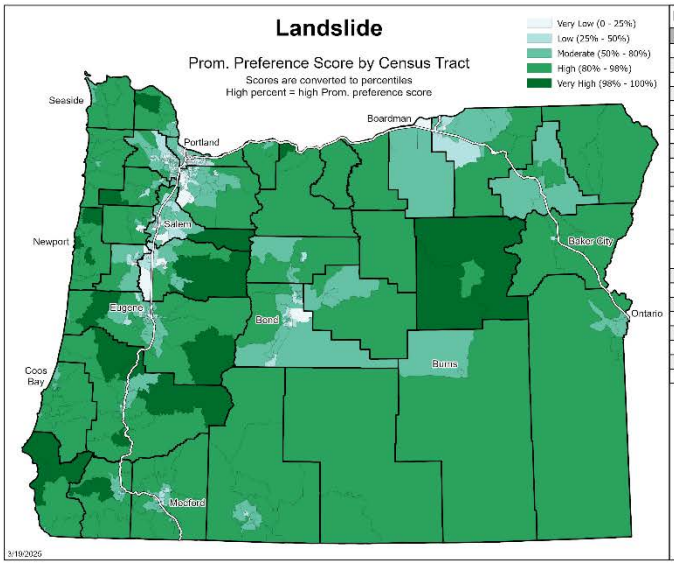
Figure 3.3.7-7: Landslide Risk Rating from the NRI. Risk Index Rating from the Federal Emergency Management Agency, National Risk Index for Landslide.



Source: Federal Emergency Management Agency, National Risk Index for Landslide. Ranking based on national percentiles. Last updated by FEMA in March 2023. Data accessed on February 12, 2025 from National Risk Index | FEMA.gov.

Figure 3.3.7-8 and Figure 3.3.7-9 show risk rankings by census tract for landslides from the Oregon Natural Hazards Risk Assessment. Darker colors show census tracts with higher risk. Figure 3.3.7-8 shows census tracts ranked using hazard and socioeconomic vulnerability indicators. Figure 3.3.7-9 shows census tracts ranked using only hazard indicators, without using socioeconomic vulnerability indicators. Cities are included for locational reference only and do not show risk by city. Chapter 9 has additional details and examples of the information available from the risk assessment model.

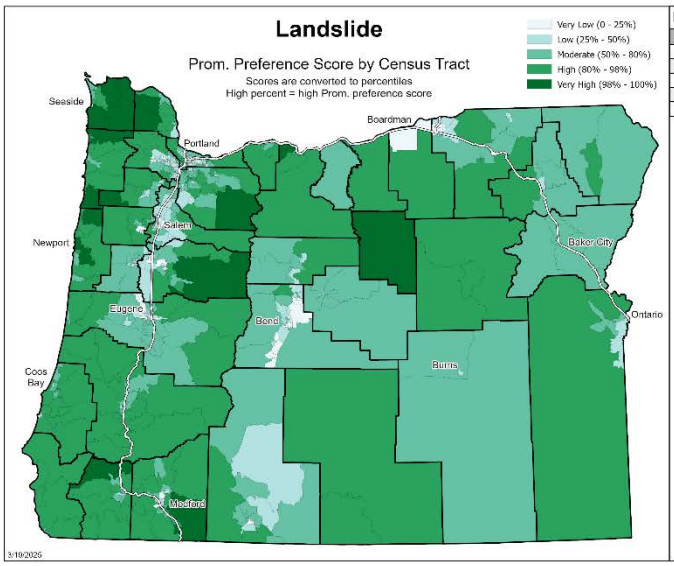
Figure 3.3.7-8: Landslide results of Oregon Risk Assessment using PROMETHEE Ranking with Socioeconomic Indicators Included.



Indicators used for the hazard Hazard indicators are worth 35% of the total weight.

Hazard	Indicator Name	Direction	Weight	Short Description
Landslide	LSS_pct_bld	1	0.07	Percentage of SBFO buildings exposed to existing landslide deposit.
Landslide	LSS_pct_CF	1	0.07	Percentage of critical facilities exposed to existing landslide deposit.
Landslide	Hwy_LSS_pct	1	0.07	Major roadway miles that are exposed to existing landslide deposits.
Landslide	Hist_LSS_ct	1	0.07	Percentage of historic buildings exposed to existing landslide deposit.
Landslide	LSS_Haz_Area	1	0.07	Area of tract in high or very high landslide hazard.
General	EP_MINRTY	1	0.046	Percentage of Black, Indigenous, and People of Color (2020 Census).
General	HousingTenure	-1	0.046	Housing tenure from the US Census.
General	EP_MOBILE	1	0.046	Percentage of people that live in mobile homes
General	Median_Yrblt	-1	0.046	Median year built of general building stock based on HAZUS default.
General	HospitalDistMile	1	0.046	Distance from tract centroid to nearest hospital.
General	NatResrcJobs	1	0.046	Rate of natural resource jobs.
General	PRFD3_PE	1	0.046	Community Resilience Estimate
General	Hosp_Beds	-1	0.046	Estimated number of hospital beds based on square footage .
General	Pct_Adherents	-1	0.046	Percentage of members to a religious group
General	Mitigation	-1	0.046	Number of migitation projects (grouped by zip code and evenly distributed to overlaying tracts)
General	Watch	-1	0.046	Neighborliness: Will watch neighbor's house
General	CountyTax	-1	0.046	County tax rate
General	CityTax	-1	0.046	City tax rate
General	Cultural	-1	0.009	Number of cultural-related buildings
General	Favors	-1	0.009	Neighborliness: Willing to do favors for neighbor
General	Advice	-1	0.009	Neighborliness: Seeks advice from neighbor
General	Parties	-1	0.009	Neighborliness: Attended parties that occur in neighborhood
General	Visits	-1	0.009	Neighborliness: Has visited neighbor's house

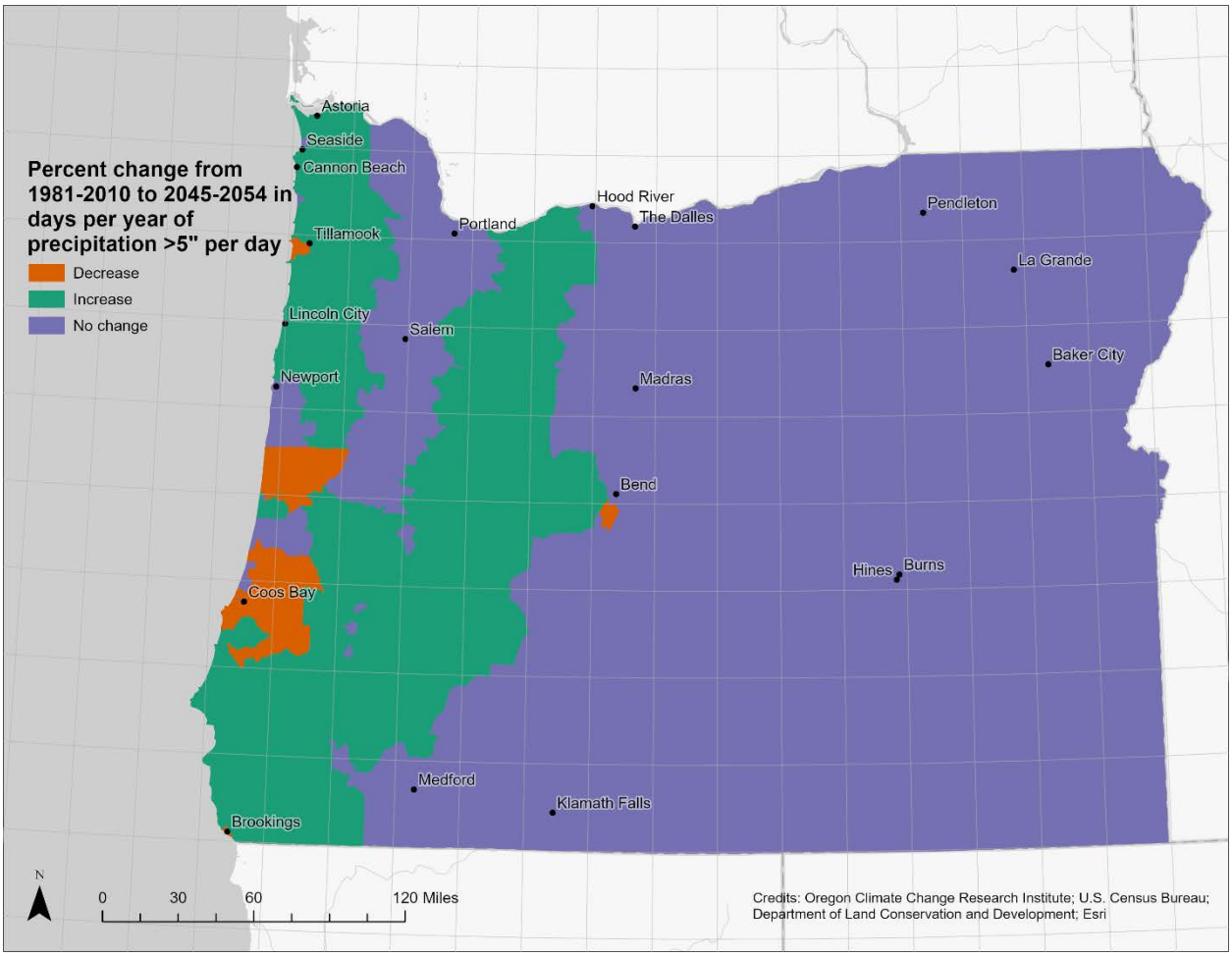
Figure 3.3.7-9: Landslide results of Oregon Risk Assessment using PROMETHEE Ranking without Socioeconomic Indicators Included.



Indicators used for the hazard

Hazard	Indicator Name	Direction	Weight	Short Description
Landslide	LSS_pct_bld	1	0.2	Percentage of SBFO buildings exposed to existing landslide deposit.
Landslide	LSS_pct_CF	1	0.2	Percentage of critical facilities exposed to existing landslide deposit.
Landslide	Hwy_LSS_pct	1	0.2	Major roadway miles that are exposed to existing landslide deposits.
Landslide	Hist_LSS_ct	1	0.2	Percentage of historic buildings exposed to existing landslide deposit.
Landslide	LSS_Haz_Area	1	0.2	Area of tract in high or very high landslide hazard.

Figure 3.3.7-10: Change in Average Number of Heavy Precipitation Days: Change from 1981-2010 to 2045-2054 in days per year of precipitation that equals or exceeds 5 inches per day.



Source: Derived from 52 ensemble members of 11 LOCA2 downscaled global climate models. Data provided by Oregon Climate Change Research Institute, 2025. Graphic produced by DLCD.

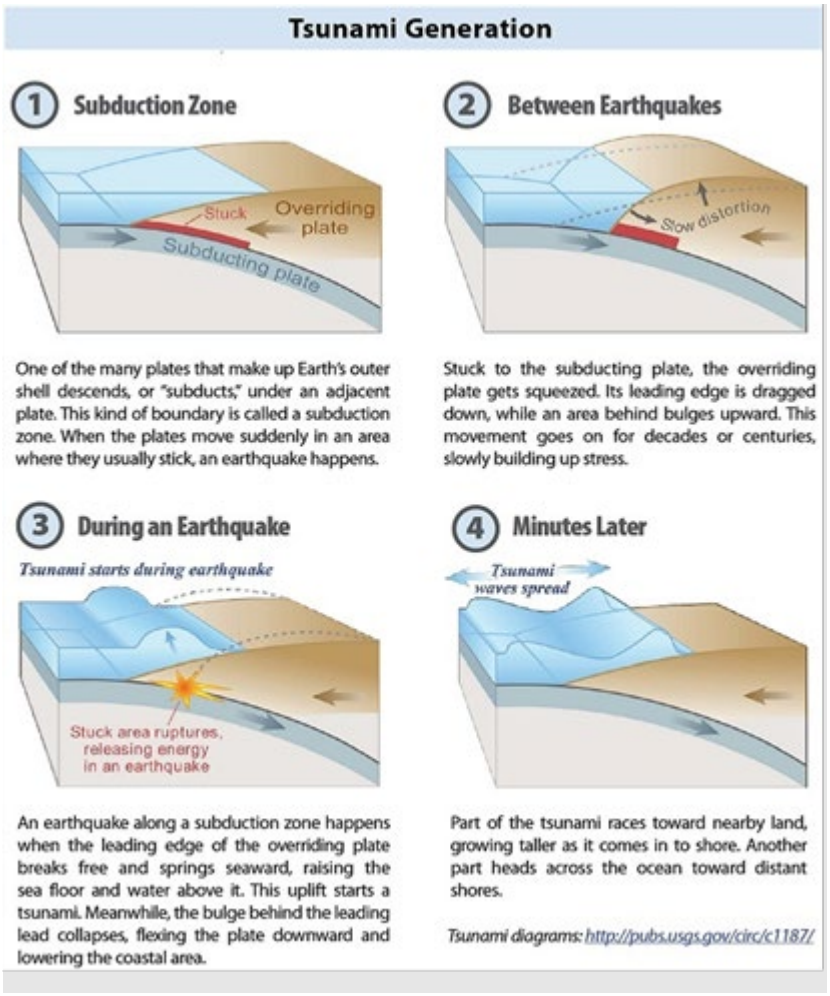
3.3.8 Tsunamis

Tsunamis are a series of water waves that may be produced by a variety of mechanisms such as seismic activity (earthquakes), aerial and submarine landslides, and volcanic eruptions. Tsunamis are almost exclusively confined to coastal margins, although they can form in inland lakes and waterways as a result of localized thrust faulting and from landslides. Earthquakes are the primary triggering mechanism, accounting for over 90 percent of tsunamis that are generated globally (Goda et al., 2025), while landslides and volcanoes produce comparatively fewer tsunamis. Landslide-induced tsunamis occur when a mass ground failure is initiated either below or above the water surface, with the tsunami wave being largely a function of the displaced landslide mass. Along low-lying coastal margins, tsunamis are often more destructive than the earthquake that caused them. Loss of lives from the tsunami can often be many times the loss of lives from the earthquake ground shaking. Property and infrastructure damage can extend miles inland and cause long lasting impacts on both the ability to recover and rebuild.

Tsunamis caused by earthquakes are the result of an abrupt, vertical uplift of the seafloor, which triggers a displacement of ocean water (Figure 3.3.8-1). The initial tsunami wave therefore mimics the shape and size of the sea floor movement that causes it, but quickly evolves into a series of waves that travel away from the source of disturbance. In the deep ocean, tsunami waves may be only a few feet high and can travel at speeds of 300–600 mph. As the tsunami travels across the deep ocean, the tsunami may interact with underwater sea mounts and islands such that refraction and diffraction processes can serve to focus and defocus the wave in different directions. These processes become especially important as the tsunami nears and eventually crosses the continental shelf, resulting in further modifications to the tsunami wave as they interact with underwater banks and canyons.

As the tsunami travels across the continental shelf, the water depth decreases. This causes the forward speed of the tsunami to begin to slow due to the frictional interaction of the tsunami with the seafloor. To maintain energy conservation, the tsunami wave height increases dramatically. By the time the tsunami wave strikes the coastline, it may be traveling at 30 mph and be anywhere from a few feet in height, to many 10s of feet high, depending on the proximity of the earthquake source relative to the coast, the amount of fault movement (uplift) on the subduction zone, the local coastal bathymetry (water depths), and shape of the coastline. When the wave makes landfall, the water is mobilized into a surging mass that floods inland until it runs out of mass and energy. The wave then retreats, carrying with it debris from onshore. Some of the tsunami energy is reflected off the coastline and then can return again and again over many hours, being “trapped” on the continental shelf due to the processes of reflection and refraction. Successive waves then batter the coast with this debris. Swimming through such turbulent, fast-moving, debris-laden water is next to impossible, making survival for those caught in a tsunami wave very slim.

Figure 3.3.8-1: Generation of a Tsunami by Subduction Zone Earthquakes



Source: DOGAMI, *Cascadia,* Winter 2012 (http://www.oregongeology.org/pubs/cascadia/CascadiaWinter2012.pdf)

Tsunamis may be differentiated into two general categories: those tsunamigenic events that occur locally near the coast, and those events that may be produced in the far-field thousands of miles from a particular coast. Distant tsunami sources reflect those areas where the expected wave arrival times are generally greater than about 3 hours, allowing for extended alert and evacuation times. Conversely, locally generated tsunami result in wave arrival times measured in minutes and often result in large loss of life.

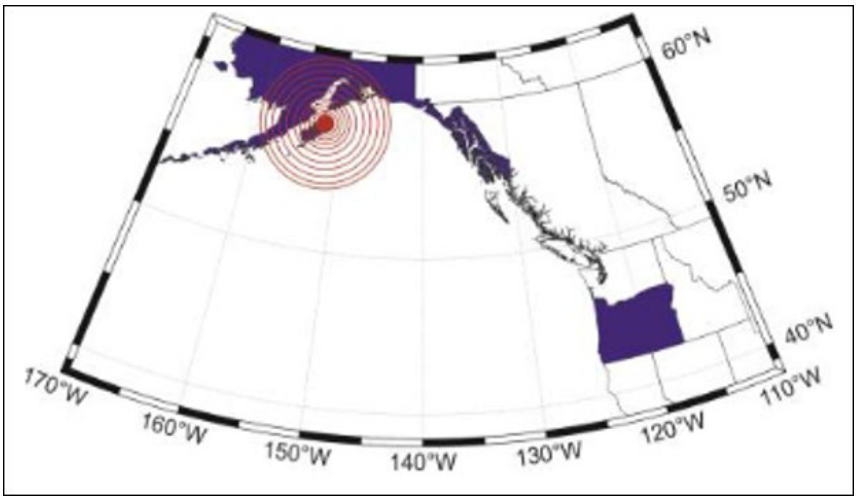
The largest tsunamis are the product of megathrust earthquakes (Moment magnitude M_W > ~8.0) that occur along subduction zones. The Cascadia Subduction Zone (CSZ) is one such region that has a long history of producing major earthquakes that can result in tsunamis. The CSZ is a 600-mile-long fault zone located offshore the coast of Oregon, Washington and Northern California and is a region where the Juan de Fuca oceanic plate is descending beneath the North American continental plate (Figure 3.3.8-2). The fault interface is located approximately 30 to 60 miles from the Oregon Coast, while the rate of convergence at the plate boundary is about 1.6 inches per year. Given that the last time the CSZ ruptured was in 1700, an estimated 43 ft of strain has already accumulated within the lock zone, as Cascadia builds towards the next megathrust earthquake and accompanying tsunami.

Figure 3.3.8-2: Cascadia Subduction Zone (CSZ) Active Fault Map. The fault, indicated by the triangles, is the contact where the Juan de Fuca Plate plunges beneath the North American continental plate.

Source: DOGAMI

Most locally generated tsunamis will produce significantly higher waves that travel farther inland (overland and up rivers) when compared with distant tsunamis generated in the far-field. Tsunami modeling undertaken by DOGAMI has revealed that a locally generated CSZ tsunami could range in height from about 20 ft to 100 ft in height; for comparison, modeling of a distant tsunami produced tsunami heights that ranged from 6 ft to ~25 ft. A local tsunami would reach the coast in as little as 10-20 minutes, with much of the open coast being fully inundated in about 30-35 minutes. Furthermore, the largest tsunami wave to strike the open coast is expected to be the initial (first) wave. However, in some upriver locations such as the middle to upper Columbia River estuary (upriver of Wanau in Clatsop County) or in the Umpqua River, the largest tsunami wave may occur several hours later after the first tsunami wave has reached the open coast, where they could combine with later occurring high tides. Modeling undertaken by DOGAMI has indicated that a CSZ tsunami wave will break up into a series of waves that will continue to strike the coast for a day or more, with the most destructive waves occurring in the first 12 hours after a local CSZ earthquake.

Figure 3.3.8-3: The greatest threat to the Oregon coast from a distant tsunami is an earthquake occurring in the eastern Aleutian Islands, Alaska. Tsunamis originating from this source would strike the coast in approximately 4 hours.



Since the Oregon Coast is part of the Pacific Basin (so called "ring of fire"), the coast is susceptible to both distant and local tsunami hazards. Aside from the CSZ, major subduction zone regions around the Pacific Basin that have a history of producing large tsunami include the Aleutian Islands in Alaska, the Kuril Island region, Japan, Tonga and potentially even Chile. However, the closest significant distant tsunami threat to the Oregon Coast is from the eastern Aleutian Islands (Figure 3.3.8-3). For example, the M_W 9.2 Good Friday 1964 Alaska tsunami reached the Oregon Coast in about four hours and killed four people in the Newport area on the central Oregon coast. In contrast, the March 11, 2011, Tōhoku Japan tsunami reached the Oregon Coast in about 9.5 hours.

3.3.8.1 Analysis and Characterization

The entire Oregon coastal zone is vulnerable to tsunami impact. Distant tsunamis caused by earthquakes on the Pacific Rim strike the Oregon coast frequently, but only a few of them have caused significant damage or loss of life. Local tsunamis caused by earthquakes on the CSZ happen much less frequently but will cause catastrophic damage and, without effective mitigation actions, great loss of life.

Notable Distant Tsunamis

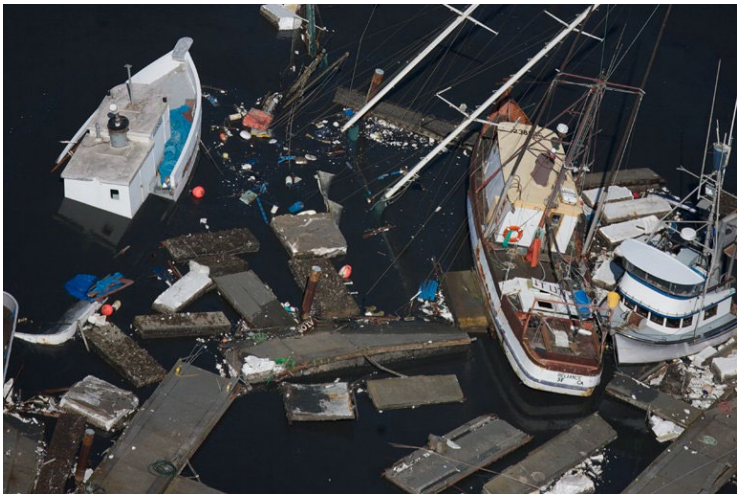
There have been at least 30 distant (far-field) earthquake events over the past 160 years that have triggered a tsunami that eventually struck the Oregon Coast. The majority (19) of the tsunamis were small, with maximum water levels < 1 ft and resulted in no impact to ports and harbors on the coast. Five events produced tsunamis with heights that ranged from 1 to 2 ft, and another five produced maximum tsunami heights that exceeded 2 ft. Those events that produced the largest tsunami on the Oregon Coast included events in 1873 (Northern California), 1946 (Alaska), 1960 (Chile), 1964 (Alaska) and 2011 (Japan). Of these, the 1964 Alaska tsunami produced the largest observed water levels on the Oregon Coast that ranged from 8 to 12 ft. Table 3.3.8-1 provides a summary of recent distant tsunamis that have been observed on the Oregon Coast and their accompanying impact.

The March 1964 earthquake occurred at the eastern end of the Aleutian Islands, beneath Prince William Sound and extended westward to include the megathrust south of Kodiak Island. The earthquake ruptured a 500-mile-long section of the Aleutian Subduction Zone and produced a massive tsunami; the earthquake shaking lasted about three and half minutes. The tsunami arrived along the Alaska coastline between 20 and 30 minutes after the earthquake, devastating villages in its path. Damages were estimated to be over $100 million (1964 dollars). One hundred thirty-one people drowned. The tsunami spread across the Pacific Ocean and caused damage and fatalities in other coastal areas, including Oregon, where the tsunami killed four people and caused an estimated $750,000 to $1 million in damage. Damage was particularly significant in northern Oregon at Cannon Beach and to a lesser extent in Seaside, where observations of higher wave heights (~12 - 16 ft) were seen at the open coast, while smaller waves (~6 ft) were observed on the southern Oregon Coast near the Chetco River. In Crescent City, California, there were 10 fatalities, while damage to property and infrastructure was estimated to range from $11 to 16 million.

On December 26, 2004, a megathrust earthquake (M_W 9.2–9.3) struck the Indonesian Island of Sumatra, producing a massive tsunami that reached 100 ft in height. Although this event did not produce a tsunami on the Oregon Coast, the event is especially noteworthy simply because of the scale of the event and large loss of life. The destruction and loss of life was particularly devastating in the Aceh province in north Sumatra, close to the earthquake source and where the tsunami inundation was particularly extensive, with tsunami waves travelling well inland and up rivers and streams. Having struck Sumatra, the tsunami travelled across the Indian Ocean where it eventually impacted Sri Lanka and India, and northward into the Andamen Sea where it stuck the coast of Thailand. The tsunami killed 227,898 people and displaced some 2 to 3 million people, and its economic impact continues to be felt to the present.

On March 11, 2011, a megathrust earthquake (M_W 9.1) struck the northeast coast of Japan, inundating much of the Sendai Plain. Tsunami wave runup heights were observed to reach over 100 ft. The tsunami killed ~18,500 people, displaced some 450,000 people, and resulted in an estimated $250 billion in total losses. Furthermore, the earthquake and tsunami destroyed 121,992 buildings (282,920 buildings experienced partial collapse and 730,359 buildings were partially damaged) and damaged 4,198 roads and 116 bridges. Over 28,000 boats were either damaged or destroyed, along with 319 ports.

Figure 3.3.8-4: Damage to a port on the Chetco river caused by the 2011 Japan tsunami.



On the US West Coast, the 2011 Japan tsunami caused about $10 million in damage to ports and marinas on the southern Oregon Coast (Figure 3.3.8-4); over ~$20 million in damage was recorded at Crescent City in Northern California, along with one fatality. Oregon received a Presidential Declaration of Disaster (DR-1964) which brought millions of dollars of financial aid to repair and mitigate future tsunami damage. Debris from tsunami-damaged buildings in Japan floated across the Pacific Ocean and began arriving on the Canadian and U.S. West Coast in December 2011 and continued to arrive several years after the event.

Several smaller tsunami events have occurred since 2011. In January 2022, the Hunga Tonga-Hunga Ha'apai volcano erupted, sending waves across the Pacific Ocean towards Oregon. The eruption and tsunami caused widespread damage to buildings and four deaths in Tonga. Tsunami warnings were issued on Oregon's coast. Although there were reports of strong currents and small sea level changes, there was no damage; several ports on the California coast experienced some damage.

Table 3.3.8-1: Historic distant tsunamis observed on the Oregon Coast

Date	Origin of Event	Affected Oregon Community	Damage	Remarks
Apr. 1868	Hawaii	Astoria		observed
Aug. 1868	N. Chile	Astoria		observed
Aug. 1872	Aleutian Islands	Astoria		observed
Nov. 1873	N. California	Port Orford		debris at high tide line
Apr. 1946	Aleutian Islands	Bandon		barely perceptible
Apr. 1946		Clatsop Spit		water 3.7 m above MLLW

Date	Origin of Event	Affected Oregon Community	Damage	Remarks
Apr. 1946		Depoe Bay		bay drained; water returned as a wall
Apr. 1946		Seaside		wall of water swept up Necanicum River
Nov. 1952	Kamchatka	Astoria		observed
Nov. 1952		Bandon	log decks broke loose	
May 1960	S. Cent. Chile	Astoria		observed
May 1960		Seaside	bore on Necanicum River damaged boat docks	
May 1960		Gold Beach		observed
May 1960		Newport		observed for about 4 hours
May 1960		Netarts	some damage observed	
Mar. 1964	Gulf of Alaska	Cannon Beach	bridge and motel unit moved inland; $230,000 damage	
Mar. 1964		Coos Bay	$20,000 damage	
Mar. 1964		Depoe Bay	$5,000 damage; 4 children drowned at Beverly Beach	
Mar. 1964		Florence	$50,000 damage	
Mar. 1964		Gold Beach	$30,000 damage	
Mar. 1964		Seaside	1 fatality (heart attack); damage to city: $41,000; private: $235,000; four trailers, 10–12 houses, two bridges damaged	
May 1968	Japan	Newport		observed
Apr. 1992	N. California	Port Orford		observed
Oct. 1994	Japan	coast		tsunami warning issued, but no tsunami observed
Mar. 2011	Japan	coast	$6.7 million; extensive damage to the Port of Brookings	tsunami warning issued, observed ocean waves
Oct. 2012	Haida Gwaii, BC	coast		M 7.7 caused a tsunami with local runup of more than 7 meters and amplitudes up to 0.8 meter on tide

Date	Origin of Event	Affected Oregon Community	Damage	Remarks
				gauges 4000 kilometers away in Hawaii. Source: NOAA
Jan. 2018	Kodiak Is., AK	coast		minor tsunami impacts in AK, HI and US west coast; the largest tsunami amplitude was recorded at 25cm in Crescent City CA 4-5 hours after the magnitude 7.9 earthquake

Sources: Lander, et al., (1993); FEMA, 2011, Federal Disaster Declaration; NOAA, https://www.ngdc.noaa.gov/hazel/view/hazards/tsunami/event-more-info/5673, downloaded on 4/15/20

Most recently, in December 2024 a shallow M_W 7.0 earthquake occurred on the Mendocino fault offshore northern California, triggering tsunami warnings for southern Oregon and northern California. These latter events, while non-life threatening, tested Oregon's tsunami preparedness, including emergency alert systems and evacuation orders.

Local Tsunamis Produced on the Cascadia Subduction Zone

Locally generated tsunamis that occur on the CSZ are relatively low probability hazards when compared with other natural hazards that affect Oregon's coastline. The most recent occasion on which the CSZ last ruptured occurred at 9 PM January 26, 1700. The megathrust earthquake is estimated to have had a magnitude of approximately 9.0. The earthquake generated a tsunami that caused death and damage as far away as Japan, where it was well-documented in the literature of the time. The earthquake and tsunami left behind geologic "footprints" in the form of (a) tsunami sand sheets in marshes, (b) layers of marsh vegetation covered by tide-borne mud when the coast abruptly subsided, and (c) submarine sand and silt slurries shaken off the continental shelf by the earthquake (turbidites). The widespread and large body of oral traditional history of the Thunderbird and Whale stories passed down by First Nations people depict both strong ground shaking and marine flooding that may have been inspired by this event. Although this earthquake undoubtedly produced tsunami waves that reached on the order of 30–40 feet at the coast, geologic evidence from numerous estuaries, coastal lakes and analyses of offshore turbidite deposits suggests that the 1700 earthquake was probably an average size event for this subduction zone. Some Cascadia earthquakes have been many times larger, so, while devastating, the 1700 earthquake and tsunami were far from the worst case.

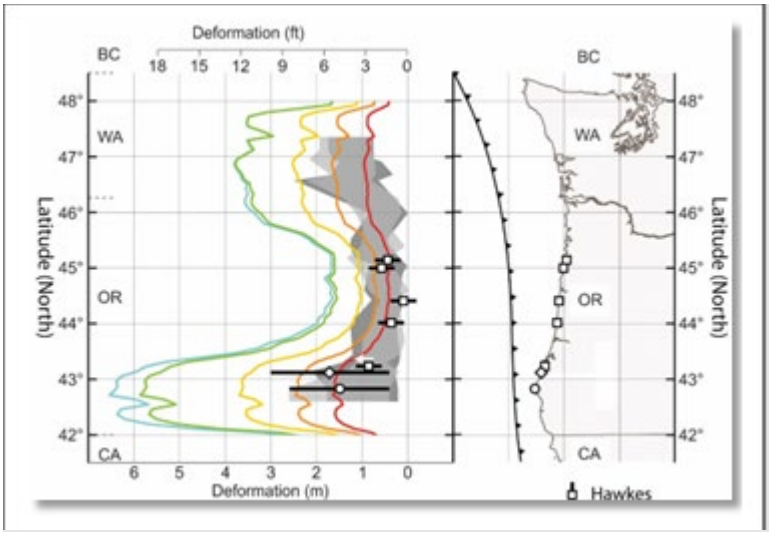
Geologists working in the Cascadia region have identified evidence for at least 19 full margin earthquake ruptures of the CSZ over the past 10,000 years, along with another 26 smaller (partial) earthquake ruptures that characterized the southern Oregon Coast. Based on these data, the average recurrence of a local CSZ tsunami is estimated to be 480-505 years; average recurrence for a partial rupture of the southern end of the CSZ is ~220 years. Although infrequent, the risk of a CSZ

tsunami impacting the Oregon Coast remains high. Scientists estimate the conditional probability of an earthquake on the CSZ at 16 percent, or 22 percent in the next 50 years, while a partial rupture of the CSZ impacting affecting the southern Oregon Coast has a higher probability of 37 percent or 43 percent in the next 50 years.

In 2013, the Oregon Department of Geology and Mineral Industries (DOGAMI) completed an analysis of a suite of locally generated Cascadia tsunamis and earthquakes, separating the results into five size classes with "T-shirt" names, S, M, L, XL, and XXL. The XL or XXL events have probably only happened once or twice in the last 10,000 years, but estimated tsunami heights from these events are comparable to those experienced in the 2011 Japan and 2004 Sumatra tsunamis, the largest known. In addition to the CSZ tsunami inundation scenarios, DOGAMI also simulated two distant (far-field) tsunami events originating from the eastern Aleutian Islands in Alaska. These included the 1964 Alaska event and a larger hypothetical maximum Alaska earthquake and tsunami termed AKmax.

The CSZ tsunami wave tends to arrive at the coast as a fast-moving surge of rising water. As the tsunami enters coastal bays and rivers, the narrowing of the landform causes channeling of the wave energy, causing it to move as a high-velocity current or a breaking wave that travels up an estuary as a bore (wall of turbulent water like the waves at the coast after they break). This inland wave of water can often cause most or all of the damage, and the current may be just as destructive when it is retreating from the land as when it is advancing. For example, in Seaside the damage from the 1964 Alaskan tsunami occurred along the Necanicum River and Neawanna Creek, well inland from the coast. In addition, storm waves and wind waves may ride on top of the tsunami waves, further compounding the level of destruction.

Figure 3.3.8-5: Measured and modeled coastal subsidence determined for the coasts of Oregon and Washington



Source: Witter et al., 2011

During Cascadia earthquakes there is also the added effect of coastal subsidence, or the drop in elevation of the land relative to sea level, during the earthquake (Figure 3.3.8-5). This is due to the release of the accumulated strain that caused the western edge of the North American Plate to bend and bulge. The new earthquake models used for the local tsunami scenarios indicate that portions of the Oregon coast could drop several feet (central Oregon Coast) to as much as 20 feet on the southern Oregon Coast.

DOGAMI completed coastwide tsunami inundation modeling in 2013 and eventually produced a series of tsunami inundation maps (TIMS) for the Oregon Coast. The inundation maps reflected the five local Cascadia tsunami scenarios (S, M, L, XL, and XXL) and two Alaska distant tsunami inundation scenarios (AK64 and AKmax). All seven are depicted on tsunami inundation maps produced by DOGAMI, plus digital files for use in geographic information systems (GIS). The five local CSZ-sourced inundation scenarios involve increasing amounts of movement (slip) on the subduction zone fault, ranging from 30 feet (S scenario) to 144 feet (XXL scenario). The seven inundation lines were eventually reduced to two zones for use in evacuation planning: AKmax inundation is the distant (orange) tsunami evacuation zone, and XXL is the local (yellow) tsunami evacuation zone. Evacuation brochures illustrating these zones and evacuation routes are available for all population centers, and both zones can also be viewed for any part of the coast using an interactive map portal and mobile phone apps at www.oregontsunami.org. The evacuation zones are critical for life safety planning and preparation. All seven scenarios were modeled on a mean higher high tide (MHHW), while the five CSZ scenarios include the effects of subsidence from the earthquake fault process (release of strain on the North American Plate). In addition to the TIMS, DOGAMI has now completed evacuation modeling for every coastal community on the Oregon Coast, which led to the development of "Beat the Wave" evacuation brochures for the XXL local CSZ tsunami. In addition to highlighting the main evacuation routes out of the tsunami inundation zone, the maps include information about how quickly people must travel to beat the wave.

3.3.8.2 Risk Maps

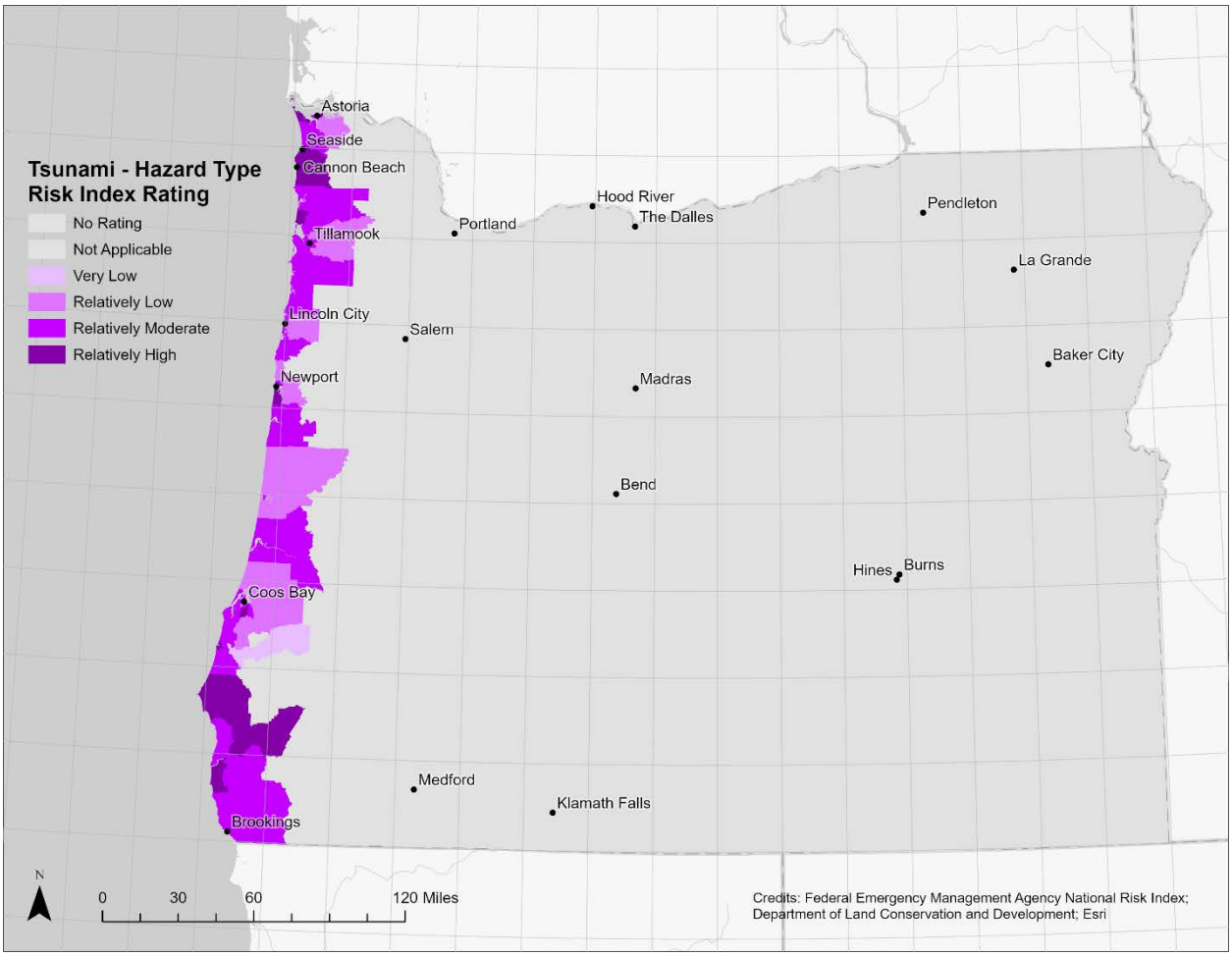
The maps in this section highlight places where the state might work with communities to develop mitigation projects.

The National Risk Index produces a measure of monetary losses experienced over the period of record. This emphasizes historic costs of harm and would direct mitigation resources to where the costs have been the greatest. Mitigation in these locations would save money over the long term.

In contrast to the National Risk Index, the Oregon Natural Hazards Risk Assessment used indicators of harm based on percentages rather than counts of exposed entities or monetary loss. This captures the potential for disruption within a census tract. The higher the percentage of entities affected, the more disruption to those living or working in the census tract.

The Oregon Natural Hazards Risk Assessment produced two statewide summary maps showing distribution of potential harm. The first map uses both socioeconomic and hazard factors. The second map uses hazard factors alone. The maps show the importance of recognizing the cost of disruption not only to buildings and infrastructure, but also to people, especially vulnerable populations. Both types of losses can be mitigated.

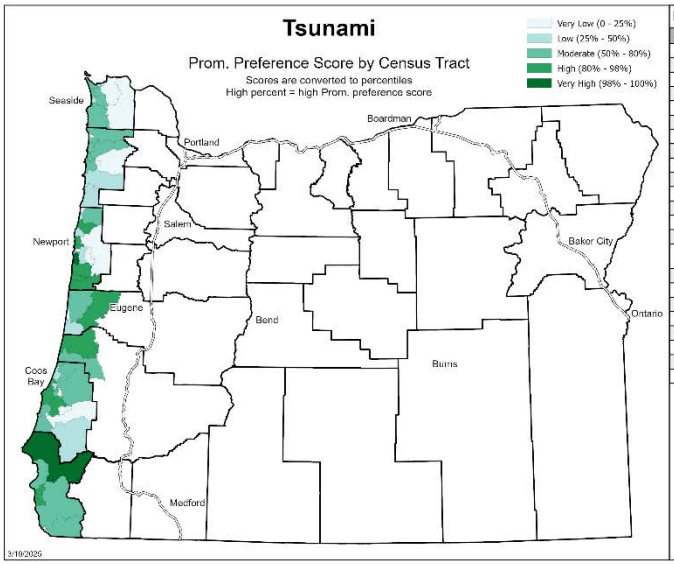
Figure 3.3.8-6: Tsunami Risk Rating from the NRI. Risk Index Rating from the Federal Emergency Management Agency, National Risk Index for Tsunami.



Federal Emergency Management Agency, National Risk Index for Tsunami. Ranking based on national percentiles. Last updated by FEMA in March 2023. Data accessed on February 12, 2025 from National Risk Index | FEMA.gov.

Figure 3.3.8-7 and Figure 3.3.8-8 show risk rankings by census tract for tsunamis from the Oregon Natural Hazards Risk Assessment. Darker colors show census tracts with higher risk. Figure 3.3.8-7 shows census tracts ranked using hazard and socioeconomic vulnerability indicators. Figure 3.3.8-8 shows census tracts ranked using only hazard indicators, without using socioeconomic vulnerability indicators. Cities are included for locational reference only and do not show risk by city. Chapter 9 has additional details and examples of the information available from the risk assessment model.

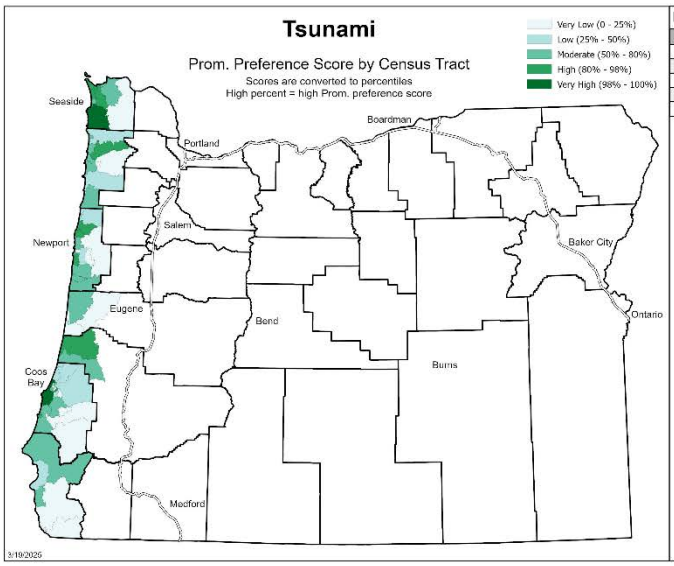
Figure 3.3.8-7:Tsunami. Results of Oregon Risk Assessment using PROMETHEE Ranking with Socioeconomic Indicators Included.



Indicators used for the hazard Hazard indicators are worth 35% of the total weight.

Hazard	Indicator Name	Direction	Weight	Short Description
Tsunami	TSU_pct_bld	1	0.07	Percentage of SBFO buildings exposed to any sized CSZ tsunami.
Tsunami	TSU_pct_CF	1	0.07	Percentage of critical facilities exposed to any sized CSZ tsunami.
Tsunami	Port	1	0.07	Presence of marine port infrastructure
Tsunami	Bridges_TSU	1	0.07	Number of bridges that are within a tsunami inundation zone.
Tsunami	Hist_Tsu_ct	1	0.07	Percentage of historic buildings exposed to any sized CSZ tsunami.
General	EP_MINRTY	1	0.046	Percentage of Black, Indigenous, and People of Color (2020 Census).
General	HousingTenure	-1	0.046	Housing tenure from the US Census.
General	EP_MOBILE	1	0.046	Percentage of people that live in mobile homes
General	Median_Yrblt	-1	0.046	Median year built of general building stock based on HAZUS default.
General	HospitalDistMile	1	0.046	Distance from tract centroid to nearest hospital.
General	NatResrcJobs	1	0.046	Rate of natural resource jobs.
General	PRFD3_PE	1	0.046	Community Resilience Estimate
General	Hosp_Beds	-1	0.046	Estimated number of hospital beds based on square footage .
General	Pct_Adherents	-1	0.046	Percentage of members to a religious group
General	Mitigation	-1	0.046	Number of migitation projects (grouped by zip code and evenly distributed to overlaying tracts)
General	Watch	-1	0.046	Neighborliness: Will watch neighbor's house
General	CountyTax	-1	0.046	County tax rate
General	CityTax	-1	0.046	City tax rate
General	Cultural	-1	0.009	Number of cultural-related buildings
General	Favors	-1	0.009	Neighborliness: Willing to do favors for neighbor
General	Advice	-1	0.009	Neighborliness: Seeks advice from neighbor
General	Parties	-1	0.009	Neighborliness: Attended parties that occur in neighborhood
General	Visits	-1	0.009	Neighborliness: Has visited neighbor's house

Figure 3.3.8-8: Tsunami. Results of Oregon Risk Assessment using PROMETHEE Ranking without Socioeconomic Indicators Included.



Indicators used for the hazard

Hazard	Indicator Name	Direction	Weight	Short Description
Tsunami	TSU_pct_bld	1	0.2	Percentage of SBFO buildings exposed to any sized CSZ tsunami.
Tsunami	TSU_pct_CF	1	0.2	Percentage of critical facilities exposed to any sized CSZ tsunami.
Tsunami	Port	1	0.2	Presence of marine port infrastructure
Tsunami	Bridges_TSU	1	0.2	Number of bridges that are within a tsunami inundation zone.
Tsunami	Hist_Tsu_ct	1	0.2	Percentage of historic buildings exposed to any sized CSZ tsunami.

3.3.9 Volcanic Hazards

Volcanic eruptions are potentially destructive natural phenomena, constructed as magma ascends and then erupts onto the earth's surface. Volcanic eruptions are typically focused around a single vent area, but vary widely in explosivity. Therefore, volcanic hazards can have far reaching consequences. Volcanic hazards may occur during eruptive episodes or in the periods between eruptions.

Volcanic hazards may be divided into two categories based on the range of their impact from the eruptive center or active vent. *Proximal* volcanic hazards have an impact limited to a distance of about 30 miles or less from the active vent. *Distal* volcanic hazards have an impact far beyond the active vent. Proximal and distal hazards are individual to each volcano. In addition to the 30-mile threshold, proximal and distal zone boundaries are based on:

- Frequency and magnitude of past events at the volcano, as recorded by their deposits;
- Modeling that predicts the extent, depth, and travel time of future events; and
- Experience and judgment derived from observations and understanding of events at other volcanoes.

Eruptive events may include proximal hazards such as:

- Lava flows;
- Pyroclastic surges and flows (fast-moving combination of very hot ash, lava, and gases);
- Lahars (volcanic mudflows or debris flows);
- Debris avalanches (landslides);
- Release of volcanic gases; and
- Tephra fall (shower of ejected rock fragments and particles);

As well as distal hazards such as:

- Lahars;
- Eruption columns and clouds; and
- Ashfall.

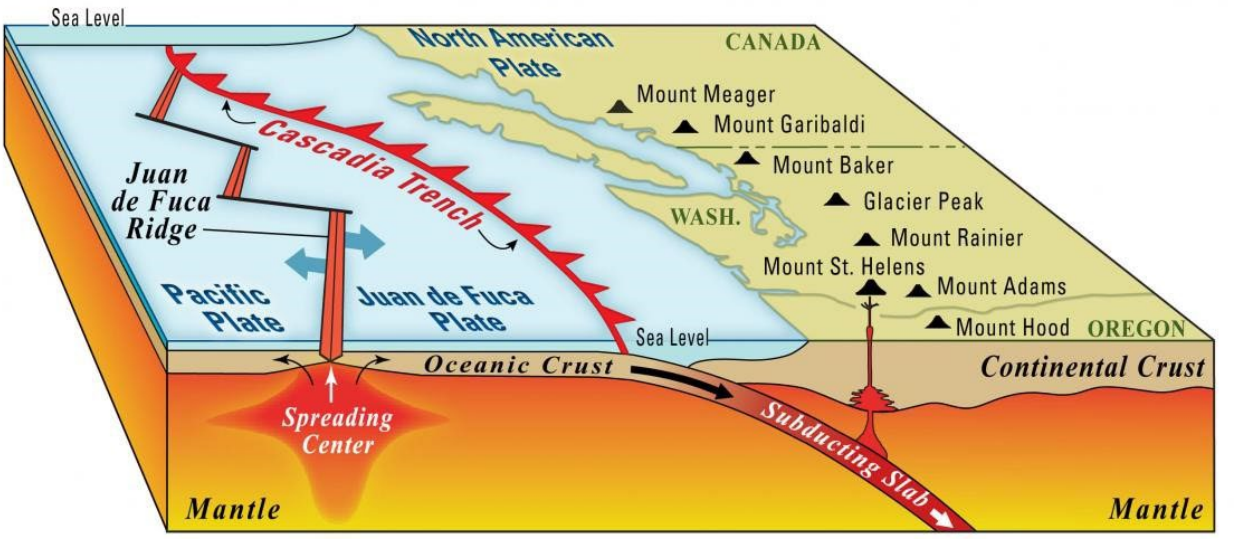
Eruptions may last from days to weeks or years, and have the potential to dramatically alter the landscape for decades. Unlike other geologic hazards (e.g., earthquakes, tsunamis), impending eruptions are often foreshadowed by a number of precursors including ground movements, earthquakes, and changes in heat output and volcanic gases. Scientists use these clues to recognize a restless volcano and to prepare for events that may follow. Hazards occurring between eruptive periods are typically related to earthquakes or natural erosion, which may trigger debris avalanches or debris flows on the flanks of the volcano. Such events often occur without warning.

Potentially hazardous volcanoes in Oregon are present along the crest of the Cascade Range and to a lesser extent in the High Lava Plains. The volcanoes within these regions provide some of Oregon's most spectacular scenery and popular recreational areas, yet the processes that led to their formation also present significant challenges and hazards to communities within the region. The catastrophic eruption of Washington's Mount St. Helens in 1980 and subsequent activity demonstrate both the power and detrimental consequences that Cascade-type volcanoes can have on the region. Lessons learned at Mount St. Helens led the U.S. Geological Survey (USGS) to establish the Cascades Volcano Observatory (CVO) in Vancouver, Washington. Scientists at CVO continually monitor volcanic activity within the Cascade Range, and in cooperation with the Oregon Department of Geology and Mineral Industries (DOGAMI), study the geology of volcanic terrains in Oregon (Ewart, Diefenbach, & Ramsey, 2018).

3.3.9.1 Analysis and Characterization

The volcanic Cascade Range extends southward from British Columbia into northern California. The volcanoes are a result of the complex interaction of tectonic plates along the Cascadia Subduction Zone (CSZ). Subduction is the process that results in the Juan de Fuca plate (oceanic crust) subducting, or sinking, underneath the North American plate (continental crust) on which people live (Figure 3.3.9-1). As the subducted plate descends, it heats up and begins to melt. This provides the reservoir of heat and molten rock needed to create the magma chambers that lie kilometers deep, beneath the Cascades.

Figure 3.3.9-1: Generalized Subduction Zone Setting.



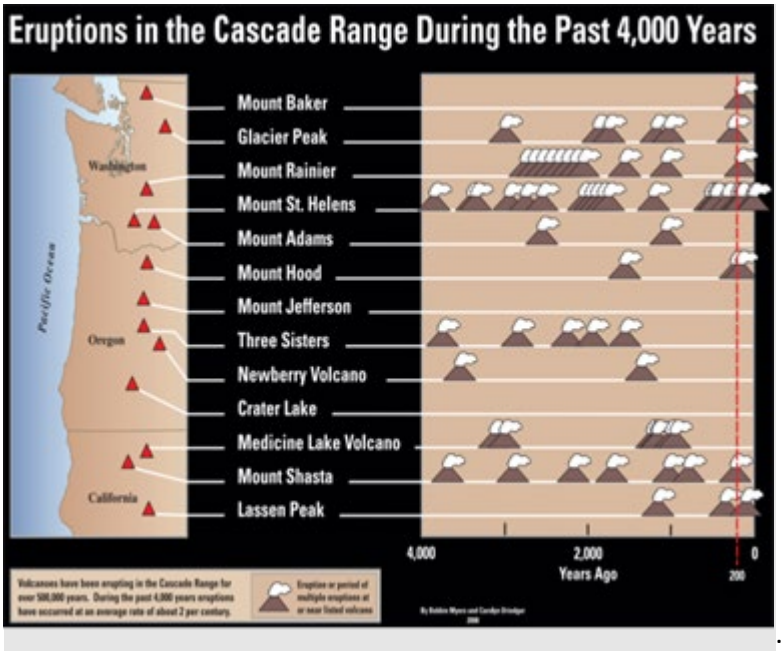
Source: Cascades Volcano Observatory Popular Graphics image gallery, http://volcanoes.usgs.gov/vsc/multimedia/cvo_popular_graphics_gallery.html

Stratovolcanoes like Mount Hood, also called composite volcanoes, are generally tall, steep, conical shaped features, built up through layering of volcanic debris, lava, and ash. Eruptions tend be explosive, for example, the violent 1980 eruption of Mount St. Helens, and they produce volcanic mudflows (lahars) that can travel far from the mountain. Future eruptions are likely to be similar and present a severe hazard to the surrounding area.

Volcanoes also pose other hazards because of their geology and resulting geomorphology. The relatively high elevation of volcanoes usually results in a meteorological effect called *orographic lifting*, which causes high precipitation and snow on the mountains that can result in flooding. The geologic material tends to be relatively weak and, when combined with the steep slopes, can cause frequent and hazardous landslides. Cascade Mountain Range volcanoes are also located near the active CSZ and nearby potentially active crustal faults, which contribute to the moderate seismic hazard in the area.

The volcanoes of the Cascade Range have a long history of eruption and intermittent quiescence. Note that in Figure 3.3.9-2, each volcano has a different frequency of eruption. Not all Cascade volcanoes have been active in the recent past. This is typical of a volcanic range and is one of the reasons forecasting eruptions can be difficult.

Figure 3.3.9-2: Eruptions in the Cascade Range During the Past 4,000 Years



Source: Myers and Driedger (2008)

Several smaller volcanoes, including Diamond Craters and Jordan Craters, in the High Lava Plains of southeast Oregon have experienced eruptions in the last 6,000 years. Generally nonexplosive eruptions at these sites have built complexes of lava flow fields and cinder cones. Unlike the far-reaching effects that may be generated by large, potentially explosive stratovolcanoes in the Cascade Range, hazards associated with future eruptions in sparsely populated southeast Oregon are most likely limited to localized lava flows.

Eruptive Hazards

Each eruption is a unique combination of hazards. Not all hazards will be present in all eruptions, and the degree of damage will vary. It is important to know that during an active period for a volcano many individual eruptions may occur, and each eruption can vary in intensity and length. For example, while Mount St. Helens is best known for its catastrophic May 1980 eruption, periodic eruptions of steam and ash and the growth of a central lava dome have continued to pose a hazard since that time.

Proximal Hazards

Lava Flows

Lava flows are streams of molten rock that erupt relatively non-explosively from a volcano and move downslope. Hazards associated with lava flow events include ashfalls near vents; extensive damage or total destruction of objects in the lava flow path(s) by burning, crushing, or burial; and disruption of local stream drainages. Lava flows are generally not life-threatening because people

can usually outwalk or outrun them. The Parkdale Lava Flow, located along the north flank of Mount Hood, erupted from a small vent about 7,600 years ago (Figure 3.3.9-3)

Figure 3.3.9-3: Oblique Air-View of the Parkdale Lava Flow. The flow erupted around 7,600 years ago from a small vent located about 6 miles south of Parkdale, Oregon.

Image source: Bill Burns, DOGAMI

Pyroclastic Flows and Surges

Pyroclastic flows are avalanches of rock and gas at temperatures of 600 to 1,500 F̊. They typically sweep down the flanks of volcanoes at speeds of up to 150 miles per hour. Pyroclastic surges are a more dilute mixture of gas and rock. They can move even more rapidly than a pyroclastic flow and are more mobile. Both generally follow valleys, but surges especially may have enough momentum to overtop hills or ridges. Because of their high speed, pyroclastic flows and surges are difficult or impossible to escape. If it is expected that they will occur, evacuation orders should be issued as soon as possible for the hazardous areas. Objects and structures in the path of a pyroclastic flow are generally destroyed or swept away by the impact of debris or by accompanying hurricane-force winds. Wood and other combustible materials are commonly burned. People and animals may also be burned or killed by inhaling hot ash and gases. The deposit that results from pyroclastic flows is composed of a combination of ash, pumice, and rock fragments. These deposits may accumulate to hundreds of feet thick and can harden to a resistant rock called tuff. Pyroclastic flows and surges are considered a proximal hazard, but in some instances may extend tens or even hundreds of miles from the volcanic vent.

Lahars

Cascade Range volcanoes and the floodplains that drain them contain abundant evidence for past lahar events. Lahars or volcanic debris flows are water-saturated mixtures of soil and rock fragments

originating from a volcano. These sediment gravity flows can travel very long distances (over 62 miles) and travel as fast as 50 miles per hour in steep channels close to a volcano; further downstream, where they reach gently sloping valley floors, speeds generally slow to 10 to 20 miles per hour. The largest of these flows are known to transport boulders exceeding 30 ft in diameter. Lahars are often associated with eruptions, but they can also be generated by rapid erosion of loose rock during heavy rains or by sudden outbursts of glacial water. Highly erodible, unconsolidated lahar deposits may be easily remobilized by normal rainfall, snowmelt, and streams for years after their deposition.

Hazards associated with lahars include direct impact and burial by the advancing flow (Figure 3.3.9-4), burial of valuable infrastructure or agricultural land, and secondary flooding due to temporary damming and breakouts along tributary streams. Because of their relatively high viscosity, lahars can move, or even carry away, vehicles and other large objects such as bridges. Municipalities, industries, and individuals who take their water from streams affected by lahars may have water quality and/or quantity issues. Wildlife could be adversely affected by changes in streams, including the deposition of debris in streambeds and floodplains. For example, salmonids trying to spawn could find it impossible to swim upstream. Long-term drainage pattern alteration and increased sedimentation rates downstream may persist for decades following such an event.

Figure 3.3.9-4: Trees Buried in Volcanic Sediment, Sandy River, Oregon. Trunks of forest trees, initially growing on a terrace above the Sandy River (Oregon) at Oxbow Regional Park, were buried by rapid deposition of sediment following a dome-building eruption at Mount Hood in

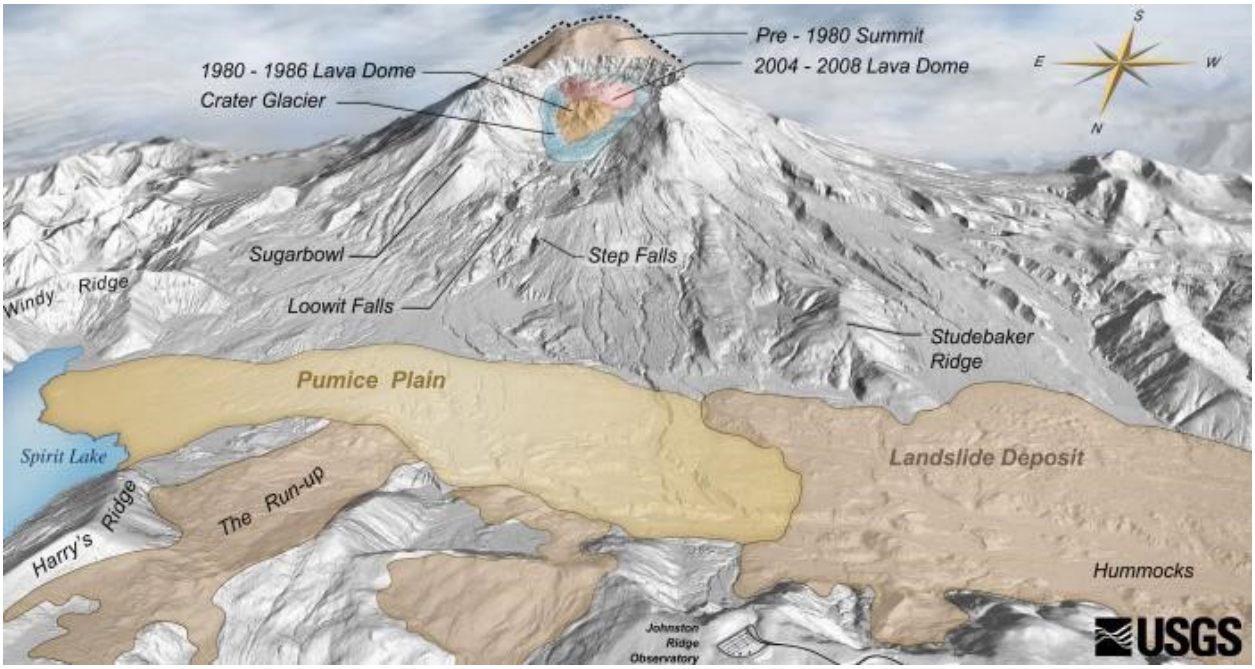
1781. Erosion during a flood about a week before the photo was taken exposed this "ghost forest."

Source: T.C. Pierson, U.S. Geological Survey, 1/15/2009

Landslides

Because the stratovolcanoes that form the Cascade Mountains are composed of layers of weak fragmented rock and lava, they are prone to landslides. Landslides range in size from small to massive summit or flank failures like the one in May 1980 at Mount St Helens (Figure 3.3.9-5). They may be triggered by volcanic activity or during times of excessive rainfall or snowmelt. Speeds of movement range from slow creep to more catastrophic failure. If enough water is incorporated into the material, the failure will become a lahar.

Figure 3.3.9-5: Mount St. Helens.



Source: USGS, Geology and history summary for Mount St. Helens, http://volcanoes.usgs.gov/volcanoes/st_helens/st_helens_geo_hist_101.html

Volcanic Gases

Magma contains dissolved gases that provide the driving force causing most volcanic eruptions. As magma rises towards the surface and pressure decreases, gases are released from the liquid portion of the magma (melt). These gases continue to travel upward and are eventually released into the atmosphere, both during and between eruptions. The majority of the gas emitted at volcanoes is water vapor (steam), derived from recent precipitation and groundwater. However, toxic gases including carbon dioxide, sulfur dioxide, hydrogen sulfide, hydrogen halides, and fluorine may also be released. Depending on their concentrations, toxic gases can have both short-term effects and long-term effects on human and animal lives, property, agriculture, and the natural environment. Some examples of gas hazards:

- Carbon dioxide is heavier than air and can be trapped in low areas in concentrations that are deadly to people and animals;
- Sulfur dioxide, Hydrogen sulfide, and Fluorine are respiratory poisons;
- Sulfur Dioxide reacts with atmospheric water to create acid rain, causing corrosion and harming vegetation; and
- Fluorine can be absorbed onto volcanic ash particles that later fall to the ground, poisoning livestock grazing on ash-coated grass and contaminating domestic water supplies.

Tephra

Tephra includes both solid and molten rock fragments, ranging in size from fine ash dust to larger "volcanic bombs" up to 3 feet in diameter. The largest rock fragments and volcanic bombs usually

fall back to the ground within 2 miles of the vent. Tephra deposits pose significant risks to lives, structures, and property in the proximity of volcanic vents. Fine tephra is extremely slippery, hampering driving and walking, and can damage the lungs of small infants, the elderly, and those with respiratory problems. Fist-sized and larger bombs, flying as airborne projectiles, can cause significant injury or death. Tephra is disorienting by reducing visibility. If tephra accumulates in sufficient thickness, it may collapse roofs, may topple or short-circuit electric transformers and power lines and clog other infrastructure such as water and sewage treatment facilities. Tephra clouds also commonly generate lightning that can interfere with electrical and communication systems and start fires.

Distal Hazards

Lahars

Lahars are both proximal and distal volcanic hazards. Please see the discussion of lahars in the *Proximal Hazards* section (above).

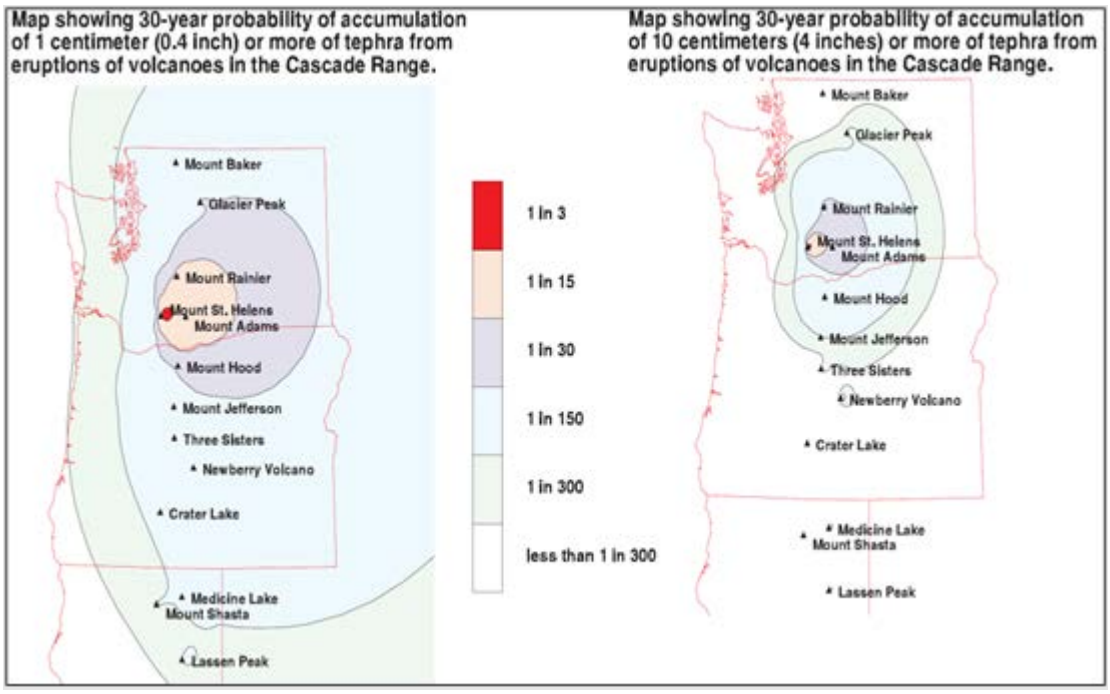
Eruption Columns and Clouds

Eruption columns and clouds occur during explosive volcanic eruptions as small fragments of volcanic glass, minerals, and rock, less than about 0.1 inch across, rise high into the air. Depending on the power of the eruption, columns can grow rapidly and reach more than 12 miles above a volcano, forming an eruption cloud. Large eruption clouds can extend hundreds of miles downwind, resulting in falling ash over enormous areas; the wind carries the smallest ash particles the farthest.

Ashfall

Dust-sized ash particles are the by-products of many volcanic eruptions. Ash, when blown into the air, can travel large distances causing significant problems for distal hazard zones. During ash-dominated eruptions, deposition is largely controlled by the prevailing wind direction. The predominant wind pattern over the Cascade Range is from the west to the east. Previous eruptions documented in the geologic record indicate most ashfall drifting to and settling in areas to the east of the Cascade volcanoes. The probable geographic extent of volcanic ashfall from select volcanic eruptions in the Pacific Northwest is shown in Figure 3.3.9-6.

Figure 3.3.9-6: Probable Geographic Extent of Volcanic Ashfall from Select Volcanic Eruptions in the Pacific Northwest.



Source: Scott, et al. (1997a)

Within a few miles of the vent, the main ashfall hazards to man-made structures and humans include high temperatures, being buried, and being hit by falling fragments. Within 10–12 miles, hot ashfall may set fire to forests and flammable structures.

Structural damage can also result from the weight of ash, especially if it is wet. Four inches of wet ash may cause buildings to collapse. Accumulations of a half inch of ash can impede the movement of most vehicles, disrupt transportation, communication, and utility systems, and cause problems for human and animal respiratory systems. It is extremely dangerous for aircraft, particularly jet planes, as volcanic ash accelerates wear to critical engine components, can coat exposed electrical components, and erodes exposed structure. Ashfall may severely decrease visibility, or even cause darkness, which can further disrupt transportation and other systems. Recent work by the Volcano Hazards Group of the U.S. Geological Survey has attempted to rank the relative hazard of volcanoes in North America. According to this study, Oregon has four Very High Threat Volcanoes: Crater Lake, Mount Hood, Newberry Volcano, and South Sister (Ewert, et al., 2005).

Ashfall can severely degrade air quality and trigger health problems. In areas with considerable ashfall, people with breathing problems might need additional services from doctors or emergency rooms. In severe events an air quality warning could be issued, informing people with breathing problems to remain inside

Ashfall can create serious traffic problems as well as road damage. Vehicles moving over even a thin coating of ash can cause clouds of ash to swell. This results in visibility problems for other drivers

and may force road closures. Extremely wet ash creates slippery and hazardous road conditions. Ash filling roadside ditches and culverts can prevent proper drainage and cause shoulder erosion and road damage. Blocked drainages can also trigger debris flows if the blockage causes water to pool on or above susceptible slopes. Removal of ash is extremely difficult as traditional methods, such as snow removal equipment, stir up ash and cause it to continually resettle on the roadway.

Non-Eruptive Hazards

Earthquakes

Earthquake effects are a significant threat along the Cascade Mountains and come from three main sources: the CSZ, crustal faults, and volcanic activity. The CSZ is generally over 150 miles away, but it produces earthquakes as a large as M9.0 every 240 to 500 years. Crustal earthquakes occur in the North American plate at relatively shallow depths of approximately 6 to12 miles below the surface. However, some can rupture through the surface. The distance from a potentially active fault is critical to the evaluation of the earthquake shaking hazard. Volcanic earthquakes are usually small and frequent, but they can be as large as or larger than the M4.5 earthquake on Mount Hood in 2002. During 2002, a swarm of earthquakes ranging from M3.2 to M4.5 occurred on the southeast flank of Mount Hood. The damaging effects of all three kinds of earthquakes can be enhanced by amplification of shaking in soft soils, liquefaction, or induced landslides.

Flooding and Channel Migration

The relatively high elevation of volcanoes usually results in the meteorological effect called orographic lifting, which causes high precipitation and snow on the mountains. The result can be very high levels of rainfall and/or rapid snowmelt that can result in flooding.

Floods cause damage to assets through inundation of water and by erosion and deposition of soil and/or large objects. Defining the hazard associated with inundation by flooding is done by calculating the area that is likely to be flooded during different levels of flooding. Larger floods are less frequent than smaller floods, so flood levels may be defined by their return period. The longer the return period, the deeper the flood waters, and hence the larger the area that is inundated. Some common return periods used in flood hazard mapping include 10-year, 25-year, 100-year, and 500-year floods. Most flooding on Cascade Range volcanoes occurs when heavy, warm rain during large winter or spring storms falls on accumulations of low-elevation snow. Channel migration hazards can occur slowly, for example, by continuous erosion along a cutbank meander and deposition onto a point bar during high flows, or very rapidly during storm events through avulsion or rapid abandonment of the current river channel for a new one. Such rapid migration can not only destroy structures but even remove the land beneath structures.

For more information on flooding and channel migration zones see the **Flood** section.

Landslides

The general term *landslide* refers to a range of geologic events including rock falls, debris flows, earth slides, and other mass movements. Most landslides that occur on volcanoes are large deep-seated landslide complexes or debris flows. Deep-seated landslides have failure surfaces usually tens of feet below the surface and can cover large areas from acres to square miles. These types of

landslides tend to move relatively slowly, but they can lurch forward if shaken by an earthquake or if disturbed by removal of material from the toe, by addition of material to the head, or by addition of water into the slide mass. Debris flows tend to initiate in the upper portion of a drainage, picking up water, sediment, and speed as they come down the drainage. As they reach the mouth of the confined or steep portion of the drainage, they tend to spread out and deposit the majority of the material, generally creating a fan. Debris flows are also commonly initiated by other types of landslides that occur on slopes near a channel. They can also initiate within the channel in areas of accelerated erosion during heavy rainfall or snowmelt.

Characterization of Individual Volcanoes

The history of volcanic activity in the Cascade Range is contained in its geologic record. The ages, eruptive history, and hazards associated with each volcano vary considerably. Cascade volcanoes may be characterized by intermittent periods of activity, followed by longer periods of relative quiescence. The incompleteness of eruptive records, even at relatively well-studied volcanoes, makes prediction of probability and recurrence intervals of future eruptions difficult to determine. Table 3.3.9-1 lists Cascade Volcanoes in southwest Washington and Oregon that can affect Oregon communities. The discussion that follows further details those volcanic centers from Table 3.3.9-1 for which the U.S. Geological Survey has developed hazard assessments and ranked as having a high to very high threat potential. Threat potential is described as very high, high, moderate, low, or very low based upon eruption history, distance to population centers, and potential impacts to aviation (Ewert, et al., 2005). From north to south these high-threat volcanoes are:

- Mount St. Helens (Wolfe & Pierson, 1995)
- Mount Adams (Scott, Iverson, Vallance, & Hildreth, 1995)
- Mount Hood (Scott, et al., 1997), (Burns W. J., et al., 2011b)
- Mount Jefferson (Walder, Gardner, Conrey, Fisher, & Schilling, 1999)
- The Three Sisters Region (Scott, Iverson, Schilling, & Fisher, 2001)
- Newberry Volcano (Sherrod, Mastin, Scott, & Schilling, 1997)
- Crater Lake (Bacon, Mastin, Scott, & Nathenson, 1997)

Digital hazard data for some of these volcanoes have been produced by Schilling (1996); Schilling, et al. (1997), Schilling, et al. (2008a), (2008b), (2008c). For a detailed inventory of each volcano's history and hazards, please refer to the appropriate report referenced above or Table 3.3.9-1. Further information can also be obtained from the U.S. Geological Survey Cascade Volcano Observatory at http://volcanoes.usgs.gov/observatories/cvo/.

Table 3.3.9-1 Prominent Volcanoes in the Cascade Range of Oregon and Southwest Washington

Volcano Name	Elevation	Volcano Type	Most Recent Eruptions	USGS Threat Potential	Nearby Towns	Remarks/Hazard Study
Mount St. Helens (Washington)	8,363 ft	strato-volcano	1980–1986; 2004–2008	high to very high	Portland, Castle Rock (Washington), Olympia (Washington),	major explosive eruption and debris avalanche in 1980; widespread ashfall;

Volcano Name	Elevation	Volcano Type	Most Recent Eruptions	USGS Threat Potential	Nearby Towns	Remarks/Hazard Study
					Vancouver (Washington), Yakima (Washington)	(Wolfe & Pierson, 1995)
Mount Adams (Washington)	12,277 ft	strato-volcano	about 520,000 to 1,000 YBP	high to very high	Portland, Hood River, Vancouver (Washington), Yakima (Washington)	numerous eruptions in last 15,000 years; major debris avalanches affecting White Salmon River at 6,000 and 300 YBP; (Scott, Iverson, Vallance, & Hildreth, 1995)
Mount Hood	11,240 ft	strato-volcano	1760–1865	high to very high	Portland, Sandy, Welches, Brightwood, Parkdale, Hood River	pyroclastic flows in the Upper White River drainage; lahars in Old Maid Flat; lava dome at Crater Rock; steam explosions; Scott (1997a); Schilling, et al. (2008a)
Mount Jefferson	10,495 ft	strato-volcano	280,000 to 15,000 YBP	low to very low	Idanha, Detroit, Warm Springs, Madras, Lake Billy Chinook	potentially active and capable of large explosive eruptions; recent history of lava domes, small shields, and lava aprons; Walder, et al. (1999); Schilling, et al. (2007)
Mount Washington	7,796 ft	mafic volcano		low to very low		no hazard study
North Sister	10,085 ft	mafic volcano	300,000 to 120,000 YBP	high to very high	Sisters, Bend, Redmond, Sunriver, La Pine, Blue River, McKenzie Bridge, Vida, Springfield	deep glacial erosion; ashfall, pyroclastic flows, lava flows and domes, and lahars; Scott, et al. (2001); Schilling, et al. (2008c)
Middle Sister	10,047 ft	strato-volcano	about 40,000 to 14,000 YBP	high to very high	Sisters, Bend, Redmond, Sunriver, La Pine, Blue River, McKenzie Bridge, Vida, Springfield	potentially active, capable of large explosive eruptions, ashfall, pyroclastic flows, lava flows and domes, and lahars;

Volcano Name	Elevation	Volcano Type	Most Recent Eruptions	USGS Threat Potential	Nearby Towns	Remarks/Hazard Study
						Scott (2001); Schilling, et al. (2008c)
South Sister	10,358 ft	strato-volcano	about 50,000 to 2,000 YBP	high to very high	Sisters, Bend, Redmond, Sunriver, La Pine, Blue River, McKenzie Bridge, Vida, Springfield	potentially active, capable of large explosive eruptions, ashfall, pyroclastic flows, lava flows and domes, and lahar; most silicic of the cones in the Three Sisters complex; phase of uplift started in 1997 within a broad area about 6 km west of South Sister; Scott (2001); Schilling, et al. (2008c)
Broken Top	9,152 ft	strato-volcano	300,000–100,000 YBP	low to very low	Bend, Sunriver, La Pine	deep glacial erosion; lava flows, pyroclastic flows, ashfall; no hazard study
Mount Bachelor	9,068 ft	mafic volcano	about 18,000 to 7,700 YBP	moderate	Bend, Sunriver, La Pine	lava flows and near vent cinder and ashfall; no hazard study
Newberry Volcano	7,986 ft	shield volcano/ caldera	about 400,000 to 1,300 YBP	high to very high	Bend, Sunriver, La Pine	potentially active and capable of large explosive eruptions; lava flows and near vent cinder and ashfalls; present-day hot springs; (Sherrod, Mastin, Scott, & Schilling, 1997); Schilling, et al. (2008b)
Mount Thielsen	9,187 ft	shield volcano	> 250,000	low to very low	Chemult	Deep glacial erosion; Lava flows, pyroclastic eruptions; no hazard study.
Crater Lake Caldera (Mount Mazama)	8,159 ft	caldera	about 420,000 to 7,700 YBP	high to very high	Grants Pass, Roseburg, Chemult, La Pine, Fort	lava flows, pyroclastic flows, ashfall; source of the widespread

Volcano Name	Elevation	Volcano Type	Most Recent Eruptions	USGS Threat Potential	Nearby Towns	Remarks/Hazard Study
					Klamath, Chiloquin, Klamath Falls	Mazama ash; Bacon, et al. (1997)
Mount McLaughlin	9,496 ft	strato-volcano	>80,000 YBP	low to very low	Medford, Grants Pass, Klamath Falls	lava flows, pyroclastic flows; no hazard study

YBP is years before present.
Sources: U.S. Geological Survey, Cascades Volcano Observatory: http://volcanoes.usgs.gov/observatories/cvo/;
Wolfe and Pierson (1995); Scott, et al. (1995), (1997a), (2001); Sherrod, et al. (1997); Bacon, et al. (1997); Walder, et al. (1999)

Mount St. Helens (Washington)

The May 18, 1980, eruption of Mount St. Helens is the best-known example of volcanism to most Oregonians. That eruption included a debris avalanche, as part of the volcanic edifice collapsed (Figure 3.3.9-6). This caused a lateral blast of rock, ash, and gas that devastated areas to the north of the volcano. Lahars rushed down the Toutle and Cowlitz River valleys, reaching the Columbia River and halting shipping for some time. All other river valleys on the volcano experienced smaller lahars. Pyroclastic flows devastated an area up to five miles north of the volcano. Ashfall deposits affected people as far away as Montana, and ash circled the earth in the upper atmosphere for over a year.

Except for the debris avalanche and lateral blast, the events of this eruptive period are typical of a Mount St. Helens eruption and can be expected to occur again (Table 3.3.9-1). The primary hazards that will affect Oregonians are ashfall and lahars that affect the Columbia River. Since the major eruptive activity in the early 1980s, Mount St. Helens has experienced two episodes of dome building activity. The latest activity lasted from 2004 until 2008. Another eruption from Mount St. Helens is very likely in the near future.

Mount Adams (Washington)

Mount Adams, located 35 miles north of Hood River, Oregon, is the largest active volcano in Washington State and among the largest in the Cascade Range (Table 3.3.9-1). The volcano was active from about 520,000 to about 1,000 years ago. Eruptions from Mount Adams within the last 500,000 years have mainly consisted of effusive lava flows; highly explosive events are rare in the geologic record of Mount Adams. Eruptions have also occurred from 10 vents in the vicinity of Mount Adams since the last period of glaciation about 15,000 years ago. Approximately 6,000 and 300 years ago, debris avalanches from the southwest face of Mount Adams generated clay-rich lahars that traveled down the White Salmon River. The summit of Mount Adams contains a large section of unstable altered rock that can spawn future debris avalanches and lahars.

Potential hazards from Mount Adams include lava flows near the central vent area and lahars that could reach and disrupt the Columbia River channel. Such lahars may have little or no advanced warning.

Mount Hood

The last major eruption of Mount Hood occurred in approximately 1781 (244 years ago) (Table 3.3.9-1 and Table 3.3.9-2). The Sandy River that drains the volcano's northwest side was originally named the Quicksand River by Lewis and Clark, who traversed the area only a couple of years after an eruption. Lahars had filled the river channel with debris, much of which has now been scoured away. There were two other minor periods of eruptions during the last 500 years, the last in the mid-1800s. Typically, these involved lava flows near the summit, pyroclastic flows, and lahars but little ashfall. From its recent eruptive history, the volcano is most likely to erupt from the south side, but planning should be done assuming eruptions could be centered anywhere on the mountain. A large eruption could generate pyroclastic flows and lahars that could inundate the entire length of the Sandy and White River valleys. An eruption from the north flank could affect the Hood River Valley.

Due to its proximity to the Portland Metro area, major east-west highways, the Bull Run Reservoir (which supplies water to a majority of Portland area residents), and ski and summer recreation areas, Mount Hood poses the greatest potential volcanic hazard to Oregonians. In addition, a large volume of debris and sediment in lahars could affect shipping lanes in the Columbia River and operation of Bonneville and The Dalles dams.

In recent years, numerous debris flows caused by winter storms have flowed down river drainages. OR-35 is periodically closed for repair work after these events damaged the bridge over the White River. If a volcanic event occurred, the same drainages would be affected.

Table 3.3.9-2 Notable Geologic Events near Mount Hood

Date or Age	Event	Deposits
A.D. 1859, 1865, 1907?	minor explosive eruptions of Mount Hood	scattered pumice
late 19th century	late neoglacial advance	prominent, sharp-crested moraines
late 18th century	Old Maid eruptive period	lava dome, pyroclastic-flow and lahar deposits, tephra
about 500 years ago	debris flows in Zigzag River	debris-flow deposits
1,000 years ago	debris flows in upper Sandy River	debris-flow deposits
1,500 years ago	Timberline eruptive period	lava dome, pyroclastic-flow and lahar deposits, tephra
7,700 years ago	eruptions from vent near Parkdale; Mount Mazama ashfall	Basaltic andesite of Parkdale lava flow; about 5 cm of Mazama ash
11,000 to 20,000 years ago	waning phases of Evans Creek glaciation	moraines
13,000 to 20,000 years ago	Polallie eruptive period	lava domes, pyroclastic-flow and lahar deposits, tephra
20,000 to 25,000 years ago	maximum of Evans Creek glaciation	belts of moraines in most valleys

Date or Age	Event	Deposits
20,000 to 30,000 years ago	Mount Hood dome eruptions	lava domes, pyroclastic-flow and lahar deposits
30,000(?) to 50,000(?) years ago	Mount Hood lava-flow eruptions	andesite lava flows of Cathedral Ridge and Tamanawas Falls

Source: Bill Burns, DOGAMI, modified from Scott, et al. (1997b)

Mount Jefferson

Mount Jefferson is located in a relatively unpopulated part of the Cascade Range. The last eruptive episode at Mount Jefferson was about 15,000 years ago. Research at stratovolcanoes around the world indicates that Mount Jefferson should be regarded as dormant, not extinct.

The steep slopes of the volcano provide the setting for possible debris flows and lahars, even without an eruption. These would be confined to valleys, generally within 10 miles of the volcano.

A major eruption, however unlikely in the short term, could generate pyroclastic flows and lahars that would travel up to a few dozen miles down river valleys. Two reservoirs could be affected by pyroclastic flows from a major eruption: Detroit Lake and Lake Billy Chinook. An explosive eruption could spew ash for hundreds of miles in the downwind direction.

Many smaller volcanoes are located between Mount Jefferson and Mount Hood to the north and Three Sisters to the south. Eruptions from any of these would be primarily *cinders* and ash to form cinder cones.

Three Sisters Region

North Sister has probably been inactive for at least 100,000 years (Table 3.3.9-1). Middle Sister last erupted between 25,000 and 15,000 years ago. South Sister had a very small ongoing uplift, which began in 1996 and became undetectable by 2003. The uplift was about one inch a year and likely indicated movement of a small amount of magma. At this writing, there is no indication that the uplift will ever develop into a volcanic eruption. However, that possibility cannot be ruled out. Hence, the Cascade Volcano Observatory has increased their monitoring of the area over the past several years.

Future eruptions at South Sister (and possibly Middle Sister) are likely to include lava flows, pyroclastic flows, and lahars. The possibility exists for lahars to travel many miles down valley floors, if an eruption melts a large amount of snow and ice. Ashfall would likely be contained within 20 miles of the vent.

Newberry Volcano

Newberry Volcano, unlike the stratovolcanoes of the Cascade Range, is a shield volcano with broad, relatively gently sloping flanks composed of stacked basaltic lavas flows (Table 3.3.9-1). The volcano is about 400,000 years old and has had thousands of eruptions both from the central vent area and along its flanks. The present 4 by 5 mi wide caldera at Newberry Volcano's summit formed about

75,000 years ago by a major explosive eruption and collapse event. This was the most recent of at least three caldera-forming eruptions that lofted pumice and ash high into the air and spread pyroclastic flows across the volcano's surface. The most recent eruption was 1,300 years ago when the "Big Obsidian Flow," a glassy rhyolitic lava flow, erupted within the caldera. Future eruptions are likely to include lava flows, pyroclastic flows, lahars, and ashfall. Newberry Volcano has attracted interest for its geothermal potential. The heat under the volcano, with temperatures in some areas in excess of 509˚F, is evidence that it is only dormant.

Crater Lake Caldera

About 7,700 years ago, Mount Mazama erupted with great violence, leaving the caldera that Crater Lake now occupies (Table 3.3.9-3). Layers of ash produced from that eruption have been found in eight western states and three Canadian provinces. The countryside surrounding Crater Lake was covered by pyroclastic flows. Wizard Island is the result of much smaller eruptions since that cataclysm. The most recent eruption was about 5,000 years ago and occurred within the caldera. No eruptions have occurred outside the caldera since 10,000 years ago.

This potentially active volcanic center is contained within Crater Lake National Park. The western half of the caldera is considered the most likely site of future activity. Effects from volcanic activity (e.g., ashfall, lava flows) are likely to remain within the caldera. If an eruption occurs outside the caldera, pyroclastic flows and lahars could affect valleys up to a few dozen miles from the erupting vent. The probability of another caldera-forming eruption is very low, as is the probability of eruptions occurring outside the caldera.

Other Volcanic Areas of Oregon

On the scale of geologic time, volcanic eruptions may occur in other parts of Oregon. However, on a human time scale, the probability of an eruption outside the Cascades is so low as to be negligible.

Although the high, snow-topped mountains of the Cascades are Oregon's most visible volcanoes, other potential eruptive centers exist. These include smaller peaks, such as the Belknap shield volcano in central Oregon, which had a lava flow about 1,400 years ago. Several smaller volcanoes, including Diamond Craters and Jordan Craters, in the High Lava Plains of southeast Oregon have experienced recent eruptions in the last 7,000 years. Generally non-explosive eruptions at these sites have built complexes of lava flow fields and cinder cones. Hazards associated with future eruptions in sparsely populated southeast Oregon would most likely include lava flows covering many square miles; ash and volcanic gases derived from these eruptions may be regionally significant.

3.3.9.2 Historic Volcanic Events

Table 3.3.9-3: Historic Volcanic Events in Oregon over the Last 20,000 Years

Date	Location	Description
about 18,000 to 7,700 YBP	Mount Bachelor, central Cascades	cinder cones, lava flows

Date	Location	Description
about 20,000 to 13,000 YBP	Polallie Eruptive episode, Mount Hood	lava dome, pyroclastic flows, lahars, tephra
about 13,000 YBP	Lava Mountain, south-central Oregon	Lava Mountain field, lava flows
about 13,000 YBP	Devils Garden, south-central Oregon	Devils Garden field, lava flows
about 13,000 YBP	Four Craters, south-central Oregon	Four Craters field, lava flows
about 7,780 to 15,000 YBP	Cinnamon Butte, southern Cascades	basaltic scoria cone and lava flows
about 7,700 YBP	Crater Lake Caldera	formation of Crater Lake caldera, pyroclastic flows, widespread ashfall
about 7,700 YBP	Parkdale, north-central Oregon	eruption of Parkdale lava flow
<7,000 YBP	Diamond Craters, eastern Oregon	lava flows and tephra in Diamond Craters field
< 7,700 YBP; 5,300 to 5,600 YBP	Davis Lake, southern Cascades	lava flows and scoria cones in Davis Lake field
about 10,000 to <7,700 YBP	Cones south of Mount Jefferson; Forked Butte and South Cinder Peak	lava flows
about 4,000 to 3,000 YBP	Sand Mountain, central Cascades	lava flows and cinder cones in Sand Mountain field
< 3,200 YBP	Jordan Craters, eastern Oregon	lava flows and tephra in Jordan Craters field
about 3,000 to 1,500 YBP	Belknap Volcano, central Cascades	lava flows, tephra
about 2,000 YBP	South Sister Volcano	rhyolite lava flow
about 1,500 YBP	Timberline eruptive period, Mount Hood	lava dome, pyroclastic flows, lahars, tephra
about 1,300 YBP	Newberry Volcano, central Oregon	eruption of Big Obsidian flow
about 1,300 YBP	Blue Lake Crater, central Cascades	Spatter cones and tephra
1760–1810	Crater Rock/Old Maid Flat on Mount Hood	pyroclastic flows in upper White River; lahars in Old Maid Flat; dome building at Crater Rock
1859/1865	Crater Rock on Mount Hood	steam explosions/tephra falls
1907 (?)	Crater Rock on Mount Hood	steam explosions
1980	Mount St. Helens (Washington)	debris avalanche, ashfall, flooding on Columbia River
1981–1986	Mount St. Helens (Washington)	lava dome growth, steam, lahars

Date	Location	Description
1989–2001	Mount St. Helens (Washington)	hydrothermal explosions
2004–2008	Mount St. Helens (Washington)	lava dome growth, steam, ash
2009--2025	Mount St. Helens (Washington)	Short term increases in small earthquakes

Note: YBP is years before present.
Sources: U.S. Geological Survey, Cascades Volcano Observatory: http://volcanoes.usgs.gov/observatories/cvo/;
Wolfe and Pierson (1995); Sherrod, et al. (1997); Scott, et al. (1997a), (2001); Bacon, et al. (1997); Walder, et al. (1999)

3.3.9.3 Risk Maps

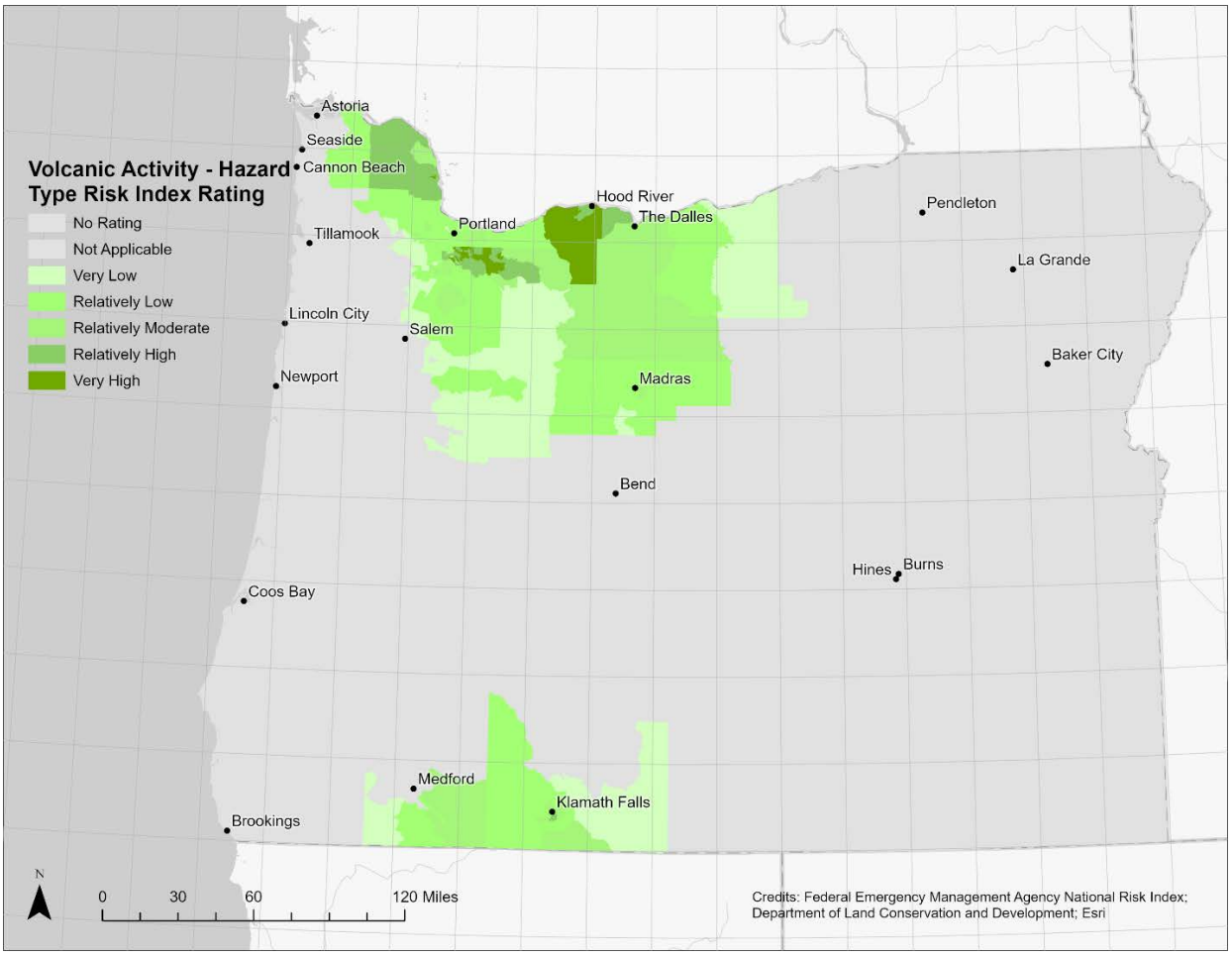
The maps in this section highlight places where the state might work with communities to develop mitigation projects.

The National Risk Index produces a measure of monetary losses experienced over the period of record. This emphasizes historic costs of harm and would direct mitigation resources to where the costs have been the greatest. Mitigation in these locations would save money over the long term.

In contrast to the National Risk Index, the Oregon Natural Hazards Risk Assessment used indicators of harm based on percentages rather than counts of exposed entities or monetary loss. This captures the potential for disruption within a census tract. The higher the percentage of entities affected, the more disruption to those living or working in the census tract.

The Oregon Natural Hazards Risk Assessment produced two statewide summary maps showing distribution of potential harm. The first map uses both socioeconomic and hazard factors. The second map uses hazard factors alone. The maps show the importance of recognizing the cost of disruption not only to buildings and infrastructure, but also to people, especially vulnerable populations. Both types of losses can be mitigated.

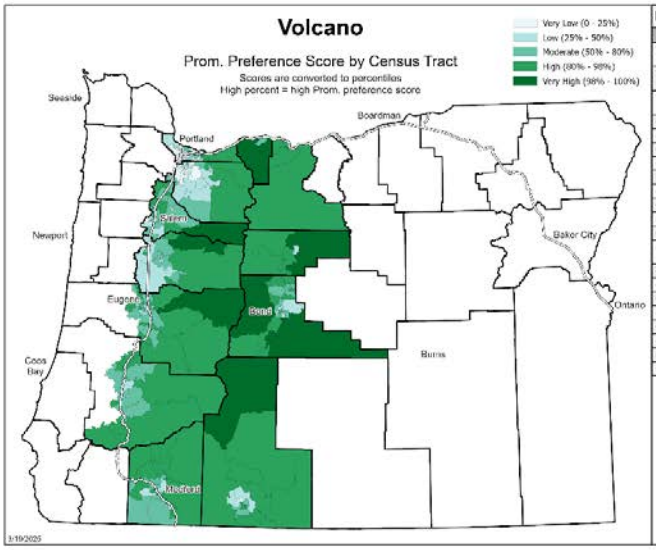
Figure 3.3.9-7: Volcanic Activity Risk Rating from the NRI: Risk Index Rating from the Federal Emergency Management Agency, National Risk Index for Volcanic Activity.



Source: Federal Emergency Management Agency, National Risk Index for Volcanic Activity. Ranking based on national percentiles. Last updated by FEMA in March 2023. Data accessed on February 12, 2025 from National Risk Index | FEMA.gov.

Figure 3.3.9-8 and Figure 3.3.9-9 show risk rankings by census tract for volcanoes from the Oregon Natural Hazards Risk Assessment. Darker colors show census tracts with higher risk. Figure 3.3.9-8 shows census tracts ranked using hazard and socioeconomic vulnerability indicators. Figure 3.3.9-9 shows census tracts ranked using only hazard indicators, without using socioeconomic vulnerability indicators. Cities are included for locational reference only and do not show risk by city. Chapter 9 has additional details and examples of the information available from the risk assessment model.

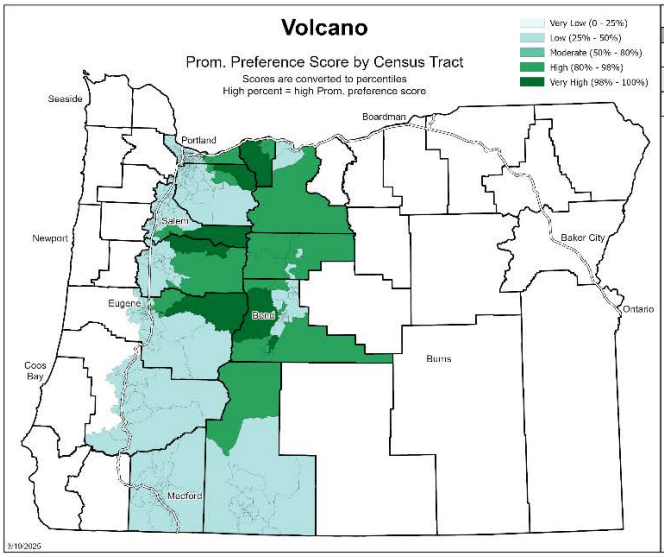
Figure 3.3.9-8: Volcano results of Oregon Risk Assessment using PROMETHEE Ranking with Socioeconomic Indicators Included.



Indicators used for the hazard Hazard indicators are worth 35% of the total weight.

Hazard	Indicator Name	Direction	Weight	Short Description
Volcano	LAH_pct_bld	1	0.117	Percentage of SBFO buildings exposed to volcanic lahar hazard of any size.
Volcano	LAH_pct_CF	1	0.117	Percentage of critical facilities exposed to volcanic lahar hazard of any size.
Volcano	Hist_Lahar_ct	1	0.117	Percentage of historic buildings exposed to volcanic lahar hazard of any size.
General	EP_MINRTY	1	0.046	Percentage of Black, Indigenous, and People of Color (2020 Census).
General	HousingTenure	-1	0.046	Housing tenure from the US Census.
General	EP_MOBILE	1	0.046	Percentage of people that live in mobile homes
General	Median_Yrblt	-1	0.046	Median year built of general building stock based on HAZUS default.
General	HospitalDistMile	1	0.046	Distance from tract centroid to nearest hospital.
General	NatResrcJobs	1	0.046	Rate of natural resource jobs.
General	PRFDS_PF	1	0.046	Community Resilience Estimate
General	Hosp_Beds	-1	0.046	Estimated number of hospital beds based on square footage.
General	Pct_Adherents	-1	0.046	Percentage of members in a religious group
General	Mitigation	-1	0.046	Number of mitigation projects (grouped by zip code and evenly distributed to overlaying tracts)
General	Watch	-1	0.046	Neighborliness: Will watch neighbor's house
General	CountyTax	-1	0.046	County tax rate
General	CityTax	-1	0.046	City tax rate
General	Cultural	-1	0.009	Number of cultural-related buildings
General	Favors	-1	0.009	Neighborliness: Willing to do favors for neighbor
General	Advice	-1	0.009	Neighborliness: Seeks advice from neighbor
General	Parties	-1	0.009	Neighborliness: Attended parties that occur in neighborhood
General	Visits	-1	0.009	Neighborliness: Has visited neighbor's house

Figure 3.3.9-9: Volcano results of Oregon Risk Assessment using PROMETHEE Ranking without Socioeconomic Indicators Included



Indicators used for the hazard

Hazard	Indicator Name	Direction	Weight	Short Description
Volcano	LAH_pct_bld	1	0.333	Percentage of SBFO buildings exposed to volcanic lahar hazard of any size.
Volcano	LAH_pct_CF	1	0.333	Percentage of critical facilities exposed to volcanic lahar hazard of any size.
Volcano	Hist_Lahar_ct	1	0.333	Percentage of historic buildings exposed to volcanic lahar hazard of any size.

3.3.10 Wildfires

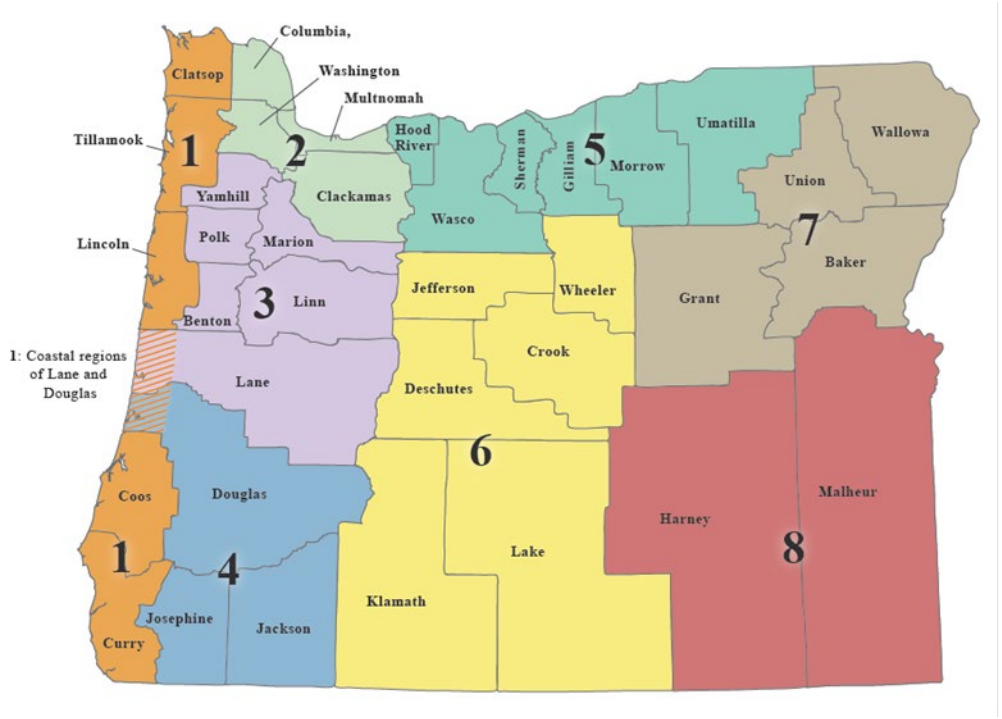
Non-regulatory map: *This wildfire risk assessment and maps are not regulatory. The Oregon Department of Forestry and Oregon State University developed a statewide wildfire hazard map as required by the Oregon Legislature for use in building codes, defensible space requirements, and grant programs. To learn more about the regulatory statewide wildfire hazard maps, visit Oregon Department of Forestry's wildfire page.*

Wildfires are common and widespread in Oregon. The state has a long and extensive history of wildfire. A significant portion of Oregon's forestland is ecosystems dependent upon fire for their health and survival. Wildfires frequently threaten communities, especially in the wildland-urban interface (WUI) where structures and other human development meet or intermingle with natural vegetative fuels.

Oregon has an excess of 41 million acres (more than 64,000 square miles) of forest and rangeland that is susceptible to damage from wildfire. In addition, significant agricultural areas of the Willamette Valley, north central, and northeastern Oregon grow crops such as wheat that are also susceptible to damage by wildfire.

The majority of wildfires take place between June and October, though fire season has been increasing in length since 1970 and is now, on average, 78 days longer than it used to be. This lengthening of the fire season is largely due to declining mountain snowpack and earlier spring snowmelt—a result of warming temperatures (Fleishman 2025). These fires primarily occur in Oregon NHMP Natural Hazard Regions 4, 5, 6, and 7 (Figure 3.3.10-1); however, even areas classified as low or moderate are susceptible to wildfire if the right combination of fuels, weather, and ignition conditions exist. Historically, Oregon's largest wildfires have burned in the Coast Range (Regions 1 and 2) where the average rainfall is high, but heavy fuel loads created a low-frequency, high-intensity fire environment during the dry periods. However, the relationship between anthropogenic climate change and increasing frequency and intensities of wildfire in the western United States is increasingly evident. Between 2020 and 2024, Oregon faced several high intensity fire seasons, including the 2020 Labor Day fires which resulted in more than one million acres burned and wildfires in the summer of 2024 which burned nearly two million acres.

Figure 3.3.10-1: Oregon NHMP Natural Hazards Regions



Extreme winds can occur in all of Oregon's eight regions. The most persistent high winds occur along the Oregon Coast and the Columbia River Gorge. The Columbia River Gorge is the most significant east-west gap in the mountains between California and Canada. It serves as a funnel for east and west winds, where direction depends solely on the pressure gradient. Once set in motion, the winds can attain speeds of 80 mph. Wind is a primary factor in fire spread and can significantly impede fire suppression efforts.

Historically, 70 percent of the wildfires suppressed on land protected by the Oregon Department of Forestry (ODF) result from human activity. The remaining 30 percent result from lightning. Typically, large wildfires result primarily from lightning in remote, inaccessible areas.

El Niño Southern Oscillation and Wildfire Hazards

El Niño winters are often warmer and sometimes drier than average. Sometimes this leads to above average fire seasons.

Unfortunately, El Niño is not a great predictor of above average fire seasons. Long-term drought is a much more accurate predictor.

Source: Oregon Department of Forestry

Large wildfires can have significant financial and social costs. Not only can they impact lives and property, they can also have negative short- and long-term economic and environmental consequences.

Life safety enhancement and cost savings may be realized by appropriate mitigation measures, starting with coordinated fire protection planning by local, state, tribes, federal agencies, the private sector, and community organizations. Additionally, individual WUI property owners play an important role in this coordinated effort.

Wildfire suppression costs escalate dramatically when agencies must adjust suppression tactics to protect structures. The cost of mobilizing personnel and equipment from across the state is significant. Non-fire agencies may also incur costs for providing or supporting evacuations, traffic control, security, public information, and other services during WUI fire incidents. These costs vary widely and have not been well documented.

The number of people living in Oregon's WUI areas is increasing. Where people have moved into these areas, the number of wildfires has escalated dramatically. Many Oregon communities (incorporated and unincorporated) are within or abut areas subject to serious wildfire hazards. In Oregon, more than one million tax lots have been identified within the WUI, which greatly complicates firefighting efforts and significantly increases the cost of fire suppression. While Oregon's Emergency Conflagration Act helps protect WUI communities that have depleted their local resources when threatened by an advancing wildfire, the escalating number of fires has led to the recognition that high fire risk communities need to provide mitigation and an appropriate level of local fire protection. Collaboration and coordination are ongoing among several agencies to promote educational efforts through programs like Firewise USA® and Fire Adapted Communities through the National Cohesive Wildfire Strategy.

Construction in vulnerable areas increases risk for certain populations. Oregon's Statewide Planning Goal 4 and Goal 7 play critical roles in guiding development in these areas. Measures to enhance life safety and save costs include Community Wildfire Protection Plans (CWPPs), coordinated fire protection planning, and coordination by local, state, tribal, federal agencies, the private sector, and community organizations. Many communities incorporate their CWPPs into their Natural Hazards Mitigation Plans (NHMPs).

Wildfire mitigation discussions are focused on reducing overabundant, dense forest fuels, particularly on public lands. The Healthy Forest Restoration Act aims to create fuel breaks by reducing overly dense vegetation and trees in an effort to protect communities at risk of wildfire, improve water quality, and restore resilient forest ecosystems. It provides funding and guidance to reduce or eliminate hazardous fuels in national forests, other public lands, and private ownership, improve forest fire fighting, and research new methods to reduce the impact of invasive insects, and requires collaboration between federal agencies and local communities to identify and prioritize fuel reduction and forest restoration projects.

Oregon continues to make efforts in fuels management and forestry resilience and health in and near WUI areas. Sustaining the work over the years requires a substantial, ongoing capacity and financial commitment. Progress is often challenging because fuel mitigation methods vary and are often up to landowners to maintain. Recurring WUI fires continue to bring the issue into public focus, work as a catalyst to unite communities and stakeholders in a common set of objectives, and create collaborative approaches to mitigate fuels.

3.3.10.1 Analysis and Characterization

History of Wildfire

Wildfires have been a feature of the Oregon landscape for thousands of years. Prehistoric fires resulted from lightning events and in controlled forms of active management practices by Native Americans. The Blue Mountains in northeastern Oregon were named so by early immigrants

because of the existence of a perpetual, blue-colored wildfire smoke haze that lingered over the region. Between 1840 and 1900, wildland fires burned at least two million acres of forestland in western Oregon. It is believed settlers caused many of these fires. Following the establishment of the U.S. Forest Service and ODF, in 1905 and 1911, respectively, an aggressive and coordinated system of fire prevention and suppression emerged. However, it took several decades before significant gains were made.

Major wildfires in 1933, 1939, 1945, and 1951 burned across more than 355,000 acres in the northern Coast Range and became known collectively as the "Tillamook Burn."

Better suppression and more effective fire prevention campaigns combined to reduce large wildfire occurrences following World War II. Suppression improvements included the establishment of organized and highly trained crews, which replaced the previous system of hiring firefighters on an as-needed basis. Additional improvement resulted from construction of an extensive system of forest roads, lookouts and guard stations, the use of aircraft for the detection of fires and the delivery of fire suppression retardant, the invention and modification of modern and efficient fire suppression equipment, and refinements in weather forecasting and fire reporting. Prevention benefited from war-era campaigns, which united prevention activities with patriotism, and birthed movements such as the Smokey Bear campaign and the Keep Oregon Green Association.

A pattern of frequent, large WUI fires emerged during the 1970s as people began flocking to more rural settings. Suburban growth increased and continued through the 1980s. This introduced substantially more structures into what had previously been wildland areas that historically depended on periodic fires to sustain a healthy forest ecosystem.

By the early 1990s, frequent, destructive WUI fires had become a major concern of the State Forester, the State Fire Marshal, and the Oregon Legislature. By the mid-1990s, over 100 structures had been destroyed by wildfires. Thousands more had been threatened and suppression costs were increasing sharply. The same trends were occurring in surrounding states, at an even greater pace.

Project Wildfire

Project Wildfire is the result of a Deschutes County effort to create long-term wildfire mitigation strategies and provide for a disaster-resistant community. Project Wildfire is a community organization that facilitates, educates, disseminates and maximizes community efforts toward effective fire planning and mitigation.

Project Wildfire achieves its mission by:

- Developing long-term wildfire prevention and education strategies designed to reach an ever-changing community.
- Creating disaster resistant communities through collaboration with community members and a network of specialized partners.
- Reducing the severity and amount of damage caused by wildfire in wildland urban interface (WUI) areas through hazardous fuels reduction programs.
- Reducing the impact of fuels reduction on the environment by recycling the woody biomass resulting from hazardous fuels reduction projects.

Source: Oregon Department of Forestry, Project Wildfire (http://www.projectwildfire.org/http://www.projectwildfire.org/)

In response to increased costs and risk of fires in the WUI, the Oregon Forestland-Urban Interface Fire Protection Act was passed in 1997. The Act recognized that "…*forestland-urban interface property owners have a basic responsibility to share in a complete and coordinated protection system*..." During the 1990s, prevention and mitigation of WUI fires included enactment of the Wildfire Hazard Zone process and the inclusion of defensible space requirements in the land use planning process. The Act and Wildfire Hazard Zone process were superseded by Oregon Senate Bill 762 in 2021. Additionally, significant efforts were made to increase voluntary landowner participation, through aggressive awareness campaigns, such as FireFree, Project Wildfire, Project Impact, Firewise USA®, and other locally driven programs.

Through the years, Oregon's wildfire suppression system continued to improve. Firefighters benefited from improved training, coordination, and equipment. Better interagency initial attack cooperation, the growth of private crew and fire engine wildfire suppression resources, formation of structural incident management teams, and regional coordination of fire suppression are additional examples of these continued improvements. Technology has improved as well with the addition of lightning tracking software and fire detection cameras to support or replace deteriorating lookout towers.

Nevertheless, the frequency of wildfires threatening WUI communities continues to underscore the need for urgent action. The summer of 2002 included 11 Emergency Conflagration Act incidents, with as many as five running concurrently. More than 50 structures burned and, at one point, the entire Illinois Valley in Josephine County seemed under siege from the Biscuit Fire, Oregon's largest wildfire on record at that time. This wildfire threatened the homes of approximately 17,000 people, with over 4,000 homes under imminent evacuation alert. At almost 500,000 acres, it was the nation's largest wildfire of the year. The summer of 2013 once again brought to bear one of the worst fire seasons in Oregon. For the first time since 1951, more than 100,000 acres burned on lands protected by ODF. Five incident management teams were deployed in a period of three days following a dry lightning thunderstorm event in late July that sparked nearly 100 fires in southern Oregon from more than 300 lightning strikes. Another storm that passed over central and eastern Oregon in mid-August produced significant fires that threatened the communities of John Day and The Dalles.

Beginning September 7, 2020, several fires ignited under critically hot and dry conditions and spread dramatically during multiple days of high winds, resulting in five simultaneous "megafires"– fires greater than 100,000 acres in size – and a total of 21 fires. The 2020 Labor Day wildfires burned more than 1.2 million acres across Oregon, causing unprecedented deaths and damage to homes, livelihoods, and the natural environment, including more than 5,000 homes and businesses destroyed. Many fires threatened or crossed the WUI, placing over 500,000 Oregonians under some level of evacuation notice, with more than 40,000 people that had to evacuate their homes. The Oregon Forest Resources Institute's 2021 report on the 2020 Labor Day fires reported an estimated economic impact of $5.9 billion to Oregon's forest sector (OFRI 2021). Other after-effects of the fires included unhealthy air quality levels for 12 days or more in many parts of the state, landslides, debris flows, and reduced drinking water quality.

In the summer of 2024, nearly two million acres burned across the state, far exceeding previous years' acreage burned, including five megafires. Between July and September, central and eastern

Oregon experienced multiple periods of excessive heat. These hot conditions aided in additional curing of fuels across the region, increasing the susceptibility of the land to fire development and growth, in conjunction with multiple periods of thunderstorms that produced abundant lightning. These wildfires not only damaged vast areas of land but also damaged electric utilities and other infrastructure and threatened communities, destroying homes and other structures.

Figure 3.3.10-2: Average Acres Burned: This chart shows wildfire acres burned by decade in Oregon for all agencies from 2005-2024.

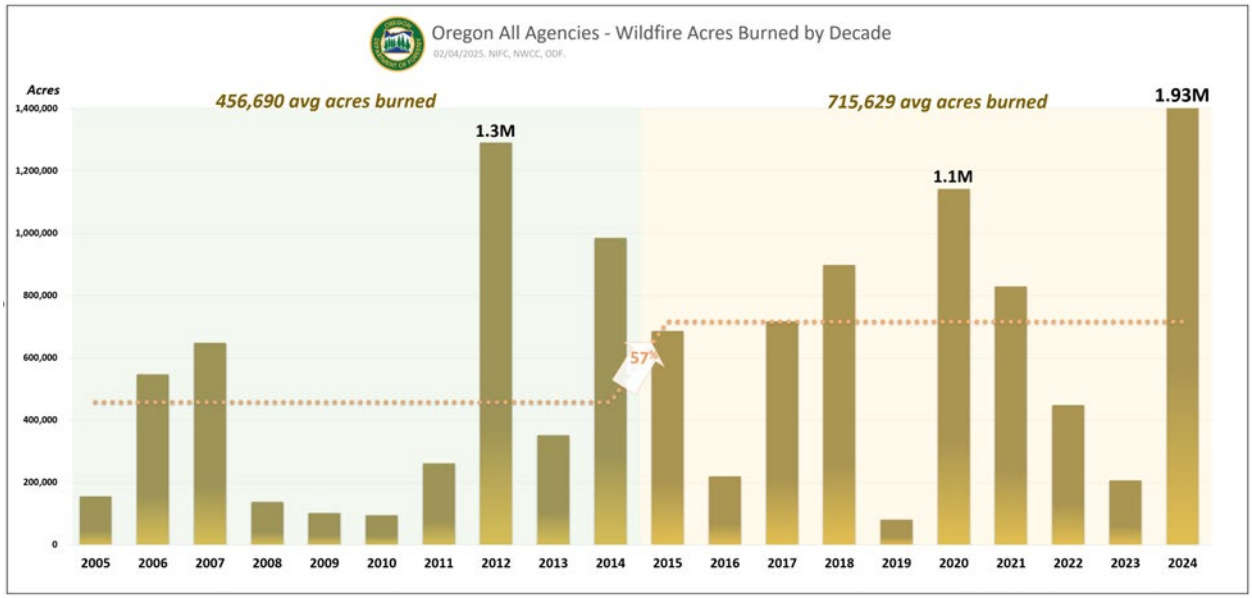
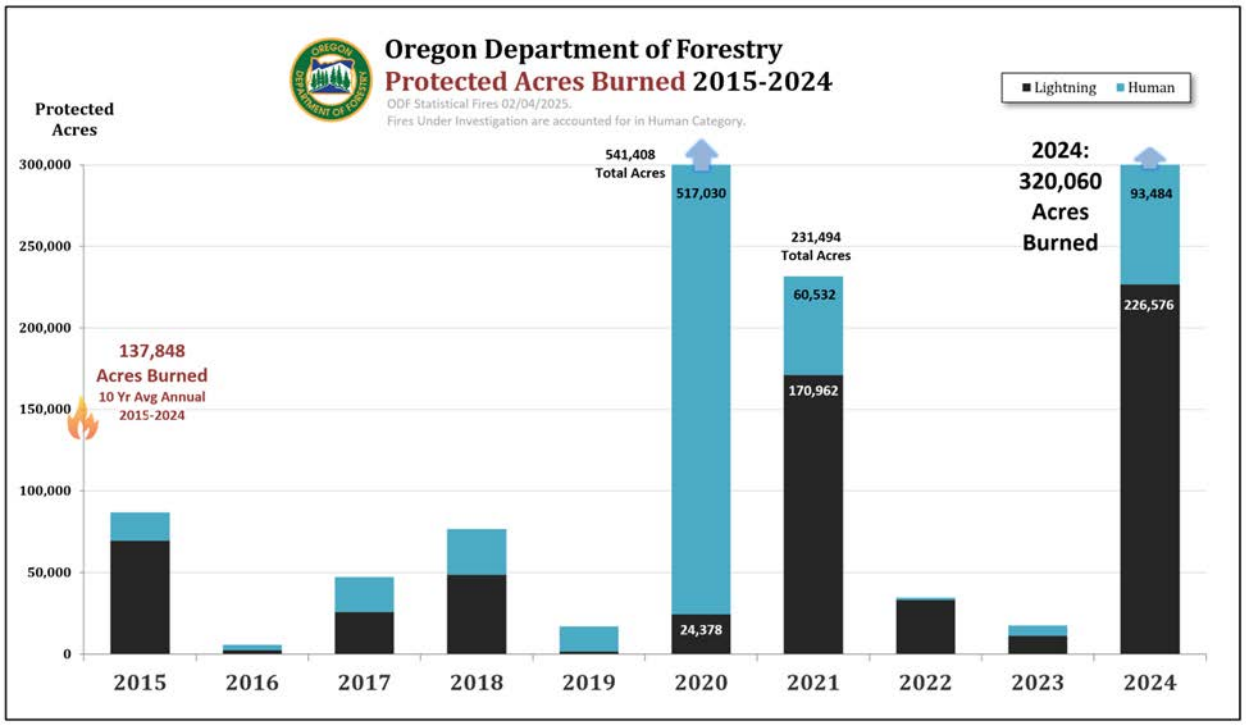


Figure 3.3.10-3: ODF Protected Acres Burned: This chart illustrates the sharp spike in acres burned in 2020, 2021, and 2024.



Federal disaster declarations related to the 2020 wildfires included DR-4562 (Major Disaster) – Oregon Wildfires and Straight-line Winds, EM-3542 (Emergency) – Oregon Wildfires, and several Fire Management (FM) Assistance declarations. In early January 2025, FEMA declared a major disaster for Oregon (DR-4854) in response to summer 2024 wildfires. Between 2020 and 2024, there were 38 FM declarations across Oregon.

Since 1996, Oregon has had 135 declared Conflagrations under Oregon's Emergency Conflagration Act. The Conflagration Act is invoked when the Governor determines threats to life, safety, and property exist because of the fire, and the threats exceed the capabilities of local firefighting personnel and equipment.

Senate Bill 762: Responding to Wildfire Risks

In 2021, the Oregon Legislature passed Senate Bill 762, a comprehensive wildfire preparedness and resiliency bill to help Oregon be better prepared to meet the increased wildfire threat. To rise to the challenge wildfire poses to Oregonians, several state agencies are working in coordination with local and federal partners to tackle the issue. These efforts aim to give people and communities the tools and knowledge to be better protected against wildfire and are ongoing as of this writing.

Types of Wildfire

Wildfires burn primarily in vegetative fuels located outside highly urbanized areas. Wildfires may be broadly categorized as agricultural, forest, range, or WUI fires.

Agricultural

Fires burning in areas where the primary fuels are flammable cultivated crops, such as wheat. This type of fire tends to spread very rapidly, but is relatively easy to suppress if adequate resources are available. Structures threatened are usually few in number and generally belong to the property owner. There may be significant losses in terms of agricultural products from such fires.

Forest

The classic wildfire; these fires burn in fuels composed primarily of timber and associated fuels, such as brush, grass, and logging residue. Due to variations in fuel, weather, and topography, this type of fire may be extremely difficult and costly to suppress. In wilderness areas these types of fires are often monitored and allowed to burn for the benefits brought by the ecology of fire, but also pose a risk to private lands when these fires escape these wilderness areas.

Range

Fires that burn across lands typically open and lacking timber stands or large accumulations of fuel. Such lands are used predominantly for grazing or wildlife management purposes. Juniper, bitter-brush, and sage are the common fuels involved. These fires tend to spread rapidly and vary from being easy to difficult to suppress. They often occur in areas lacking both wildland and structural fire protection services.

Wildland-urban interface (WUI)

These fires occur in portions of the state where urbanization and natural vegetation fuels are mixed together. This mixture may allow fires to spread rapidly from natural fuels to structures and vice versa. Such fires are known for the large number of structures simultaneously exposed to fire. Especially in the early stage of WUI fires, structural fire suppression resources may be quickly overwhelmed, which may lead to the destruction of a large number of structures. Nationally, wildland interface fires have frequently resulted in catastrophic structure losses.

Secondary Hazards

Increased risk of landslides and erosion are secondary hazards associated with wildfires that occur on steep slopes. Wildfires tend to denude the vegetative cover and burn the soil layer creating a less permeable surface prone to sheetwash erosion. This - in turn - increases sediment load and the likelihood of downslope failure and impact.

Wildfires can also impact water quality (e.g., drinking water intakes). During fire suppression activities some areas may need coordinated efforts to protect water resource values from negative impact.

Wildfire smoke may also have adverse effects on air quality and visibility and create nuisance situations. Strategies to limit smoke from active wildfires are limited, but interagency programs exist to alert the public of potential smoke impact areas where hazardous health or driving conditions may occur.

Source: Unknown

Common Sources of Wildfire

For statistical tabulation purposes, wildland fires are grouped into nine categories based on historically common wildfire ignition sources.

Figure 3.3.10-4: Fires By General Cause: This graphic illustrates the general causes of wildfire across the state from 2015-2024.

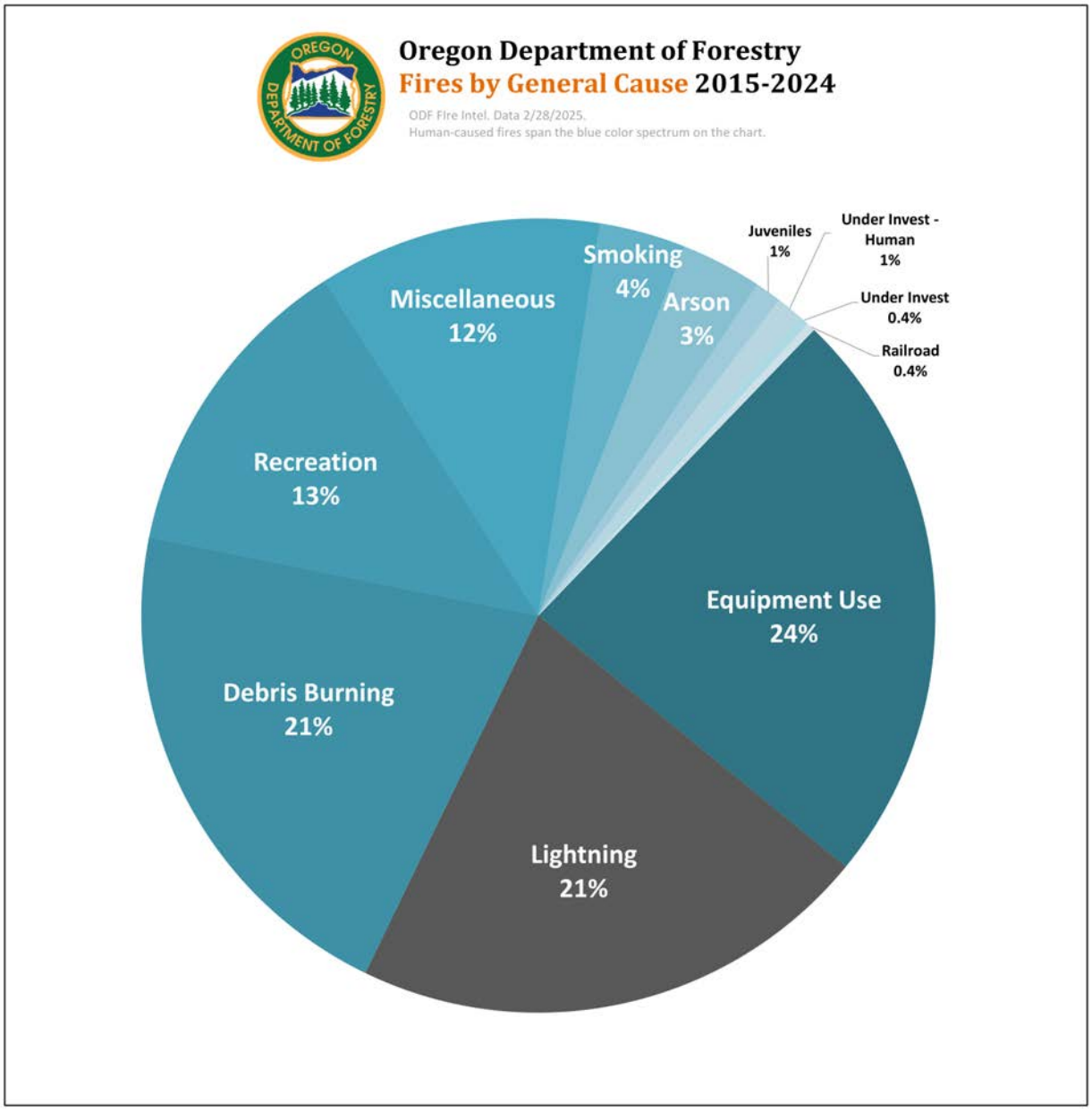
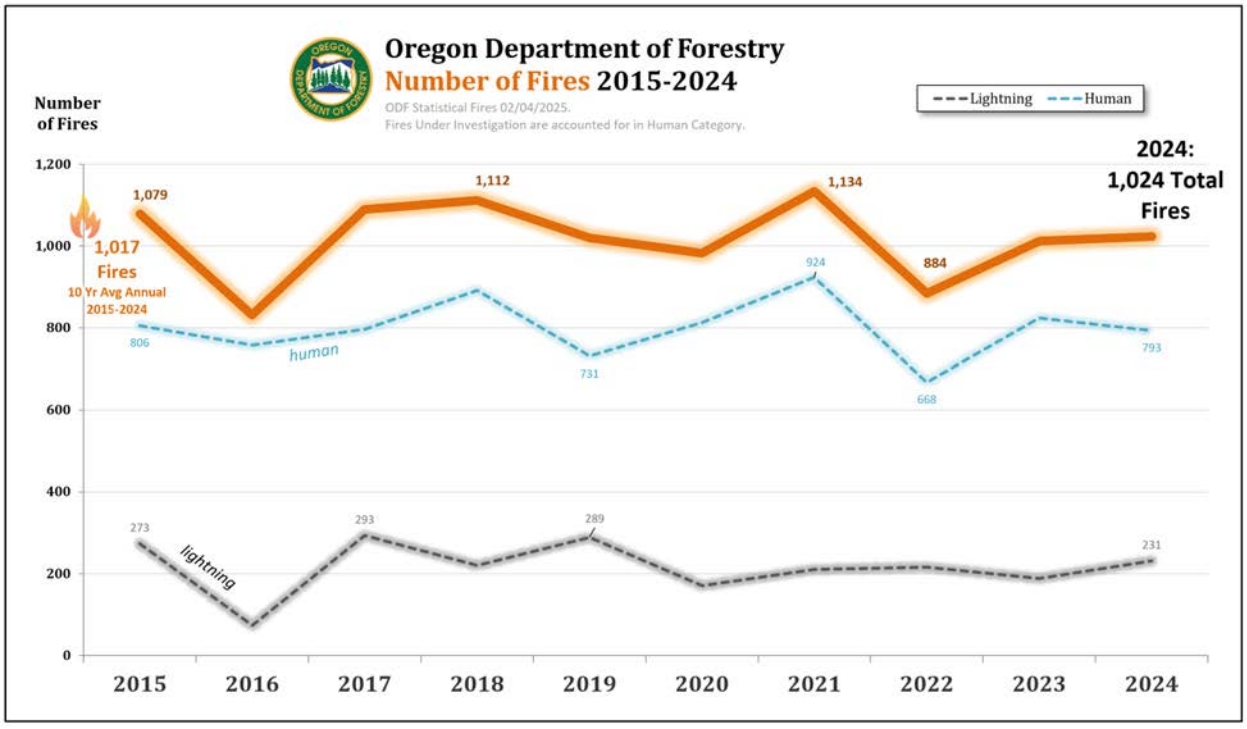


Figure 3.3.10-5: Number of Fires: This graphic illustrates the total number of fires due to human activity and lighting strike from 2015-2024.



Lightning

There are tens of thousands of lightning strikes in Oregon each year. Of the nine categories, lightning is the second highest ignition source of wildfires between 2015 and 2024 at 21 percent, along with debris burning.

Equipment use

This source ranges from small weed eaters to large logging equipment; many different types of equipment may readily ignite a wildfire, especially if used improperly or illegally. Although fire agencies commonly limit or ban certain uses of fire-prone equipment, the frequency of fires caused by equipment has increased. Increases in fires from this source may be related to the expansion of the wildland urban interface, which results in more people and equipment being in close proximity to forest fuels. Equipment use was the highest cause of all fires between 2015 and 2024 at 24 percent, pointing to the need for continued focus on this source.

Recreation

The trend in fires caused by people recreating in and near Oregon's forests has continued to rise. Recreation is the third highest cause of fires between 2015 and 2024 at 13 percent. This trend may reflect the state's growing population as well as a greater interest in outdoor recreation opportunities. Local, state, and federal land management and recreation agencies should continue to focus on strategies to engage visitors and residents alike.

Debris burning

Historically, debris burning activities have been a leading source of human-caused wildfires. Between 2015 and 2024, debris burning was the second highest cause of wildfires at 21 percent, along with recreation. Partnering fire protection agencies, primarily through local fire defense boards, continue to seek solutions to curb ignitions and escapements. Besides consistent messaging during fire season that draws attention to the illegal activity, fire prevention professionals provide additional education to encourage alternatives to burning and safe burning practices during fall and winter months when fire danger is less severe.

Juvenile

Concerted efforts by local fire prevention cooperatives to deliver fire prevention messages directly to school classrooms and the Oregon State Fire Marshal's aggressive youth intervention program has helped address this ignition source. Between 2015 and 2024, juveniles caused 1 percent of fires. In 1999, according to the ODF, juveniles were reported to have started 60 wildland fires. Conversely, juveniles accounted for just 6 fires on ODF protected land in 2024. Additionally, parents or guardians, under Oregon Law, are responsible for damage done by fires started by their children. ORS 30.765 covers the liability of parents; ORS 163.577 holds parents or guardians accountable for child supervision, ORS 477.745 makes parents liable for wildfire suppression costs of a fire by a minor child, and ORS 480.158 holds a parent liable for fireworks-caused fires. Additionally, parents may be assessed civil penalties.

Arson

Oregon experienced a rapid rise in the frequency of arson-caused fires in the early '90s. 1992 was the worst fire season for arson with 96 fires attributed to the category. In response, the state instituted aggressive arson prevention activities with solid working relationships with local law enforcement and the arson division of the Oregon State Police. Between 2015 and 2024, only 3 percent of fires were attributed to arson.

Smoking

Fires caused by smoking and improperly discarded cigarettes have slightly risen to 4 percent between 2015 and 2024.

Railroad

Wildfires caused by railroad activity are relatively infrequent. In the early twentieth century, this had been a major cause of fires, but has been decreasing for many years. Between 2015 and 2024, the number of railroad-caused fires was just 0.4 percent. In the past few decades, Oregon has responded to railroad-caused fires with aggressive fire investigation and cost recovery efforts. ODF works with the railroad on hazard abatement along tracks and requires water cars and chase vehicles during high fire danger. The resulting quick return to normal fire incidence showed that railroad fires are very preventable.

Miscellaneous

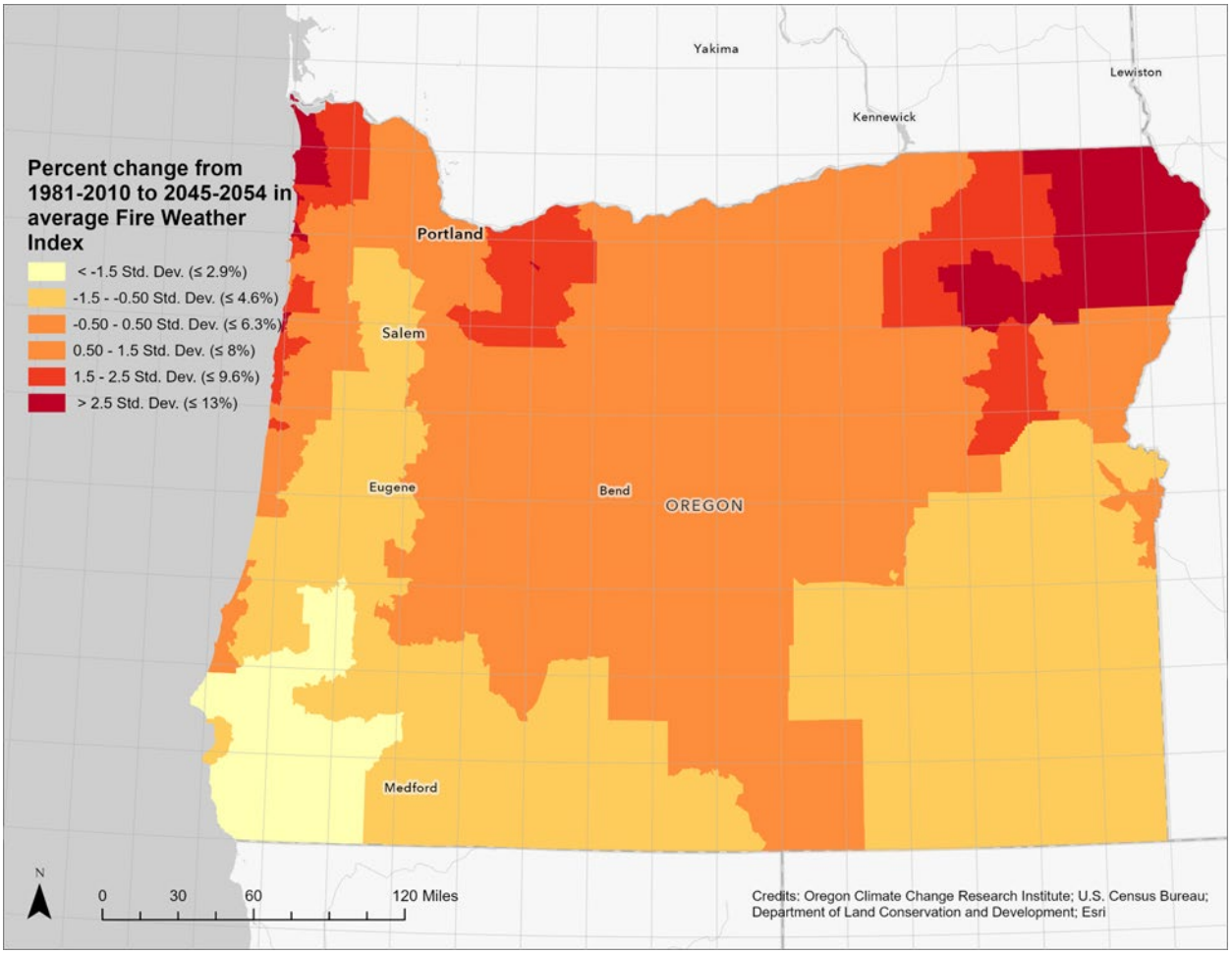
Wildfires resulting from a wide array of causes: automobile accidents, burning homes, pest control measures, shooting tracer ammunition and exploding targets, and electric fence use are a few of the causes in this category. The frequency of such fires has been rising in recent years.

Smoke Exposure

The effect of wildfire smoke exposure on public health is a growing topic of interest for public health and natural hazard mitigation. The Oregon Climate Assessment estimates that the number of smoke wave day-related all-cause mortality events, per six years, could exceed 151 adults and 192 older adults by the year 2050, with a total economic loss of 1.63 billion for all adults and 2.08 billion for older adults. Additionally, the number of smoke wave related emergency department visits could increase by about two-thirds by 2050, a dramatic increase from 2005 rates, according to the Oregon Climate Assessment (Fleishman 2025). The intersecting nature of wildfire hazards necessitates mitigation actions that address multiple risks to support multi-hazard resiliency.

3.3.10.2 Fire Weather Index

Figure 3.3.10-6: This map illustrates future statewide changes in average Fire Weather Index, measured in standard deviations.



Source: Data and map courtesy Oregon Climate Change Research Institute

3.3.10.3 Historic Wildfire Events

Table 3.3.10-1: Historic Wildfires in Oregon

Date	Location	Description
1902	Clackamas, Multnomah	**Columbia Fire/Yacolt Burn** 170,000 acres caused 38 deaths in the Lewis River area, 9 deaths in Windy River, and 18 deaths in the Columbia River Gorge.
1933-1951	Tillamook, Washington, Yamhill and Clatsop	**Tillamook Burn** was a series of large fires that struck in 6-year intervals burning a combined total of 355,000 acres and killing 35 people.
1936	Coos	**Bandon Fire** was a 287,000-acre fire that destroyed 100's of homes and killed 10 people.
2002	Josephine	**Biscuit fire** burned nearly 500,000 acres starting from lighting strikes and the product of the joining of 4 different fires and burned over 4 months long.
2006	Harney	**South End Complex** burned 117,553
2010	Jackson	**Oak Knoll Fire** in Ashland destroyed 11 homes in less than 45 minutes
2011	Wasco	**High Cascade Complex** burned on the east side of Mount Hood into **Warm Springs**, consuming 101,292 acres
2012	Tillamook, Washington, and Yamhill	**Holloway Fire** burned more than 245,000 acres in Oregon from a lightning strike and burned more than 215,000 acres in Nevada. One firefighter was killed.
2012	Malheur and Harney	**Long Draw Fire** consumed 557,648 acres and was started by lightning.
2013	Josephine, Douglas	**Douglas Complex** burned about 49,000 acres started by lightning strikes. Made up of 3 fires: Rabbit Mountain, Dad's Creek, and Farmer's Fire.
2013	Jefferson	**Sunnyside Turnoff** started by a firecracker that was thrown into vegetation. It grew to 51,480 acres on the Warm Springs Indian Reservation.
2014	Wallowa	**Buzzard Complex** burned over 400,000 acres and significantly impacted rangeland and cattle farms.
2014	Grant	**South Fork Complex** started with lightning strikes burning 62,476 acres.

Date	Location	Description
2015	Grant	**Canyon Creek Complex** burned 110,422 acres started by lightning. It destroyed more private property than any Oregon wildfire for 80 years before it. It destroyed 43 homes and almost 100 other structures.
2015	Wallowa	**Grizzly Bear Complex** burned 82,659 acres started by lightning. Destroyed 2 homes and dozens of other structures.
2015	Jefferson	**County Line 2** burned over 67,000 acres.
2015	Baker	**Cornet Windy Ridge** burned 103,887 Acres started by lightning strike.
2017	Curry	**Chetco Bar** burned 191,125 acres and started by lightning strike.
2017	Multnomah and Hood River	**Eagle Creek Fire** burned 48,831 acres and was caused by a 15-year- old playing with fireworks.
2017	Lake and Harney	**Cinder Butte** burned over 52,000 acres of rangeland that was human caused and threatened Tribal Archaeological Sites.
2017	Wasco	**Nena Springs** burned more than 68,000 acres, was human cause and did significant damage to the Confederate Tribes of Warm Springs.
2018	Josephine	**Klondike** burned more than 175,258 acres and eventually merged into the Taylor Creek Fire that had burned 52,839 acres.
2018	Wasco	**Boxcar** burned 100,207 acres and started due to lightning.
2018	Jackson and Douglas	**Miles** burned 54,134 acres and was a combination of merged fires: Sugar Pine, South Umpqua Complex, and the Miles fire.
2018	Josephine	**Taylor Creek** burned 52,839 acres started by a lightning strike.
2018	Wasco	**Substation** burned 78,425 acres moving over 18 miles in just days.
2018	Lake	**Watson Creek** burned over 58,900 acres.
2020	Wasco	**Mosier Creek** burned 985 acres.
2020	Wasco	**White River** burned 17,404 acres from August 17 – September 10, 2020.
2020	Klamath	**Oregon Two Four Two 404** burned 14,473 acres over 17 days.

Date	Location	Description
2020	Clackamas, Linn, Jefferson, Marion, and Warm Springs Indian Reservation	**Beachie Creek Lionshead Complex** burned 193,566 acres from September 7 – October 15, 2020.
2020	Lane	**Holiday Farm** burned 173,393 acres from September 8 – October 3, 2020.
2020	Jackson	**Almeda Glendower** burned 3,200 acres over 8 days.
2020	Clackamas	**Riverside** burned 138,054 acres from September 8 – October 15, 2020.
2020	Lincoln	**Echo Mountain Fire Complex** burned 1,879 acres from September 8 – September 22, 2020.
2020	Douglas, Lane	**Archie Creek** burned from September 8 – October 15, 2020.
2020	Josephine	**Slater Fire** burned 166,127 acres from September 9 – November 3, 2020.
2020	Clackamas	**Clackamas County Fire Complex** burned 11,210 acres from September 8 – October 6, 2020.
2020	Lake	**Brattain** burned 50,951 acres from September 12 – 29, 2020.
2021	Deschutes	**Oregon 0419** burned 90 acres.
2021	Klamath, Lake	**Bootleg** burned 413,717 acres from July 10 – August 15, 2021
2021	Lake	**Patton Meadow** burned 8,946 acres from August 15 – 31, 2021.
2022	Wasco	**Miller Road** burned 10,847 acres over 5 days.
2023	Klamath	**Golden** burned 2,137 acres.
2023	Marion	**Liberty** burned 25 acres.
2024	Josephine	**Upper Applegate** burned 1,142 acres.
2024	Baker, Malheur	**Durkee** burned 294,265 acres from July 17 – August 13, 2024
2024	Baker	**Town Gulch Fire** burned 18,220 acres in August 2024.
2024	Deschutes	**Darlene 3** burned 3,903 acres.
2024	Jackson	**Salt Creek Road** burned 4,102 acres from July 7 – 24, 2024

Date	Location	Description
2024	Wasco	**Larch Creek** burned 18,286 acres.
2024	Gilliam, Morrow, and Wheeler	**Lone Rock** burned 137,222 acres from July 13 – August 12, 2024.
2024	Grant, Harney	**Falls Fire** burned 151,689 acres from July 10 – September 1, 2024.
2024	Lane, Douglas	**Lane 1** burned 25,265 acres from July 17 – October 1, 2024.
2024	Grant, Morrow, Umatilla	**Battle Mountain Complex** burned 162,389 acres.
2024	Harney	**Telephone Fire** burned 38,954 acres July 22 – September 1, 2024.
2024	Grant	**Boneyard** burned 52,473 acres from July 17 – August 10, 2024.
2024	Grant	**Courtrock Fire** burned 20,023 acres from July 17 – August 17, 2024.
2024	Deschutes	**Mile Marker 132** burned 78 acres.
2024	Wallowa	**Winding Waters Complex** burned 728 acres from July 25 – August 13, 2024.
2024	Jefferson	**Elk Lane** burned 5,640 acres and was started by a lightning strike.
2024	Douglas	**Dixon Fire** burned 1,970 acres from August 10 – 21, 2024.
2024	Washington	**Lee Falls** burned 240 from August 8 – 10, 2024.
2024	Klamath	**Copperfield** burned 3,822 acres from September 2 – 10, 2024.
2024	Crook, Grant, Wheeler	**Rail Ridge** burned 176,661 acres from September 2 – October 10, 2024.
2024	Wheeler	**Shoe Fly Fire** burned 26,893 acres from September 2 – 22, 2024.
2024	Fossil Complex	**Fossil Complex** burned 24,430 acres from September 5 – 24, 2024.

Source: Oregon Department of Forestry, 2025, and InciWeb the Incident Information System, accessed 3/3/2025.

3.3.10.4 Risk Maps

Non-regulatory map: *This wildfire risk assessment and maps are not regulatory. The Oregon Department of Forestry and Oregon State University developed a statewide wildfire hazard map as required by the Oregon Legislature for use in building codes, defensible space requirements, and grant programs. To learn more about the regulatory statewide wildfire hazard maps, visit Oregon Department of Forestry's wildfire page.*

The maps in this section highlight places where the state might work with communities to develop mitigation projects.

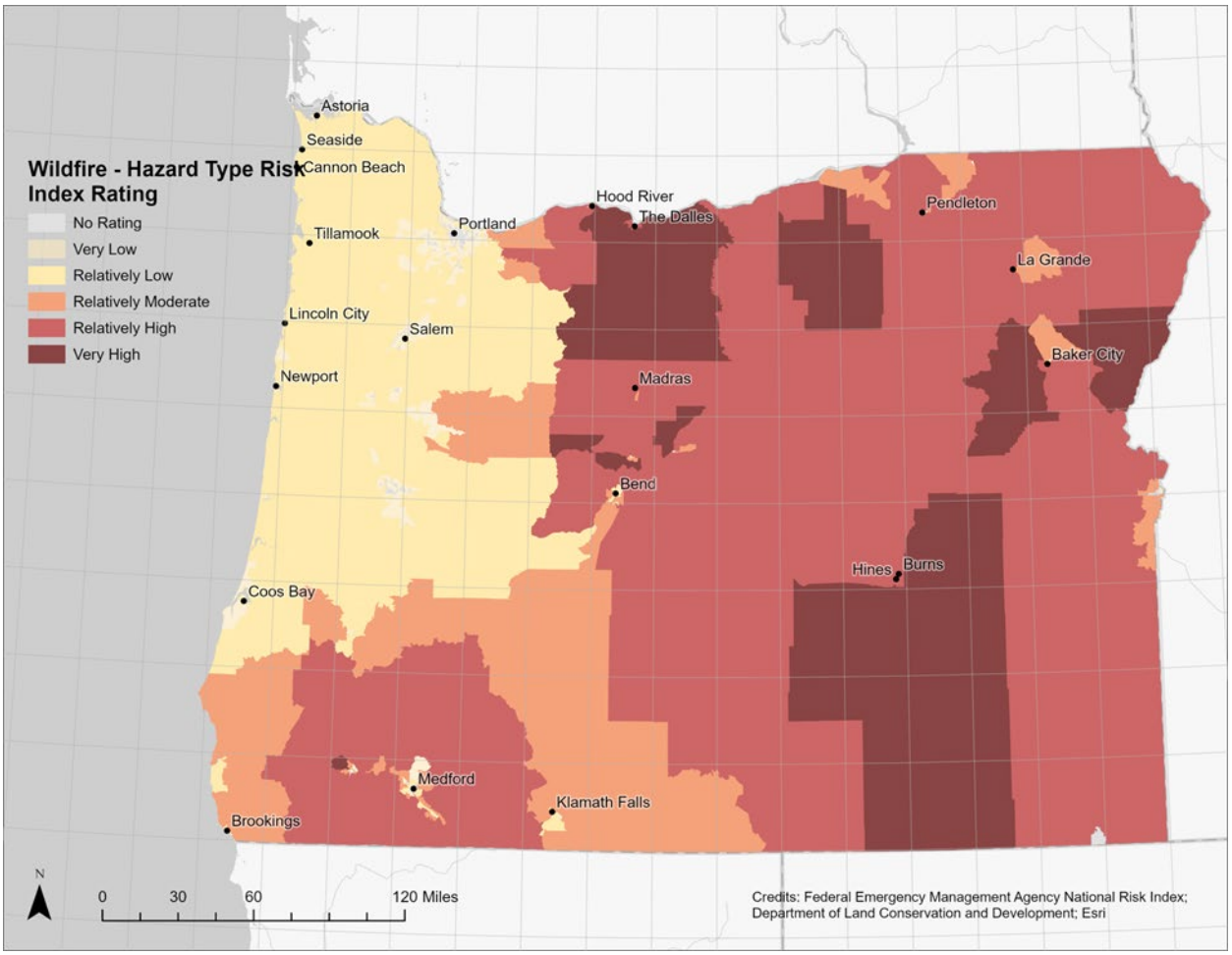
The National Risk Index produces a measure of monetary losses experienced over the period of record. This emphasizes historic costs of harm and would direct mitigation resources to where the costs have been the greatest. Mitigation in these locations would save money over the long term.

In contrast to the National Risk Index, the Oregon Natural Hazards Risk Assessment used indicators of harm based on percentages rather than counts of exposed entities or monetary loss. This captures the potential for disruption within a census tract. The higher the percentage of entities affected, the more disruption to those living or working in the census tract.

The Oregon Natural Hazards Risk Assessment produced two statewide summary maps showing distribution of potential harm. The first map uses both socioeconomic and hazard factors. The second map uses hazard factors alone. The maps show the importance of recognizing the cost of disruption not only to buildings and infrastructure, but also to people, especially vulnerable populations. Both types of losses can be mitigated.

The climate change maps show where risk is projected to increase. Areas with a high risk and a high increase in risk would be especially good places to work with communities to find mitigation projects.

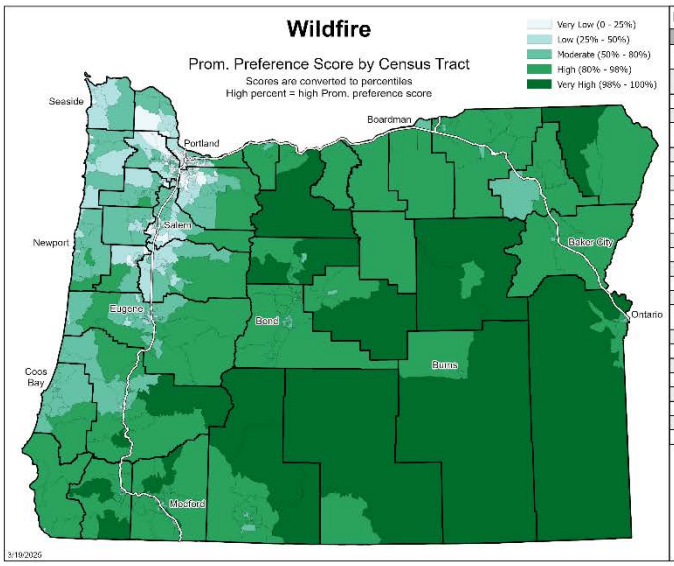
Figure 3.3.10-7: Wildfire Risk Rating from the NRI: Risk Index Rating from the Federal Emergency Management Agency, National Risk Index for wildfire.



Federal Emergency Management Agency, National Risk Index for wildfire. Ranking based on national percentiles. Last updated by FEMA in March 2023. Data accessed on February 12, 2025 from National Risk Index | FEMA.gov.

Figure 3.3.10-8 and Figure 3.3.10-9 show risk rankings by census tract for wildfire from the Oregon Natural Hazards Risk Assessment. Darker colors show census tracts with higher risk. Figure 3.3.10-8 shows census tracts ranked using hazard and socioeconomic vulnerability indicators. Figure 3.3.10-9 shows census tracts ranked using only hazard indicators, without using socioeconomic vulnerability indicators. Cities are included for locational reference only and do not show risk by city. Chapter 9 has additional details and examples of the information available from the risk assessment model.

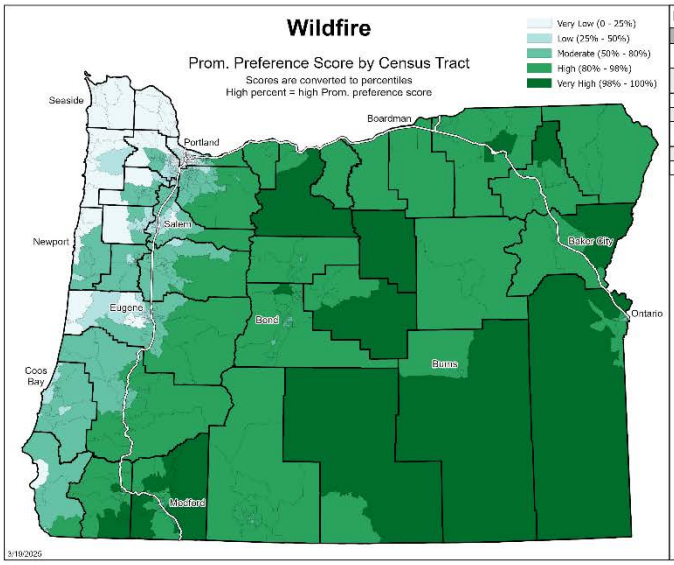
Figure 3.3.10-8: Census tracts ranked using hazard and socioeconomic vulnerability indicators.



Indicators used for the hazard Hazard indicators are worth 35% of the total weight.

Hazard	Indicator Name	Direction	Weight	Short Description
Wildfire	WF_pct_bld	1	0.05	Percentage of SBFO buildings exposed to Medium and High Burn Probability.
Wildfire	WF_pct_CF	1	0.05	Percentage of critical facilities exposed to Medium and High Burn Probability .
Wildfire	BurnProb	1	0.05	Burn probability from the QPNW.
Wildfire	Hwy_WF_pct	1	0.05	Percentage of highway within High Burn Probability zones
Wildfire	Hist_WF_ct	1	0.05	Percentage of historic buildings exposed to Medium and High Burn Probability.
Wildfire	Over90th	1	0.05	Mean days that are above the historic 90th percentile temp
Wildfire	Over90F	1	0.05	Mean days above 90 degrees Fahrenheit
General	EP_MINRTY	1	0.046	Percentage of Black, Indigenous, and People of Color (2020 Census).
General	HousingTenure	-1	0.046	Housing tenure from the US Census.
General	EP_MOBILE	1	0.046	Percentage of people that live in mobile homes
General	Median_Yrblt	-1	0.046	Median year built of general building stock based on HAZUS default.
General	HospitalDistMile	1	0.046	Distance from tract centroid to nearest hospital.
General	NatResrcJobs	1	0.046	Rate of natural resource jobs.
General	PRED3_PE	1	0.046	Community Resilience Estimate
General	Hosp_Beds	-1	0.046	Estimated number of hospital beds based on square footage .
General	Pct_Adherents	-1	0.046	Percentage of members to a religious group
General	Mitigation	-1	0.046	Number of migitation projects (grouped by zip code and evenly distributed to overlaying tracts)
General	Watch	-1	0.046	Neighborliness: Will watch neighbor's house
General	CountyTax	-1	0.046	County tax rate
General	CityTax	-1	0.046	City tax rate
General	Cultural	-1	0.009	Number of cultural-related buildings
General	Favors	-1	0.009	Neighborliness: Willing to do favors for neighbor
General	Advice	-1	0.009	Neighborliness: Seeks advice from neighbor
General	Parties	-1	0.009	Neighborliness: Attended parties that occur in neighborhood
General	Visits	-1	0.009	Neighborliness: Has visited neighbor's house

Figure 3.3.10-9: Census tracts ranked using only hazard indicators, without using socioeconomic vulnerability indicators.

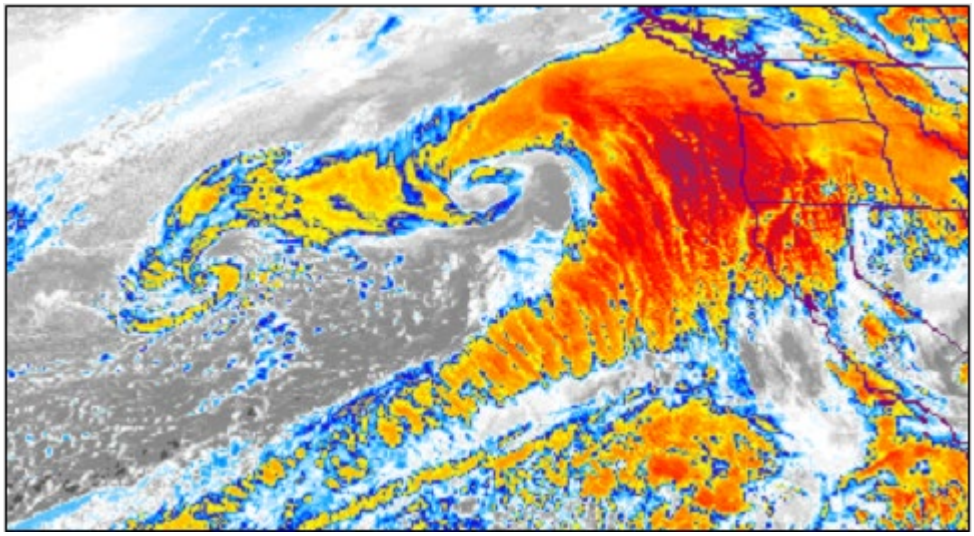


Indicators used for the hazard

Hazard	Indicator Name	Direction	Weight	Short Description
Wildfire	WF_pct_bld	1	0.143	Percentage of SBFO buildings exposed to Medium and High Burn Probability.
Wildfire	WF_pct_CF	1	0.143	Percentage of critical facilities exposed to Medium and High Burn Probability .
Wildfire	BurnProb	1	0.143	Burn probability from the QPNW.
Wildfire	Hwy_WF_pct	1	0.143	Percentage of highway within High Burn Probability zones
Wildfire	Hist_WF_ct	1	0.143	Percentage of historic buildings exposed to Medium and High Burn Probability.
Wildfire	Over90th	1	0.143	Mean days that are above the historic 90th percentile temp
Wildfire	Over90F	1	0.143	Mean days above 90 degrees Fahrenheit

3.3.11 Windstorms

Figure 3.3.11-1: Satellite Image of the Type of Severe Pacific Storm that Can Bring High Winds to Western Oregon.



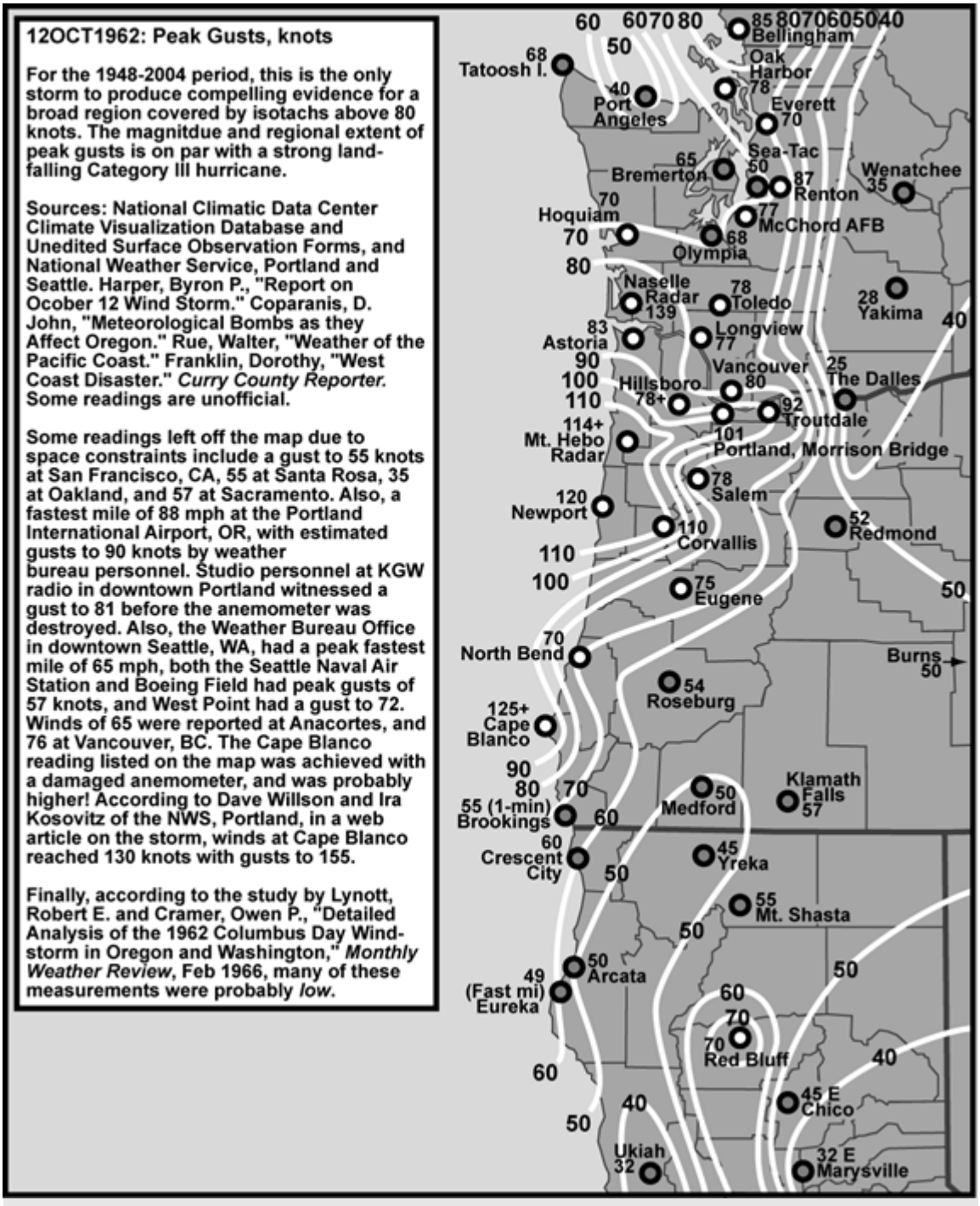
Source: NOAA

This section covers most kinds of windstorm events in Oregon, including the wind aspects of Pacific storm events. The precipitation aspects of Pacific storm events are covered earlier in the **Flood** section. Winds specifically associated with blizzards and ice storms are covered in the **Winter Storm** section. Wildfires driven by high winds are covered in the Wildfire section.

3.3.11.1 Analysis and Characterization

High winds can be among the most destructive weather events in Oregon; they are especially common in the exposed coastal regions and in the mountains of the Coast Range. Most official wind observations in Oregon are sparse, taken at low-elevation locations where both the surface friction and the blocking action of the mountain ranges substantially decrease the speed of surface winds. Furthermore, there are few long-term reliable records of wind available. Even the more exposed areas of the coast are lacking in any long-term set of wind records. From unofficial, but reliable observations, it is reasonable to assume that gusts well above 100 mph occur several times each year across the higher ridges of the Coast and Cascades Ranges. At the most exposed Coast Range ridges, it is estimated, that wind gusts of up to 150 mph and sustained speeds of 110 mph will occur every 5–10 years.

Figure 3.3.11-2: Peak Gusts for Windstorm on October 12, 1962

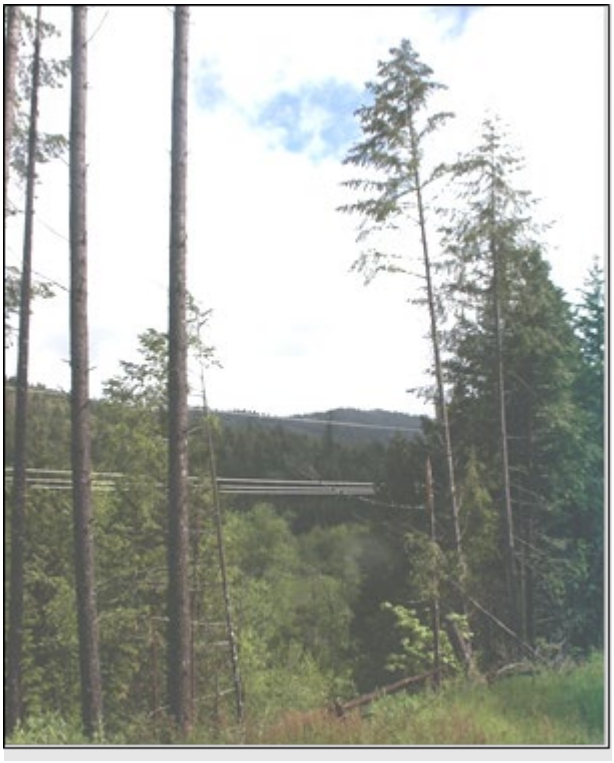


Source: Wolf Read, Climatologist, Oregon Climate Center, Oregon State University

Pacific storms can produce high winds and often are accompanied by significant precipitation and low barometric pressure. These storms usually produce the highest winds in Western Oregon, especially in the

coastal zone. These storms are most common from October through March. The impacts of these storms on the state are influenced by storm location, intensity, and local terrain.

Figure 3.3.11-3: Unstable Trees Near Electric Lines Left after a Logging Operation



Note: Unstable trees near electric lines left after a logging operation near electric lines pose a serious threat of personal injury, forest fire, and outages should high winds develop. Forest owners and workers need to coordinate their "leave trees" with electric utilities to prevent dangerous conditions as depicted here.
Source: Randy Miller, PacifiCorp

The historian Lancaster Pollard documented exceptional storms that occurred in 1880, 1888, 1920, 1931, and 1962. On January 29, 1920, a hurricane off the mouth of the Columbia River had winds estimated at 160 miles per hour (Pitzer, 1988).

One easterly windstorm that affected much of Oregon, particularly northern Oregon, was the northeasterly gale of April 21-22, 1931. This storm proved to be very destructive. Dust was reported by ships 600 miles out to sea. "While officially recorded wind speeds were not extreme, sustained wind speeds observed were 36 mph at Medford, 32 mph at Portland, 28 mph at Baker, and 27 mph at Roseburg. Unofficial wind measuring equipment reported winds of up to 78 mph. Damage was heavy to standing timber and fruit orchards." (http://www.wrh.noaa.gov/Portland/windstorm.html; for more information on this 1931 storm, see Appendix **9.1.4**.)

Effects

The damaging effects of windstorms may extend for distances of 100 to 300 miles from the center of storm activity. Isolated wind phenomena in the mountainous regions have more localized effects. Near-surface winds and associated pressure effects exert loads on walls, doors, windows, and roofs, sometimes causing structural components to fail.

Positive wind pressure is a direct and frontal assault on a structure, pushing walls, doors, and windows inward. Negative pressure also affects the sides and roof: passing currents create lift and suction forces that act to pull building components and surfaces outward. The effects of high-velocity winds are magnified in the upper levels of multi-story structures. As positive and negative forces impact and remove the building protective envelope (doors, windows, and walls), internal pressures rise and result in roof or leeward building component failures and considerable structural damage.

Debris carried along by extreme winds can directly contribute to loss of life and indirectly to the failure of protective building envelope components. Upon impact, wind-driven debris can rupture a building, allowing more significant positive and internal pressures. When severe windstorms strike a community, downed trees, power lines, and damaged property are major hindrances to response and recovery.

The most destructive winds are those which blow from the south, parallel to the major mountain ranges. The Columbus Day Storm of 1962 was a classic example of a south windstorm. The storm developed from Typhoon Freda remnants in the Gulf of Alaska, deepened off the coast of California and moved from the southwest, then turned, coming into Oregon directly from the south. This was the most damaging windstorm in Oregon of the last century. Winds in the Willamette Valley topped 100 mph, while in the Coast Range they exceeded 140 mph. The Columbus Day Storm was the equivalent of a Category IV hurricane in terms of central pressure and wind speeds.

In terms of damage, numbers vary, but it is clear that hundreds, if not thousands, of buildings suffered substantial damage. Downed powerlines left many people without power for weeks. The reports generally agree that more than 11 billion board feet of timber were lost in Pacific Northwest forests west of the Cascades, with some estimates as high as 15 or 17 billion board feet. Any of these estimates is more than the National Forest Service's usual annual harvest in Oregon and Washington together at that time. Damage costs are estimated at $230-$280 million, about $1.8-$2.2 billion in 2014 dollars. Reports agree that the storm caused 46 fatalities, but how many of those were in Oregon ranges from half to 38. Clearly, most of the people who lost their lives were Oregon residents. (https://www.oregonencyclopedia.org/articles/columbus_day_storm_1962_/; https://www.statesmanjournal.com/story/news/2020/10/12/oregon-history-remembering-columbus-day-storm-1962/5968606002/; https://nbc16.com/news/local/columbus-day-storm-the-storm-that-all-other-pacific-nw-wind-storms-are-measured-against; https://journals.ametsoc.org/view/journals/mwre/94/2/15200493_1966_094_0105_daotcd_2_3_co_2.pdf; https://thatoregonlife.com/2024/10/columbus-day-storm/; https://en.wikipedia.org/wiki/Columbus_Day_storm_of_1962; https://doi.org/10.1175/1520-0493(1966)094%3C0105:DAOTCD%3E2.3.CO;2;)

Other Issues

The Hazard Mitigation Survey Team (HMST) Report developed in response to the February 7, 2002 windstorm the recommended that "differences in definitions of easements and allowable practices within them ('easement language') for private versus public, and urban forests vs. rural forests should be resolved." Recent wildfires, particularly the Camp Fire in California (2018), have brought attention to the importance of vegetation management within and adjacent to utility power line right of ways. Many stakeholders are now coming to the table to address the following issues that were highlighted in the report as well as newly identified.

- "Land use actions being proposed by agencies with nonutility interests, which would affect land for which utilities have an interest, should be coordinated and should address vegetation management as it affects utility system operations."
- "Agencies and organizations should be identified to work with federal and state landowners to streamline processes by which electric utilities conduct hazard mitigation work on those lands..." Currently, ODOT issues permits for right-of-way work and ODF issues permits for the use of power equipment in forested areas.

Other areas of ongoing concern from this HMST Report are:

- Under Coordination — Utility providers should receive notification, from property owners, of planned tree harvesting operations near utility lines.
- Under Vegetation Management — Diseased, damaged, and hazard trees near power lines that could fall or hit utility lines should be removed. Some "leave trees" remaining after new building developments and tree harvesting operations pose a threat to utility line safety and reliability. See the International Society of Arboriculture's website and brochure for information about managing tree hazards and risk at https://www.treesaregood.org/Portals/0/TreesAreGood_Recognizing%20Tree%20Risk_0721.pdf.
- Under Engineering, Construction, and Compliance — "During initial planning and design of utility lines, identify types of geographic areas already known to pose hazards during windstorms. Inventory and analyze areas of repetitive failures to determine alternate designs and construction methods that will mitigate future damages... Consider selective undergrounding of lines where repetitive tree damage occurs, keeping in mind excavations can undermine tree root zones and create new hazards."

Increasing wildfire probability due to climate change has accelerated the need to resolve the following:

- Access to State and Federal Lands – Many utilities have identified difficulty in gaining access to these lands for vegetation management. The Oregon Department of Forestry is improving its processes to accelerate issuing permits. The Bureau of Land Management (BLM) recently updated and simplified its process for granting access to utility rights-of-way on its lands. BLM processes are consistent across all the properties it owns. US Department of Forestry has been the most challenging to work with and there is now pressure at the Federal level to simplify and accelerate the permitting process.
- Ability to Remove Vegetation Outside of the Utility Easement — This issue is controversial in forest lands, urban areas, and rural areas. Managers of protected lands are hesitant to disturb the natural

ecosystems by removing vegetation that has been identified as a potential hazard. Likewise, individuals in both urban and rural areas are very protective of vegetation that adds beauty and character to an area.

Emerging concerns include:

- Impacts of intense windstorms that can significantly reduce efficiency and impair operations of renewable energy facilities (e.g., solar panels and wind turbines), in particular on agricultural land where producers produce renewable energy to supply their operations and to sell to diversify their revenue streams. To date, little or no data have been collected on economic impacts of this issue.
- Impacts of intense wind and precipitation events that damage crops (e.g., grain, corn, orchards); cause uncontrolled discharges from permitted animal waste holding facilities that subsequently reach waterways and can adversely impact downstream water quality and shellfish farms. Little or no data have been collected or compiled on the economic impacts of this issue.

3.3.11.2 Historic Windstorm Events

Table 3.3.11-1: Historic Windstorms in Oregon

Date	Location	Comments
Oct. 1962	W. Oregon and locations east of Cascades, Oregon	Columbus Day Storm: Oregon's most famous and most destructive windstorm; barometric pressure low of 960 mb*
Mar. 1963	W. Oregon	second strongest windstorm in the Willamette Valley since 1950
Oct. 1967	most of western and central Oregon	an intense 977 mb low produced a sudden, destructive blow (*)
Nov. 1981	Oregon coast and N. Willamette Valley, Oregon	back-to-back storms on Nov. 13 and 15
Jan. 1993	North Coast Range, Oregon	Inauguration Day Storm; major disaster declaration in Washington State
Dec. 1995	NW Oregon	FEMA-1107-DR-Oregon (*); strongest windstorm since Nov. 1981; barometric pressure of 966.1 mb (Astoria), and Oregon record low 953 mb (off the coast)
Feb. 2002	south and central coast, Southern Willamette Valley, Oregon	FEMA-1405-DR-Oregon; surprise windstorm
Feb. 2007	NW and central coast and north central Oregon	FEMA-1683-DR-Oregon; severe winter storm with a wind component
Dec. 2007	Oregon coast and Willamette Valley, Oregon	FEMA-1733-DR-Oregon; severe winter storm, including flood and landslide events

Date	Location	Comments
Dec. 2015	Regions 1-4	FEMA-4258-DR: severe winter storms, straight-line winds, flooding, landslides, and mudslides
Oct. 2016	Manzanita, Oceanside in Tillamook County	tornadoes; EF2 in Manzanita with estimated damages of $1M; EFU in Oceanside with no damage
Jul. 2018	Portland, Multnomah County	tornado; EF0; damage to trees and homes
Apr. 2019	Curry, Douglas, Linn, Wheeler, Grant, and Umatilla	FEMA-4452-DR: Severe storms, straight-line winds, flooding, landslides, and mudslides
Feb. 2020	Regions 5 and 7: Umatilla, Union, Wallowa Counties	FEMA-4519-DR: Severe storms, tornadoes, straight-line winds and flooding
Sep.-Nov. 2020	Benton, Clackamas, Columbia, Coos, Deschutes, Douglas, Jackson, Jefferson, Josephine, Klamath (& Klamath TDSA), Lake, Lane, Lincoln, Linn, Marion, Multnomah, Tillamook, Wasco, Washington, Yamhill	FEMA-4562-DR: Oregon Wildfires and Straight-line Winds
Jan. 2024	Benton, Clackamas, Coos, Hood River, Lane, Lincoln, Multnomah, Sherman, Siletz Indian Reservation, Tillamook, Wasco	FEMA-4768-DR: Oregon Severe Winter Storms, Straight-line Wind, Landslides, and Mudslides

*For comparison, surface barometric pressures associated with Atlantic hurricanes are often in the range of 910 to 960 mb. The all-time record low sea level barometric pressure recorded was associated with Typhoon Tip in the Northwest Pacific Ocean on October 12, 1979 at 870 mb.
Sources: Oregon Climate Service, http://www.ocs.oregonstate.edu/; Pitzer (1988); https://www.fema.gov/disaster/; https://www.ncdc.noaa.gov/stormevents/; https://www.weather.gov/pqr/07-01-2019

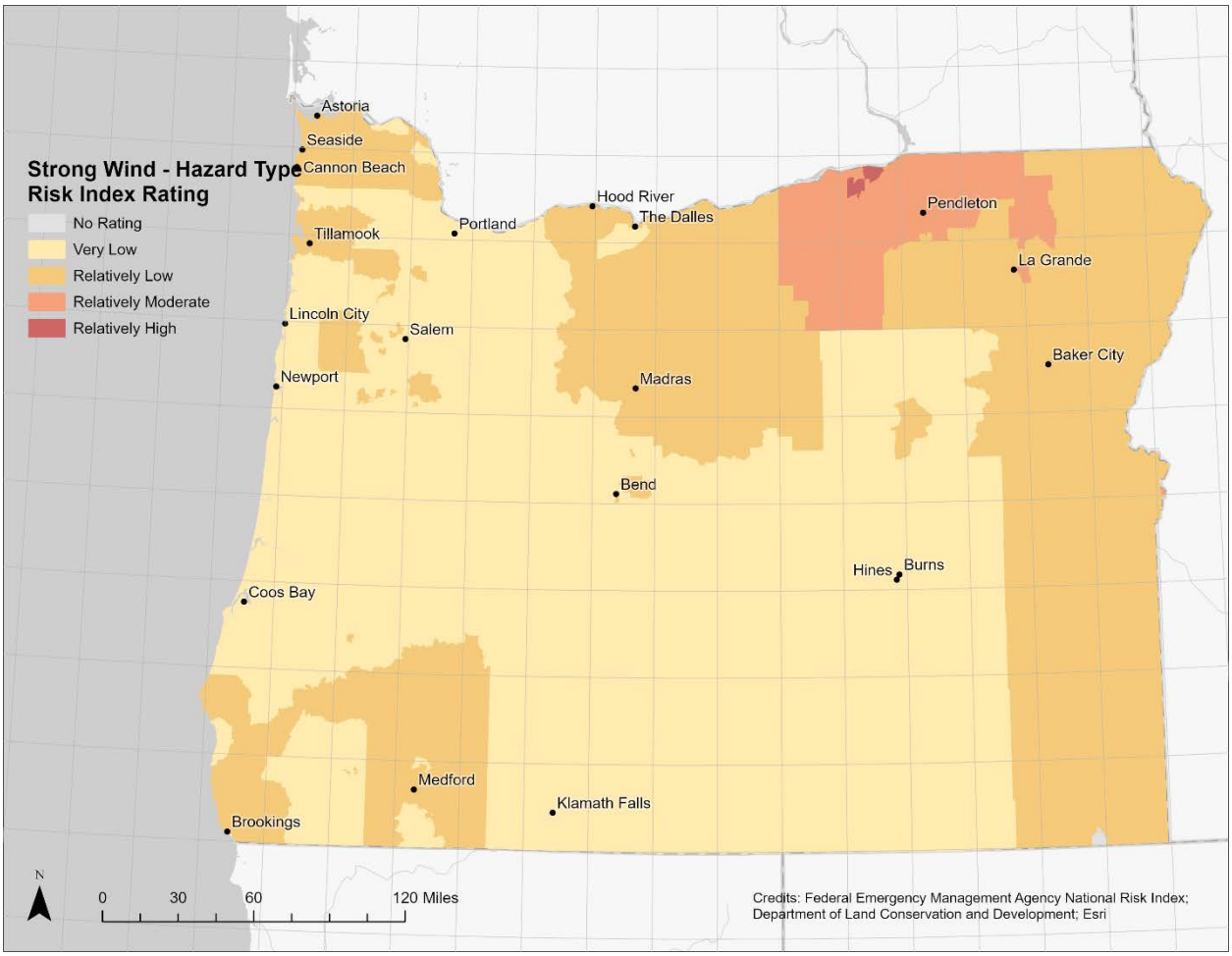
3.3.11.3 Risk Maps

The maps in this section highlight places where the state might work with communities to develop mitigation projects.

The National Risk Index produces a measure of monetary losses experienced over the period of record. This emphasizes historic costs of harm and would direct mitigation resources to where the costs have been the greatest. Mitigation in these locations would save money over the long term.

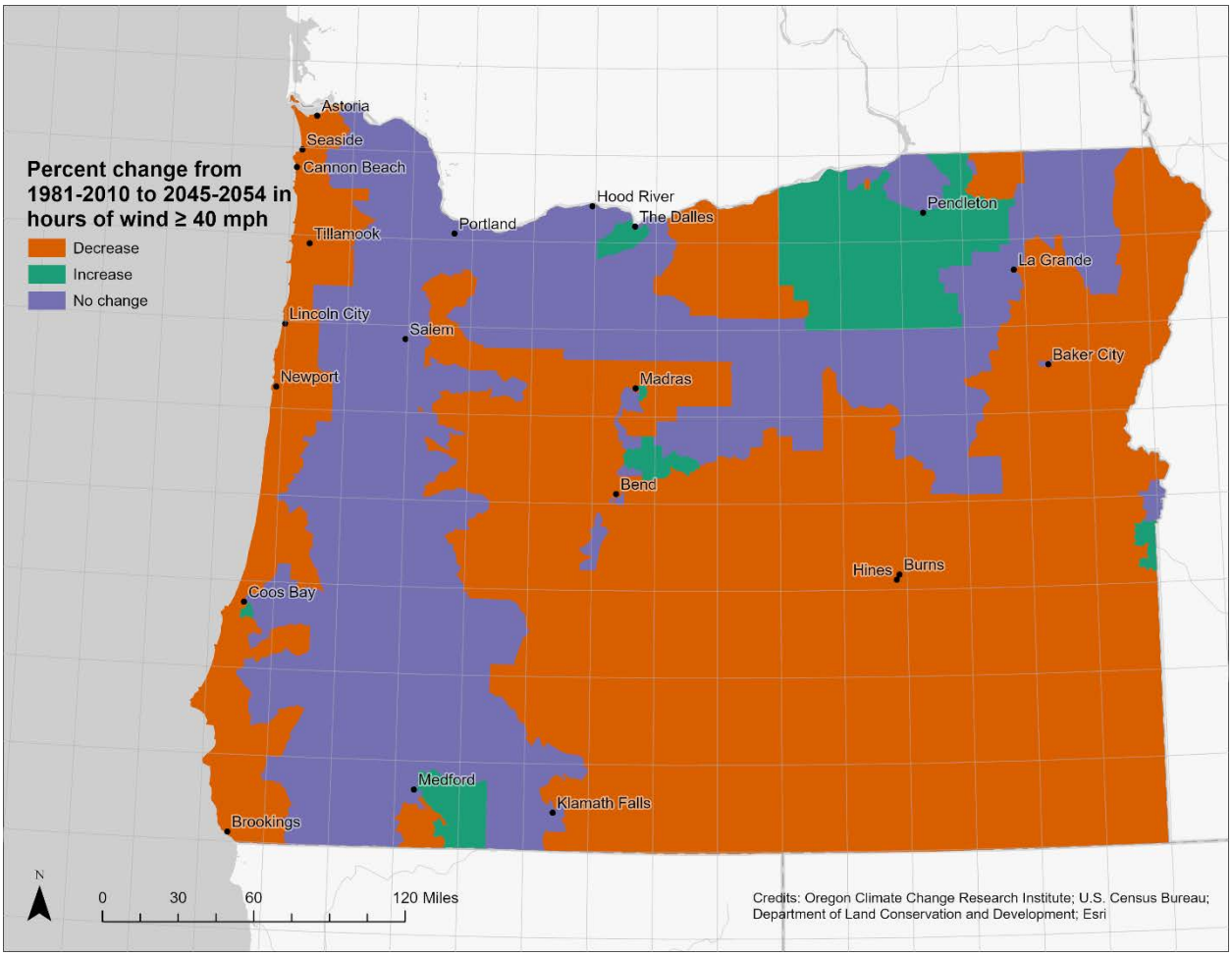
The climate change map shows where risk is projected to increase. Areas with a high risk and a high increase in risk would be especially good places to work with communities to find mitigation projects.

Figure 3.3.11-4: Strong Wind Risk Rating from the NRI: Risk Index Rating from the Federal Emergency Management Agency



Source: Federal Emergency Management Agency, National Risk Index for Strong Wind. Ranking based on national percentiles. Last updated by FEMA in March 2023. Data accessed on February 12, 2025 from National Risk Index | FEMA.gov.

Figure 3.3.11-5: Change in Hours of High Wind: Percent change from 1981-2010 to 2045-2054 in hours of wind >= 40 mph.



Source: Derived from an ensemble of 14 regional climate model simulations that cover the period 1980-2100. Data provided by OCCRI, 2025. Graphic produced by DLCD.

3.3.12 Winter Storms

Winter storms are among nature's most impressive spectacles. The combination of heavy snow, ice accumulation, and extreme cold can severely impact areas across the state, halting the activities of day-to-day life, as snow and ice blanket the ground, making travel extremely hazardous. In addition, the accumulation of snow and ice on vegetation can down trees, powerlines, and telecommunication. Compounding extremely cold temperatures with hazardous travel and power outages shows how vulnerable communities are to winter storms.

This section will focus generally on snow, ice, and extreme cold. Heavy wind events will, for the most part, be covered in the **Windstorm** section. While heavy precipitation events, which sometimes lead to flooding, are covered in the **Flood** section. Analysis and Characterization

According to the National Weather Service (2003) — "Most snowstorms need two ingredients: cold air and moisture. Rarely do the two ingredients occur at the same time over western Oregon, except in the higher elevations of the Coast Range and especially in the Cascades. But snowstorms do occur over eastern Oregon regularly during December through February. Cold arctic air sinks south along the Columbia River Basin, filling the valleys with cold air. Storms moving across the area drop precipitation, and if conditions are right, snow will occur.

However, it is not that easy of a recipe for western Oregon. Cold air rarely moves west of the Cascades Range. The Cascades act as a natural barrier, damming cold air east of the range. The only spigot is the Columbia River Gorge, which funnels the cold air into the Portland area. Cold air then begins deepening in the Columbia River valley, eventually becoming deep enough to sink southward into the Willamette valley. If the cold air east of the Cascades is deep, it will spill through the gaps of the Cascades and flow into the western valleys via the many river drainage areas along the western slope. The cold air in western Oregon is now in place. The trick is to get a storm to move near or over the cold air, which will use the cold air and produce freezing rain, sleet, and/or snow. Sometimes, copious amounts of snow are produced. Nearly every year, minor snowfalls of up to six inches occur in the western interior valleys. However, it is a rare occurrence for snowfalls of over a foot in accumulations [sic]."

Figure 3.3.12-1: Troutdale Area - December 1996

Source: National Weather Service

Figure 3.3.12-2: Shielded snow gauge used in the pacific northwest to register snowfall, 1917

Source: National Weather Service

Snow is relatively rare along the coast in Oregon. There is, however, a noticeable relationship between latitude and snowfall. Appendix **9.1.6** shows average annual snowfall at various Oregon stations. Notice, in particular, Crater Lake, one of the snowiest measurement stations in the United States, which once reported nearly 900 inches of snow in one season (Taylor & Hannan, The climate of Oregon: from rain forest to desert, 1999).

Ice storms and freezing rain can cause severe problems when they occur. The most common freezing rain events occur in the proximity of the Columbia Gorge. The Gorge is the most significant east-west air passage through the Cascades. In winter, cold air from the interior commonly flows westward through the Gorge, bringing very cold air to the Portland area. Rain arriving from the west falls on frozen streets, cars, and other sub-freezing surfaces, creating severe problems. As one moves away from the Gorge, temperatures moderate as the marine influence becomes greater and cold interior air mixes with milder west-side air. Thus, freezing rain is often confined to areas in the immediate vicinity of the Gorge: Corbett, Troutdale, perhaps as far west as Portland Airport. Downtown Portland and the western and southern suburbs often escape with no ice accumulation (Taylor & Hannan, The climate of Oregon: from rain forest to desert, 1999)
.

Freezing rain (also known as an ice storm) is rain that falls onto a surface with a temperature below freezing. The cold surface causes the rain to freeze so the surfaces, such as trees, utilities, and roads, become glazed with ice. Even small accumulations of ice can cause a significant hazard to property, pedestrians, and motorists. According to the Oregon Climate Change Research Institute (OCCRI) report Projections of Freezing Rain and Ice Accretion, frequency of freezing rain is primarily affected by changes in wind, rain, and a warming climate (Rupp et al. 2024).

Sleet is rain that freezes into ice pellets before reaching the ground. Sleet usually bounces when hitting a surface and does not stick to objects; however, it can accumulate like snow and cause roads and walkways to become hazardous.

Black ice can fool drivers into thinking water is on the road. What they may not realize is that condensation, such as dew, freezes when temperatures reach 32 ℉ or below, forming a thin layer of ice. This shiny ice surface is one of the most dangerous road conditions. Black ice is likely to form under bridges and overpasses, in shady spots and at intersections.

Meteorologists define *heavy snow* as six inches or more falling in less than twelve hours, or snowfall of eight inches or more in twenty-four hours. A *blizzard* is a severe winter weather condition characterized by low temperatures and strong winds blowing a great deal of snow. The National Weather Service defines a blizzard as having wind speeds of 35 mph or more, with a visibility of less than a quarter mile. Sometimes a condition known as a *whiteout* can occur during a blizzard. This is when the visibility drops to zero because of the amount of blowing snow.

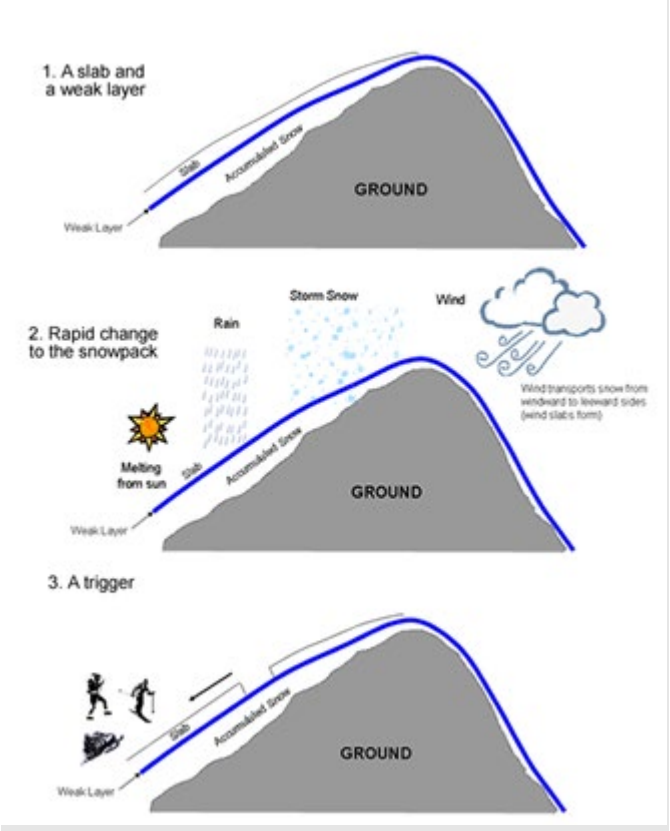
Wind blowing across your body makes you feel colder. The *wind chill* factor is a measure of how cold the combination of temperature and wind makes you feel. Wind chill of 50°F or lower can be very dangerous: exposed skin can develop frostbite in less than a minute, and a person or animal could freeze to death after just 30 minutes of exposure.

A snow avalanche is a mass of snow falling down a mountain or incline. Three variables interact to determine whether an avalanche is possible:

- *Terrain:* the slope must be steep enough to avalanche,
- *Snowpack:* the snow must be unstable enough to avalanche, and
- *Weather:* changing weather can quickly increase instability.

According to the Northwest Weather and Avalanche Center, avalanches don't happen by accident and most human involvement is a matter of choice, not chance. Most avalanche accidents are caused by slab avalanches that are triggered by the victim or a member of the victim's party. However, any avalanche may cause injury or death, and even small slides may be dangerous.

Figure 3.3.12-3: Ingredients for a Slab Avalanche



Source: Northwest Weather and Avalanche

On average, about 30 people in the United States are killed in avalanches each year. For the 21 years between 1985 and 2006. With five fatalities, Oregon ranks 10th among the states for avalanche fatalities. This is based on statistics from the Colorado Avalanche Information Center. Avalanche victims are almost exclusively backcountry recreationists — snowmobilers, climbers, snowboarders, snowshoers, skiers, and hikers. Nationally snowmobilers lead the list with twice as many fatalities as any other activity.

According to Portland Mountain Rescue, most avalanche victims triggered the very avalanche that caught them. The group advises people to be aware of the constantly changing conditions in the backcountry and take a certified avalanche class to increase their avalanche awareness.

Ski areas are different from the backcountry. It is very rare for someone to get caught in an avalanche within a ski area. Professional snow safety crews rely on explosives and ski compaction to stabilize ski area snowpack.

3.3.12.1 Historic Winter Storm Events

Table 3.3.12-1: Historic Winter Storms in Oregon

Date	Location	Description
Dec. 16–18, 1884	Linn, Marion, Washington, Multnomah, Hood River and Wasco Counties	heavy snow in the Columbia River Basin from Portland to The Dalles and along the Cascades foothills in the Willamette Valley; 1-day snow totals: Albany, 16.0 inches; The Dalles, 29.5 inches; Portland, 12.4 inches
Dec. 20–23, 1892	Linn, Marion, Washington, Multnomah, and Umatilla Counties	substantial snow across most of northern Oregon; greatest snowfall in the northwest part of the state; totals from 15 to 30 inches with Albany, 15.0 inches; Corvallis, 14.0 inches; Portland, 27.5 inches; Forest Grove, 28.0 inches; Pendleton, 8.0 inches
Jan. 5–10, 1909	Josephine, Jackson, Douglas Lane, Linn, Marion, Clackamas, Hood River, and Wasco Counties	heavy snowfall in mountainous areas; 34.5 inches at Siskiyou Summit; many locations, particularly in western Oregon, received more snow in this 6-day period than they normally would receive in an entire year; snow totals: Ashland, 9.1 inches; Eugene, 15.1 inches; Forest Grove, 29.0 inches; Lakeview, 17.0 inches; Portland, 19.3 inches; The Dalles, 14.5 inches
Jan. 11–15, 1916	Josephine, Jackson, Douglas Lane, Linn, Marion, Clackamas, Hood River, and Waco Counties	5-8 inches of snow in western Oregon, except for the southwestern interior and the coastal areas; McMinnville had the most snow in one day, with 11 inches falling on January 12; another 24 inches at Siskiyou Summit; higher elevations in the Cascades received very heavy snowfall
Jan. 30–Feb. 3, 1916	Hood River, Clackamas, Marion, Wasco, Jefferson, and Multnomah Counties	snow and ice storm along the northern Oregon border; heaviest snowfall in the Hood River Valley with 29.5 inches in one day at Parkdale, and 81.5 inches total; heavy snow especially in the higher Cascades with Government Camp 41.0 inches in a day and storm total of 87.5 inches; the ice inflicted severe damage to electric light, telephone and telegraph companies, fruits and ornamental trees; many locations, earlier snow had not melted, resulting in substantial snow depths
Dec. 9–11, 1919	statewide	one of three heaviest snowfall-producing storms to hit Oregon on record; lowest statewide average temperature since record keeping began in 1890; the Columbia River froze over, closing the river to navigation from the confluence with the Willamette River upstream; nearly every part of the state affected; snow totals (inches): Albany, 25.5; Bend, 49.0; Cascade Locks, 21.5; Eugene, 8.5; Heppner, 16.0; Parkdale, 63.0; Pendleton, 15.0; Siskiyou Summit, 50.0
Feb. 10, 1933	statewide	cold outbreak across state; the city of Seneca, in northeast Oregon, recorded the state's all-time record low temperature of −54°F; the next day high was nearly 100 degrees warmer at 45°F

Date	Location	Description
Jan. 31–Feb. 4, 1937	statewide	heavy snowfalls in the western slopes of the Cascades and the Willamette Valley; deep snowdrifts blocked major highways and most minor roads in northern Oregon and passes of the Cascade Mountains for several days
Jan. 5–7, 1942	Columbia, Clackamas, Multnomah, Washington, Marion, Linn, Yamhill, and Polk Counties	considerable sleet, followed by freezing rain in some areas; freezing rain, resulting in heavy accumulations of ice in upper and middle Willamette Valley; roads and streets dangerous for travel, orchard and shade trees damaged, and telephone, telegraph, and power wires and poles broken down.
Mid Jan.–Feb, 1950	statewide	extremely low temperatures injured a large number of orchard and ornamental trees and shrubs, and harmed many power and telephone lines and outdoor structures; severe blizzard conditions and a heavy sleet and ice storm together caused several hundred thousand dollars damage and virtually halted traffic for two to three days; Columbia River Highway closed between Troutdale and The Dalles leaving large numbers of motorists stranded, removed to safety only by railway; damage to orchard crops, timber, and power services, costing thousands in damages.
Jan. 9–20, 1950	Columbia, Washington, Multnomah, Hood River, Wasco, Clackamas, Yamhill, Marion, Polk, Linn, Benton, and Lane Counties	frequent snowstorms throughout January; snow heavier during this January than ever before on record; snow plus high winds created widespread blowing and drifting of snow; deep snowdrifts closed all highways west of the Cascades and through the Columbia River Gorge; sleet 4-5 inches in northwestern Oregon; sleet turned to freezing rain, creating havoc on highways, trees, and power lines; hundreds of motorists stranded in the Columbia River Gorge, only rescued by train; hundreds of thousands of dollars of damage occurred; winds reached 60–70 mph in gusts along the coast and excess of 40 mph in Portland and Grants Pass; outdoor work and school halted due to impeded traffic, down power lines, and community isolation; in Portland 32.9 inches of snow fell (5.8 inches was the January average)
Dec. 5–7, 1950	Washington, Multnomah, Hood River, Wasco, Sherman, Gilliam, Morrow, and Umatilla Counties	severe ice storm with light freezing rain over the Columbia Basin east of the Cascades; heavy ice accretions on trees, highways, power and telephone lines causing accidents due to broken limbs, slippery pavements, and downed power lines; heavy snowfall across Oregon; Crater Lake reported 93 inches of snow for December
Jan. 18, 1956	Washington, Multnomah, Hood River, Wasco, Sherman, Gilliam, Morrow, and Umatilla Counties	freezing rain mixed with snow. Ice coated trees, highways, and utility lines; traffic accidents due to slick surfaces; trees heavy with ice broke, sometimes on top of houses
Jan. 11–12, 1960	Columbia, Clackamas, Multnomah, Washington,	light to moderate snows and freezing rain produced dangerous highway conditions; automobile accidents, but no known fatalities; accidents blocked arterial highways, creating serious traffic jams

Date	Location	Description
	Marion, Linn, Yamhill, and Polk Counties	
Jan. 30–31, 1963	Columbia, Clackamas, Multnomah, Washington, Marion, Linn, Yamhill, Polk, Hood River, Waco, Jefferson, and Deschutes Counties	substantial snowfall amplified by moderate to severe icing created hazardous conditions on highways; power lines downed due to ice or felled trees; injuries, one reported death, and statewide school closures due to the icy streets and highways
Jan. 25–31, 1969	Douglas, Coos, Josephine, Jackson, Columbia, Clackamas, Multnomah, Washington, Marion, Linn, Yamhill, and Polk Counties	snowfall records throughout Lane, Douglas, and Coos Counties were surpassed by incredible numbers; 2-3 feet on the valley floors; heavier amounts at higher elevations; at Eugene, a snow depth of 34 inches. Total January snowfall was 47 inches, nearly 7 times the normal monthly snowfall. Roseburg reported 27 inches and monthly snowfall of 35.2 inches; along the coast, where the average snowfall is generally less than 2 inches, January snowfall totals ranged 2-3 feet, with snow depths of 10–20 inches reported; hundreds of farm buildings and several large industrial buildings collapsed under the weight of the heavy wet snow; heavy losses in livestock; entire communities completely isolated for nearly a week; traffic on major highways west of the Cascades and central Oregon halted; total losses estimated $3 to $4 million
Jan. 17–19, 1970	Washington, Multnomah, Hood River, Wasco, Sherman, Gilliam, Morrow, and Umatilla Counties	Stagnant and cold air in the Columbia River Basin east of the Cascades had surface temperatures well below freezing for a week. Ice accumulated on tree branches up to 1.5 inches. Damage was mostly destroyed orchards and utilities.
Nov. 22-23, 1970	Columbia, Washington, Multnomah, Hood River, Wasco, Clackamas, Yamhill, Marion, Polk, Linn, Benton, and Lane Counties	freezing rain across western Oregon, especially in Corvallis, Albany, Salem, Independence, and Dallas; ice accumulations up to 0.5 inches broke thousands of tree limbs and telephone lines; hazardous traffic conditions, power and phone outages, and felled trees
Feb. 4–6, 1972	Columbia, Clackamas, Multnomah, Washington, Marion, Linn, Yamhill, and Polk Counties	several days of sub-freezing temperatures across Oregon followed by warm moist air across northwestern Oregon; glazed roads were hazardous; 140 persons in Portland treated for sprains, fractures or head injuries; some ambulance services doing twice their normal business
Jan. 11–12, 1973	Columbia, Clackamas, Multnomah, Washington, Marion, Linn, Yamhill, and Polk Counties	rains beginning in the Willamette Valley glazed streets and highways in the Portland area and into the Gorge; auto, bus and truck accidents and persons injured in falls; hospitals reported “full house” conditions; glaze of 0.25–0.75 inches in the Portland area
Jan. 1978	Columbia Gorge, Willamette Valley,	over an inch of rain froze, covering everything with ice; power outages (some for more than 10 days); areas east of Portland hit hardest

Date	Location	Description
	Portland, Oregon and Vancouver, Washington	
Jan. 9–10, 1979	Portland and Multnomah Counties	severe ice storm in Portland area as a Pacific storm moved across the state; temperatures ranged from low teens to 33°F; half inch of rain turned to ice
Jan. 5, 1986	Multnomah, Hood River, Wasco Counties	roads covered with ice and caused power outages to several thousand houses
Feb. 1–8, 1989	statewide	heavy snow across state; up to 6–12 inches of snow at the coast, 9 inches in Salem, more than a foot over the state; numerous record temperatures set; wind chill temperatures 30–60 degrees below 0°F; power failures throughout state, with home and business damage resulting from frozen plumbing; several moored boats sank on the Columbia River because of ice accumulation; five weather-related deaths (three auto accidents caused by ice and snow, and two women froze to death); damage estimates exceeded one million dollars
Feb. 14–16, 1990	Columbia, Clackamas, Multnomah, Washington, Hood River, Wasco, Marion, Linn, Yamhill, and Polk Counties	24–35 inches of snow in Cascade Locks and Hood River; up to 28 inches in the North Coast Range, 16 inches at Timberline Lodge; the Willamette Valley had 2–4 inches with up to 1 foot in higher hills around Portland; 10-15 inches of snow in the North Coast Range, 20–35 inches in the North Cascades, 1-2 feet in the South Cascades; snow in south-central areas included 9 inches at Chemult, 6–8 in Klamath Falls and Lakeview; 6 inches at Tipton Summit in the northeast mountains and Juntura in the southeast.
Jan. 6-7, 1991	all of eastern Oregon	constant precipitation all over Oregon; freezing rain in Willamette Valley made transportation difficult; two auto fatalities; 1–6 inches of new snow in high ground of eastern Oregon; 12 inches of snow in the Columbia Gorge
Jan. 16–18, 1996	Columbia Gorge, Willamette Valley, Portland, Oregon Columbia, Clackamas, Multnomah, Washington, Hood River, Wasco, Marion, Linn, Yamhill, and Polk Counties	freezing rain with heavy accumulations of glazed ice in the Gorge, Northern Cascades and extreme eastern Portland Metro area; numerous minor traffic accidents due to power outages; freezing rain in the Willamette Valley as far south as Eugene
Feb. 2–4, 1996	Columbia Gorge, Willamette Valley, Portland, Oregon Columbia, Clackamas, Multnomah, Washington, Hood River, Wasco,	ice storm caused disruption of traffic and power outages in the Willamette Valley and Coast Range valleys; freezing rain in the Willamette Valley; traffic accidents, including a 100-car pileup near Salem; one traffic fatality near Lincoln City

Date	Location	Description
	Marion, Linn, Yamhill, and Polk Counties	
Dec. 26–30, 1996	Columbia Gorge, Willamette Valley, Portland, Oregon Columbia, Clackamas, Multnomah, Washington, Hood River, Wasco, Marion, Linn, Yamhill, and Polk Counties	ice storm paralyzed the Portland Metro area and the Columbia Gorge; ice accumulations of 4-5 inches in the Columbia Gorge; I-84 through the Gorge closed for 4 days; widespread electricity outages and hundreds of downed trees and power lines in the Portland area
Dec.28, 2003–Jan. 9, 2004	statewide storm	

DR-1510. $10,289,394 of assistance. Baker, Benton, Clackamas, Clatsop, Columbia, Crook, Deschutes, Douglas, Gilliam, Grant, Harney, Hood River, Jefferson, Lake, Lane, Lincoln, Linn, Malheur, Marion, Morrow, Multnomah, Polk, Sherman, Tillamook, Umatilla, Union, Wallowa, Wasco, Wheeler, Yamhill declared. The most significant winter storm in several years brought snowfall to most of Oregon. The largest snowstorm to hit the Siskiyou Pass in Jackson County in a quarter century. I-5 shut down for nearly a day as ODOT maintenance crews and Oregon State Police troopers dug stranded motorists out of snowdrifts reaching 5-6 feet. Two feet of snow in the Blue Mountains in eastern Oregon. Roadside snow levels exceeded six feet along the Tollgate Highway, OR-204. The eastbound lanes of I-84 closed at Ladd Canyon east of La Grande. Additional segments of I-84 eastbound at Pendleton closed as stranded motorists filled truck stops, motels and restaurants in the La Grande area.

Wet snow on highways in the Willamette Valley, toppled power lines and trees. Oregon 34 east of Philomath closed for 30 hours while crews removed trees. Snow on the Siskiyou Pass made national news and was a top story on the CNN website. 150 miles of I-5 from Ashland to south of Redding, California closed, leaving 100 to 200 vehicles stranded on the Siskiyou Pass overnight. The American Red Cross opened a shelter on the Southern Oregon University campus, and reports out of cities from Redding to Medford confirmed that all motels were full. Emergency services delivered gasoline, food, and water to stranded motorists and hard-to-reach areas. One fatality related to the storm. (Heart attack after helping a stranded motorist.)

I-5 North on the Siskiyou Pass closed for 19 hours. The snow event turned into a major ice storm. Icy roads made driving hazardous. Trees damaged or destroyed by ice adhering to the branches. Downed power lines, often due to falling trees, caused power outages. Businesses, school districts, and government offices closed or shortened their hours. Several hundred flights cancelled at the Portland International Airport. Thousands of passengers stranded at the airport. The MAX light rail system also was shut down by the storm. ODOT closed I-84 through the Columbia Gorge twice, for almost 70 hours total. Freight trucks and passenger cars had to detour over Mount Hood where, ironically, road conditions were better than they were in downtown Portland where all vehicles were required to chain up. ODOT closed US-101 over the Astoria Megler Bridge for about 14 hours as large chunks of ice fell off the bridge's superstructure. Many other highways in the state were closed. Freezing rain also in eastern Oregon. Minus 30 degrees reported in Meacham. 60 mph wind gusts in Union County created whiteout conditions, prompting the closure of I-84 between La Grande and Baker City. 2 fatalities.

President Bush issued a major disaster declaration for 26 Oregon counties affected by the winter storm, later extended to 30 of Oregon's 36 counties.

Estimated the cost of damages to public property at $16 million. A frigid arctic air mass, heavy snow, sleet and freezing rain, strong east winds and blizzard conditions through and near the Columbia River Gorge snarled travel,

Date	Location	Description
forced school and business closures, and resulted in widespread power outages and properly damage in Northwestern Oregon. 2-6 inches of snow along the North Oregon Coast, 2–8 inches in the Willamette Valley, 5–8 inches in the Portland Metro area, and up to 27 inches in the Cascade Mountains. Up to 2 inches of sleet and freezing rain followed the snowfall. In Portland this winter storm: • limited or halted most forms of travel • resulted in the cancellation of over 1,300 flights at Portland International Airport, stranding 90,000 passengers • shut down Portland's light rail train system • closed most businesses and schools Blizzard conditions in the Columbia River Gorge: • closed I-84 between Troutdale and Hood River • closed Washington State Route 14 between Washougal, and White Salmon, Washington • Halted east-west travel through the Gorge and stranded hundreds of trucks at both ends of the Gorge Weight from snow and ice buildup: • downed trees and power lines, leaving 46,000 customers without power, and collapsed roofs at Portland's Gunderson Steel and Rail, Fred Meyer stores in Gateway and Clackamas, and a barn in Forest Grove that killed 4 horses • collapsed a Scappoose marina roof, sinking 4 boats and damaging many others • snowfall in the Cascades ranged from 8 inches at Blue Box Pass and Bennett Pass to 27 inches at Timberline Lodge and White River		
Mar. 8–10, 2006	Lane, Linn, Benton, Marion, Jefferson, Polk, Yamhill, Clackamas Counties	snow fell up to a few inches at the coast and through the Willamette Valley; 2–4 feet in the Coast Range, Cascades, and Cascade Foothills; many school closures
Jan. 2–Feb. 9, 2008	Hood River, Wasco, Sherman, Gilliam, Morrow, Umatilla, Union, Grant, Baker, Wheeler, Jefferson Deschutes, Crook Counties	heavy snow and freezing rain across eastern Oregon; 5–13 inches of snow; a multi-vehicle accident closed I-84, 15 miles west of Arlington, for 5 hours; 36 Oregon National Guard personnel helped with snow removal in Detroit and Idanha with over 12 feet of record snow. Inmate crews removed snow that cracked walls and collapsed roofs
Dec. 2008	northern Oregon coast	third unusually cold storm system that season with heavy snow in northwest Oregon; heavy snowfall across northwest Oregon; 11–24 inches of snow in the north Oregon Coast Range
Dec. 9–11, 2009	Marion, Linn, Lane Counties	freezing rain covered the central valley with a coating of ice; south of Salem, numerous road closures due to accidents caused by icy roadway; I-84 from Troutdale to Hood River closed for 22 hours

Date	Location	Description
Nov. 29-30, 2010	Hood River, Multnomah, Wasco Counties	4-5 inches of snow reported in Cascade Locks and Hood River; 1/2 inch of ice in Corbett
Jan. 12–18, 2012	Hood River, Wasco Counties	4.5 inches of new snow reported in Hood River; I-84 closed due to ice and snow east of Troutdale
Jan. 2012	Multnomah County	snow and ice east of Troutdale; I- 84 closed for 9 hours
Feb. 6–10, 2014	Lane, Benton, Polk, Yamhill, Columbia, Clackamas, Multnomah, Washington, Linn, Marion, Hood River, Lincoln, Tillamook and Clatsop Counties	DR-4169 Linn, Lane, Benton and Lincoln Counties declared. A strong winter storm system affected the Pacific Northwest during the February 6–10, 2014 time period bringing a mixture of arctic air, strong east winds, significant snowfall and freezing rain to several counties in northwest Oregon; a much warmer and moisture-laden storm moved across northwest Oregon after the snow and ice storm (Feb. 11-14), which produced heavy rainfall and significant rises on area rivers from rain and snowmelt runoff; during the 5-day period Feb. 6–10, 5 to 16 inches of snow fell in many valley locations and 2 to10 inches in the coastal region of northwest Oregon; freezing rain accumulations generally were 0.25 to 0.75 inches; the snowfall combined with the freezing rain had a tremendous impact on the region
Feb. 11–14, 2014	Lane, Benton, Polk, Yamhill, Columbia, Clackamas, Multnomah, Washington, Linn, Marion, Hood River, Lincoln, Tillamook and Clatsop Counties	another weather system moved across northwest Oregon during the February 11–14 time frame; this storm was distinctly different from the storm that produced the snow and ice the week prior and brought abundant moisture and warm air from the sub-tropics into the region; as this storm moved across the area, 2 to 7 inches of rain fell across many counties in western Oregon; the heavy rainfall combined with warm temperatures led to snowmelt and rainfall runoff that produced rapid rises on several rivers, which included flooding on three rivers in northwest Oregon
March 2, 2014	Hood River County, Upper Hood River Valley, Central Columbia River Gorge	East winds brought very cold air from east of the Cascades through the Columbia River Gorge as a moist front pushed in from the Pacific. The combination of the cold air mass and frontal precipitation resulted in snow and ice for the Gorge. There were numerous reports of snow and ice in the Central Columbia River Gorge with generally 6 to 8 inches of snow. There was a quarter of an inch of ice on top of the snow in Hood River and White Salmon, and as much as 0.4 to 0.5 inch of ice in Parkdale where the cold air held on the longest.
Nov. 13, 2014	Clackamas, Marion, Linn, Multnomah and Hood River Counties (North Cascade foothills and Western Columbia River Gorge)	An early cold snap hit the Pacific Northwest before moist Pacific air moved in and resulted in one of the earliest snow, sleet, and freezing rain events in northwestern Oregon. Sleet and freezing rain in particular created hazardous commutes for tens of thousands in the western and eastern suburbs of Portland. Farther south, 1/2 of freezing rain accumulated on trees in the coast range foothills outside of Corvallis and Dallas, Oregon. Upwards of a quarter of an inch of ice fell around Dallas, Oregon. Some snow fell, but accumulations were primarily restricted to the Cascade valleys and the central Columbia

Date	Location	Description
		River Gorge. Spotters reported around 6 to 8 inches of snow for the Cascade Foothills followed by a quarter of an inch of ice. A combination of heavy snow and ice resulted in slick driving conditions for the Western Columbia River Gorge. Areas in the gorge measured a quarter of an inch of ice whereas other areas had 5 to 8 inches of snow.
Dec. 6–23, 2015	Statewide	DR-4258. Clatsop, Columbia, Multnomah, Clackamas, Washington, Tillamook, Yamhill, Polk, Lincoln, Linn, Lane, Douglas, Coos, and Curry Counties declared. Severe winter storms, straight-line winds, flooding, landslides, and mudslides. On December 12, A series of systems brought heavy precipitation to southern Oregon. Several pacific storm systems moved across the region over the Dec 12-13 weekend from southern Oregon to northeast Oregon. Another series of storms moved across Oregon on Dec 16-17 and Dec 21-23. Each storm system brought several inches of snow to the mountain areas. Snowfall amounts in inches include: 21.0 10 miles west of La Pine, 14.0 at Tollgate, 12.0 13 miles southwest of Mitchell, and 9.0 6 miles east southeast of Granite. Another in a long series of storms brought heavy snow to portions of south-central Oregon. The cooperative observer at Chemult reported 17 inches of snow in 24 hours ending Dec. 17th. A narrow but long-lived band of precipitation moved across Wallowa County the morning of December 19th. Several reports of moderate snow occurred over the Joseph and Enterprise areas. Snowfall amounts in inches ranged from 5 to 6 inches, with northern Wallowa County receiving reports of up to 9 inches just outside of Flora. On December 21st heavy snow fell over portions of central Washington and Oregon due to a cold front. Snowfall amounts are as followed: 14” recorded at the Milk Shakes Snotel and 10” in 24 hours 5 miles north northwest of La Pine. Also on the 21st, a series of storms made for a long-lasting winter storm over southwest and south-central Oregon. Initially the heavy snows were limited to higher altitudes...but a colder air mass moved in towards the end of the event and snow fell in areas that rarely see snow...such as the southwest Oregon valley floors. Moist onshore winds produced a steady stream of showers over the foothills of the Cascades with snow levels between 1000 and 2000 feet. This resulted in heavy snow for the Northern Oregon Cascades and Coast Range. At one point after the storm, 25,000 people were without power. Several highways around Crater Lake were closed for a week due to heavy snow and fallen trees blocking the roads.
Mar. 13, 2016	Clackamas, Marion, Linn and Lane Counties (North Oregon Cascades and Cascades in Lane County)	A strong low-pressure system generated frequent and persistent snow showers over the northern and central Oregon Cascades. Several SNOTEL stations measured 16 to 24 inches of snow over a 24 to 30-hour period above 3500 feet.
Dec. 8, 2016	Multnomah, Clackamas, Washington, Columbia,	A strong frontal system brought strong east winds to the North Willamette Valley and a mix of snow, sleet, and freezing rain down to

Date	Location	Description
	and Hood River Counties (Greater Portland Area and Western Columbia River Gorge)	the Valley Floor. Four to six inches of snow fell along interstate 84 before turning to sleet and freezing rain. One to 1.5 inches of ice accumulation was also reported. The Portland Metro area generally had 1-2 inches of snow, with 0.2 to 0.3 inch of ice accumulation. Ice accumulations were higher in the West Hills and near the Columbia River Gorge, with 0.8 inch of ice accumulation reported at Council Crest in SE Portland. The NWS Office in Parkrose had 0.4 inch of ice accumulation.
Dec. 14–17, 2016	Lane, Lincoln, Benton, Marion, Clackamas Josephine and Linn Counties (Central Coast Range, Southern Willamette Valley, Cascade foothills in Lane County, Northern Cascade foothills)	DR-4296. Lane and Josephine counties declared. Severe winter storm and flooding. East winds ahead of an approaching low-pressure system brought temperatures down below freezing across the area ahead of the approaching precipitation. This lead [sic] to a mix of freezing rain, sleet, and snow across the area. While areas farther north saw more of a snow/sleet mix before a changeover to freezing rain then rain, areas in Lane County saw freezing rain for most of this event, causing power outages, damage to trees, and many car accidents around Eugene and Springfield. Snow [was] followed by sleet and freezing rain. The freezing rain turned into a major ice storm occurred in Eugene and the vicinity with 0.5 to 1.0 inch of ice accumulation observed. There was significant damage to trees and power lines, and fairly widespread power outages across the region. 15,000 people were without power. There was a report of 0.4 inch of ice accumulation near Sodaville.
Dec. 19, 2016	Hood River County (Upper Hood River Valley and Central Columbia River Gorge)	A warmer low-pressure system moved into to Northwest Oregon, bringing high winds along the North and Central Oregon Coast. Cold east winds through the Columbia River Gorge continued for the first part of the event, leading to light accumulations of snow and sleet in portions of far northwest Oregon and higher accumulations in the Columbia River Gorge and Hood River Valley. Estimate the Columbia Gorge had around 0.2 to 0.5 inch of ice accumulation as temperatures in the lower 30s with reports of snow and freezing rain in Hood River. A frontal system brought high winds to the Central Oregon Coast, heavy snow to the Cascades and a mix of ice and snow in the Columbia River Gorge and Hood River Valley. SNOTELs and other stations reported a range of 12 to 25 inches of snow. Some specific reports include 25 inches at Mt Hood Meadows, 22 inches at Timberline, 14 inches at Government Camp and 12 inches at McKenzie Snotel.
Dec. 26-27, 2016	Linn, Marion, Clackamas Counties (North Oregon Cascades)	A frontal system brought high winds to the Central Oregon Coast, heavy snow to the Cascades and a mix of ice and snow in the Columbia River Gorge and Hood River Valley. Estimate the Columbia Gorge had around 0.2 to 0.5 inch of ice accumulation as temperatures in the lower 30s with reports of snow and freezing rain in Hood River. SNOTELs and other stations reported a range of 12 to 25 inches of snow in the Cascades. Some specific reports include 25 inches at Mt

Date	Location	Description
		Hood Meadows, 22 inches at Timberline, 14 inches at Government Camp and 12 inches at McKenzie Snotel.
Jan. 7–10, 2017	Multnomah, Clackamas, Washington, Columbia, Lane, Benton, Polk, Yamhill, Linn, Marion, Josephine and Hood River Counties (Greater Portland Area, Central Coast Range, Central and Southern Willamette Valley, North Cascades foothills, Western and Central Columbia Gorge, Upper Hood River Valley and the Siskiyou Mountains)	DR-4328. Columbia, Hood River, Deschutes and Josephine Counties declared. Severe Winter Storms, Flooding, Landslides, And Mudslides. A storm system moving across southern Oregon produced heavy snow across portions of central and northeast Oregon. Also, heavy snow fell over portions of the Columbia River Gorge. A broad shortwave trough brought multiple rounds of precipitation, including a wintry mix of snow and ice for many locations across Northwest Oregon. Strong easterly pressure gradients generated high winds through the Columbia River Gorge as well on January 8. General snowfall totals of 2-4 inches were reported, with the greatest total being 4.5 inches. Major ice accumulations occurred after the snow, with several locations reporting 0.50-1.00. The combination of snow and ice resulted in significant power outages and closures across the area.
Feb. 3-4, 2017	Multnomah and Hood River Counties (Western and Central Columbia River Gorge, Upper Hood River Valley)	Fronts associated with a low-pressure system passing north into the Olympic Peninsula brought heavy snow and ice to the Columbia Gorge. The Hood River area reported 4 to 6 inches of snow turning to ice in the western-most part of this zone.
Feb. 8-9, 2017	Wasco, Sherman, Gilliam, Wheeler, Jefferson, Crook, and Grant Counties (Eastern Columbia River Gorge, Eastern Cascades, Central Oregon, Ochoco-John Day Highlands)	A strong Pacific storm system brought snow, sleet and freezing rain to many areas of the Interior Northwest from February 7th through 9th. Winter storm produced a total snow accumulation of 5.25 inches with an ice accumulation of 0.25 inches on top of the snow. The storm occurred 5 miles SSW of Chenoweth in Wasco county.
Dec. 24, 2017	Multnomah and Hood River Counties (Western Columbia River Gorge	Low pressure system moving into the Pacific Northwest pulled cold air from the Columbia Basin west into the Willamette Valley, through the Columbia River Gorge. As this system started to bring moisture and precipitation into NW Oregon, temperatures were around or below freezing, allowing for a mix of snow and ice to fall all the way to the Valley Floor around the Portland Metro, in the Columbia River Gorge, and the Hood River Valley. A local Broadcast Meteorologist reported 2.5 inches of snow and 0.2 inch of ice in Corbett. Also, a Skywarn Spotter in Cascade Locks reported getting 4.8 inches of snow.
Feb. 22–26, 2019	Coos, Curry, Douglas, Lane, Deschutes, Jefferson, Wheeler, Wasco, Sherman, Gilliam, Morrow, Umatilla, Crook, Grant, Baker, Malheur and Union Counties (Oregon Coast	DR-4432. Jefferson, Lane, Douglas, Coos and Curry Counties declared. Severe Winter Storms, Flooding, Landslides, And Mudslides. Persistent troughing off the coast of the Pacific Northwest focused a stream of mid-level moisture over the Inland Northwest resulting in a long duration snow event as the plume drifted north and south several times between the 22nd and 27th of February. Snowfall rates were greatly enhanced over central Oregon with the proximity of a nearly

Date	Location	Description
	Range, South and Central Coast, North Central and Central Oregon, Blue Mountains, Eastern Columbia River Gorge, Eastern Cascades, Grand Ronde Valley, Lower Columbia Basin, John Day Basin)	stationary surface boundary where snowfall rates were in excess of 1 inch per hour. The low-pressure system moved south into eastern Washington, bringing a cold front southeastward across western Oregon. The front then stalled across the southern Willamette Valley and Lane County Cascades as colder and colder air moved in aloft. What started as rain at low elevations turned to snow during the afternoon of the 23rd. The stalled front kept producing snow over the same areas through the next 24 hours with a direct tap of moisture from the Pacific Ocean. Storm total snowfall amounts were measured at: 40 inches in Sisters, 33 inches in Bend, 30 inches in Redmond, 26 inches in Meacham, 22 inches in Prineville, 21 inches in Elgin, 16 inches in Mitchell, 14 inches in Lostine and La Grande, 12 inches in Pendleton and Joseph and 10 inches in John Day. In Bend a few roofs collapsed under the weight of the snow.
Jan. 15-16, 2020	Multnomah, and Hood River Counties (Western and Central Columbia River Gorge)	A 980 mb low located near 45N/130W along with an attendant warm front moved into the southern Oregon Coast and overran a cold air mass originating from the Columbia River Gorge. This resulted in snow that gradually transitioned to freezing rain in the Gorge on Wednesday night into Thursday. The amounts of snow and ice varied greatly across the Columbia River Gorge, with heaviest amounts in the Central Columbia River Gorge zone. The combination of snow, ice, and wind resulted in the closure of I-84 between Troutdale and Cascade Locks. Based on ODOT and spotter reports, 4 to 10 inches fell in the stretch from Corbett to Cascade Locks, followed by a few hours of light freezing rain. Additionally, east winds gusted to 56 mph at Corbett, with higher gusts at Crown Point (although the anemometer was frozen).
Feb. 11-15, 2021	Benton, Clackamas, Linn, Marion, Polk, Yamhill, Grand Ronde Indian Reservation	DR-4599: Oregon Severe Winter Storm
Jan. 10-22, 2024	Benton, Clackamas, Coos, Hood River, Lane, Lincoln, Multnomah, Sherman, Siletz Indian Reservation, Tillamook, Wasco	DR-4768: Oregon Severe Winter Storms, Straight-line Wind, Landslides, and Mudslides

Source: The National Weather Service; https://www.fema.gov/disaster; https://www.ncdc.noaa.gov/stormevents

Figure 3.3.12-4: Rescuing snowbound vehicles, Old Oregon Trail Highway between Kamela and Meacham, 1923

Source: ODOT

Figure 3.3.12-5 Stranded Motorists on I-5 Southbound at Siskiyou Pass, Late December 2003. Note: Vehicles being towed out the "wrong way"

Source: ODOT

Figure 3.3.12-6 Detroit, Oregon, February 2, 2008, Buried from the 12 Feet of Snow.

Source: ODOT

Figure 3.3.12-7 Trees Collapse from Weight of the Snow on Oregon 62 near Prospect, February 2, 2008

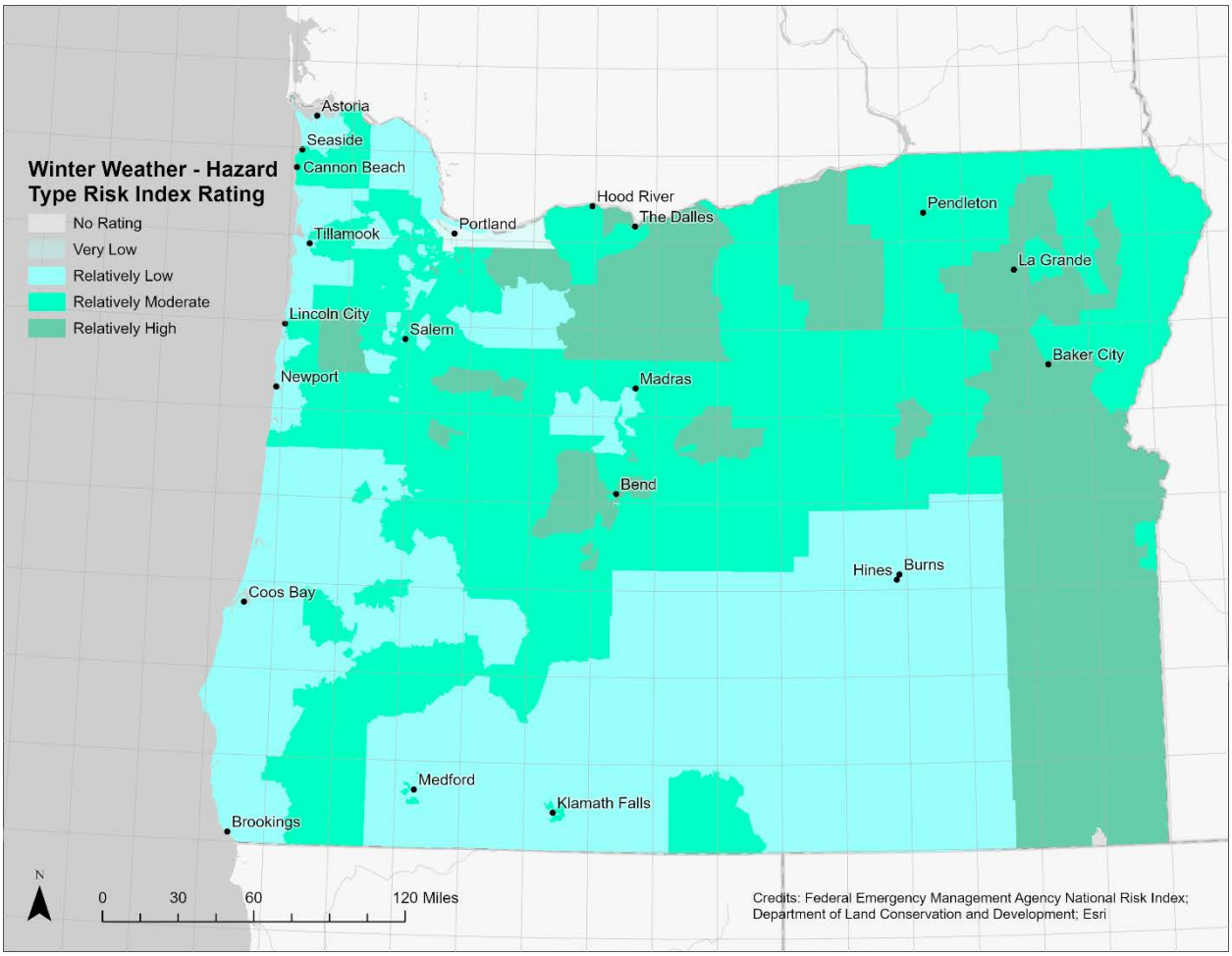
Source: ODOT

3.3.12.2 Risk Maps

The map in this section highlights places where the state might work with communities to develop mitigation projects.

The National Risk Index produces a measure of monetary losses experienced over the period of record. This emphasizes historic costs of harm and would direct mitigation resources to where the costs have been the greatest. Mitigation in these locations would save money over the long term.

Figure 3.3.12-8 Winter Weather Risk Rating from the NRI: Risk Index Rating from the Federal Emergency Management Agency, National Risk Index for Winter Weather.



Source: Federal Emergency Management Agency, National Risk Index for Winter Weather.
Ranking based on national percentiles. Last updated by FEMA in March 2023.
Data accessed on February 12, 2025 from National Risk Index | FEMA.gov

3.4 Changes in Development

3.4.1 Overview

Understanding what development has occurred in hazardous areas and how much more development could potentially occur in hazardous areas is important for assessing risk. Overall, Oregon has limited development and potential future development in hazardous areas. In most counties, recent development and potential development in all hazard areas is five percent or less. The outliers are counties with higher population and greater development overall: Multnomah County and to a lesser degree, Clackamas, Washington, and Jackson Counties.

3.4.2 Method

DLCD analyzed recent development by comparing land cover in hazard areas from 2019 to 2023. We calculated future potential development by measuring the area of undeveloped land in hazard areas designated for medium to high-density development in local comprehensive plans.

DLCD calculated changes in land cover between 2019 and 2023 using the Annual Impervious Descriptor Surface product from the National Land Cover Database (NLDC) (USGS, Annual National Land Cover Database, Collection 1, October 2024). The NLCD data consists of 30m x 30m LANDSAT imagery pixels interpreted and classified into impervious surface thematic classes called “Impervious Descriptor” classes. The NLCD 2019 data has 11 Impervious Descriptor classes while 2023 only has three. Therefore, DLCD aggregated the 2019 classes into the three 2023 classes: unclassified, road, and urban. From the three Impervious Descriptor classes, DLCD determined three types of change in land cover: 1) change from “unclassified” to “road” or “urban” class equals “undeveloped to developed”; 2) change from “road” to “urban” class equals “developed to increased developed”; and 3) all other pixels were classified as “no change detected.” Note there were no pixels in the study areas that changed from “urban” or “road” to “unclassified” or from “urban” to “road.”

DLCD calculated changes in the three, aggregated, Impervious Descriptor classes between 2019 and 2023 in ArcGIS Pro using a raster change function. We then converted the resulting impervious change raster and the 2023 Impervious Descriptor raster to vector format in order to overlay with the remaining vector data: counties, census tracts and comprehensive plans. DLCD then overlayed (intersect) this master vector dataset individually with each, available natural hazard type dataset producing a separate impervious dataset for each hazard. DLCD used these datasets to calculate the acres and percentage of land within each hazard area that changed from “undeveloped to developed”, “developed to increased developed” and “no change detected.” The results are in tables for individual hazards below.

DLCD determined potential future development using city and county comprehensive plan land use designations, where available, and the amount of "unclassified” area from the 2023 Impervious Descriptor data. We used the “unclassified” descriptor as undeveloped land because the impervious fraction of the pixel is below the threshold for an “Impervious Descriptor.” DLCD generalized the local comprehensive plan designations into six intensities of prescribed development from high to none: medium- to high-density; sparse; limited; unbuildable; federal or tribal land; and unknown. “Unknown” typically means that comprehensive plan information for that area was unavailable. Within each natural hazard area and each

development intensity class, we calculated the acres and percentage of land designated as “unclassified” in the 2023 NLCD Impervious Descriptor data. For potential future development we focus on just those areas designated as “medium- to high-density" development, assuming the “unclassified” areas could be built out, but the sparse and limited development areas are more likely to remain undeveloped. The results are in tables in sections for individual hazards below.

3.4.3 Hazard Specific Analysis

DLCD determined changes in development and potential future development for all counties that are directly exposed to seven of the twelve total natural hazards. The remaining five hazards (high hazard potential dams, windstorm, winter storm, heat, and drought) are not included.

The tables in sections below show vulnerability ratings for each county taken from county NHMP risk assessments, the total area of hazard exposure for each county in acres, the percent of each county’s total area that falls within that hazard zone, the percentage of the hazard area that changed from pervious to impervious between 2019 and 2023 (past change), and the percent of the hazard zone that is developable (future potential change). Local risk assessment ratings are included to help understand the relationship between the hazards that counties have identified as high, moderate, and low risk, and how development has changed and has the potential to change within those hazard zones.

3.4.3.1 Coastal Flood

For coastal flooding, the hazard-prone areas are areas with a 1 percent annual chance of flood in parts of counties within the coastal zone (Benton, Clatsop, Columbia, Coos, Curry, Douglas, Lincoln, Lane, and Tillamook) determined from 2024 digital Flood Insurance Rate Maps (D-FIRM) produced by the Federal Emergency Management Agency.

Past change in development, 2019-2023, in coastal flood hazard areas was moderate to high, ranging from 1.5 percent in Douglas County to 5.1 percent in Curry County. Tillamook and Clatsop Counties have the highest percentage of developable land at 7 percent each. The other coastal counties are much lower ranging from 0-2 percent.

Table 3.4.3-1: Coastal flood changes in development summary table

County	Local Risk Assessment Rating (From Local NHMP)	Total Hazard Area in acres	Percent of County Within Hazard Area	Percent Haz Area Changed from Perv. to Imperv. (Past Change)	Percent Hazard Zone Developable (Potential Future Change)
Benton	-	533	0.1 percent	2.4 percent	0.4 percent *
Clatsop	M	5,332	0.9 percent	2.0 percent	3.7 percent
Columbia	-	1,302	0.3 percent	4.6 percent	2.9 percent
Coos	L	11,557	1.1 percent	2.3 percent	2.3 percent
Curry	M	2,517	0.2 percent	5.1 percent	0 percent

County	Local Risk Assessment Rating (From Local NHMP)	Total Hazard Area in acres	Percent of County Within Hazard Area	Percent Haz Area Changed from Perv. to Imperv. (Past Change)	Percent Hazard Zone Developable (Potential Future Change)
Douglas	L	3,950	0.1 percent	1.5 percent	1.1 percent
Lane	-	4,609	0.2 percent	2.2 percent	2.1 percent
Lincoln	L	5,384	0.8 percent	3.4 percent	0.8 percent
Tillamook	M	5,317	0.7 percent	2.1 percent	4.3 percent

*Future potential development in Benton County is likely higher than indicated because the city of Siletz was excluded due to lack of comprehensive plan information.

Figure 3.4.3-1 and Figure 3.4.3-2 show the past changes in development within hazard areas in the coastal zone, or the percentage of the hazard area that changed from pervious to impervious between the 2019 and 2023 NLCD data. Figure 3.4.3-1 shows the change at the census tract level. Census tracts with the most change in impervious in coastal flood areas are located in Tillamook and around Coos Bay. Figure 3.4.3-2 shows change at a county level. Columbia and Curry Counties have the highest change in development in hazard zones followed by Lincoln County.

Figure 3.4.3-1: Change in impervious surface in coastal zone flood hazard areas by census tract

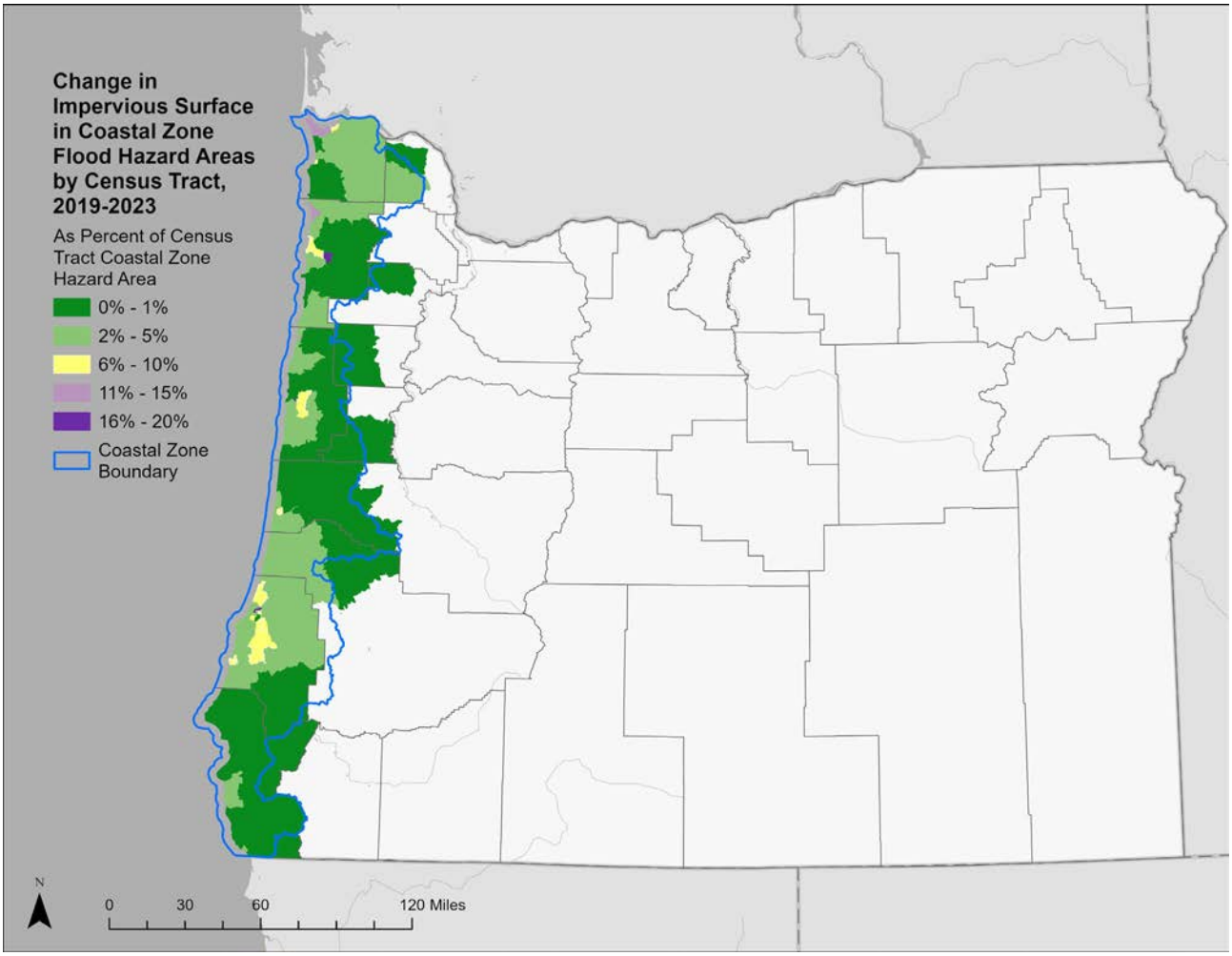


Figure 3.4.3-2: Change in impervious surface in coastal flood hazard areas by county

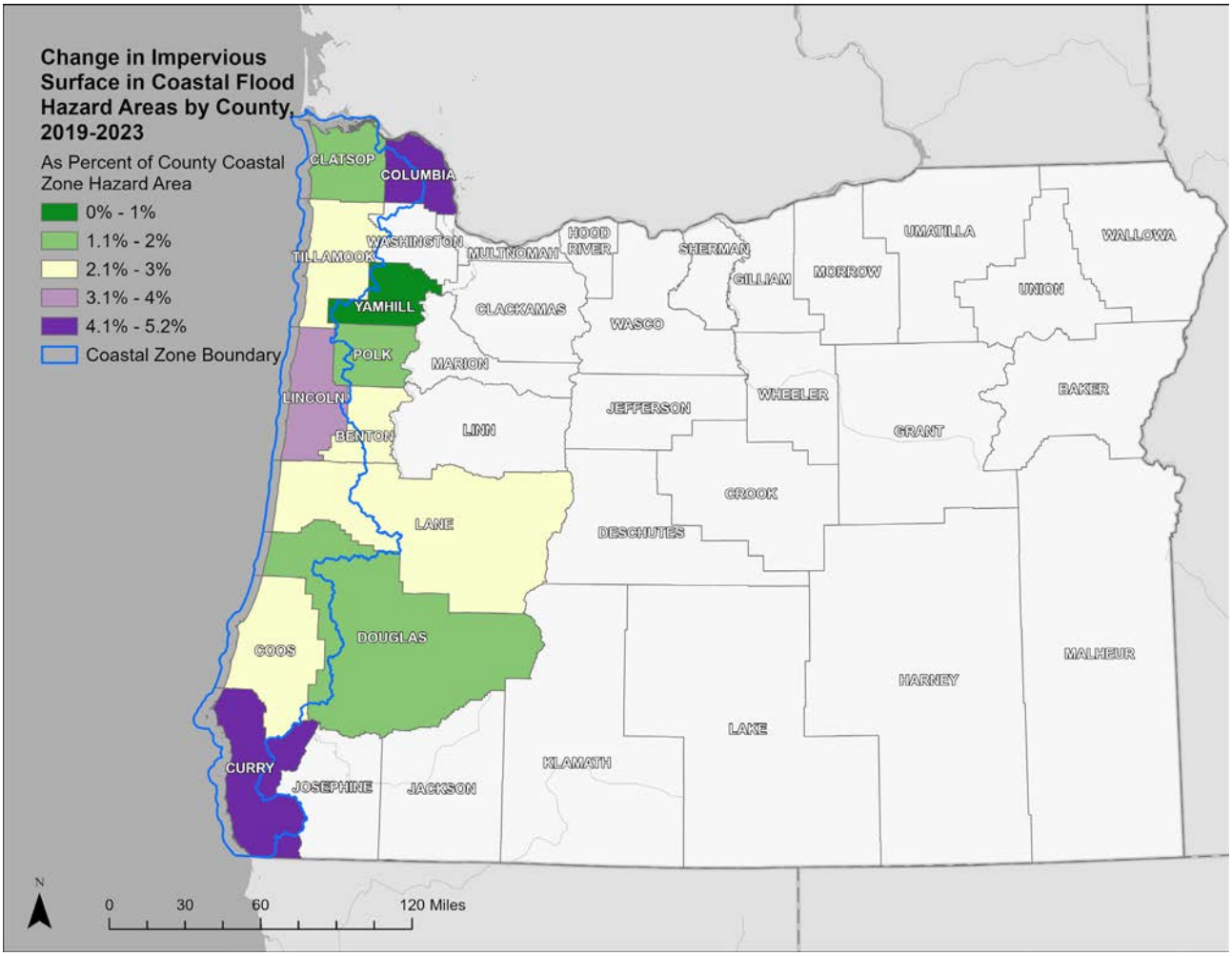


Figure 3.4.3-3 and Figure 3.4.3-4 show the potential future changes in development within hazard areas in the coastal zone, or the percentage of the hazard area in medium or high-density development designations that are not yet developed. Figure 3.4.3-3 shows the potential future change at the census tract level. Census tracts with the most percentage of developable land in coastal flood areas are in and around Tillamook and Coos Bay. Figure 3.4.3-4 shows change at a county level. Clatsop and Tillamook Counties have the highest potential change in development in hazard zones.

Figure 3.4.3-3: Future growth potential in coastal zone flood hazard areas by census tract

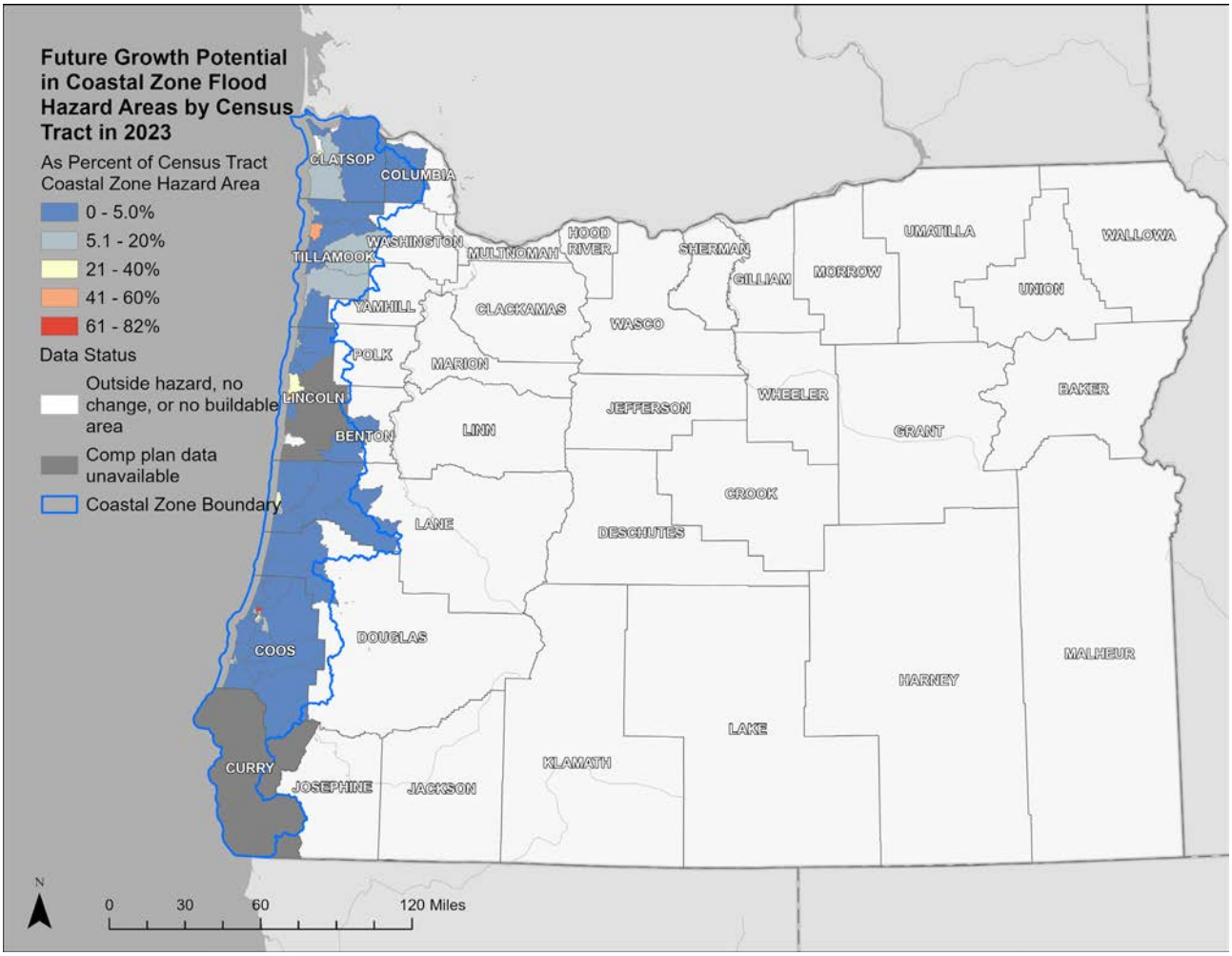
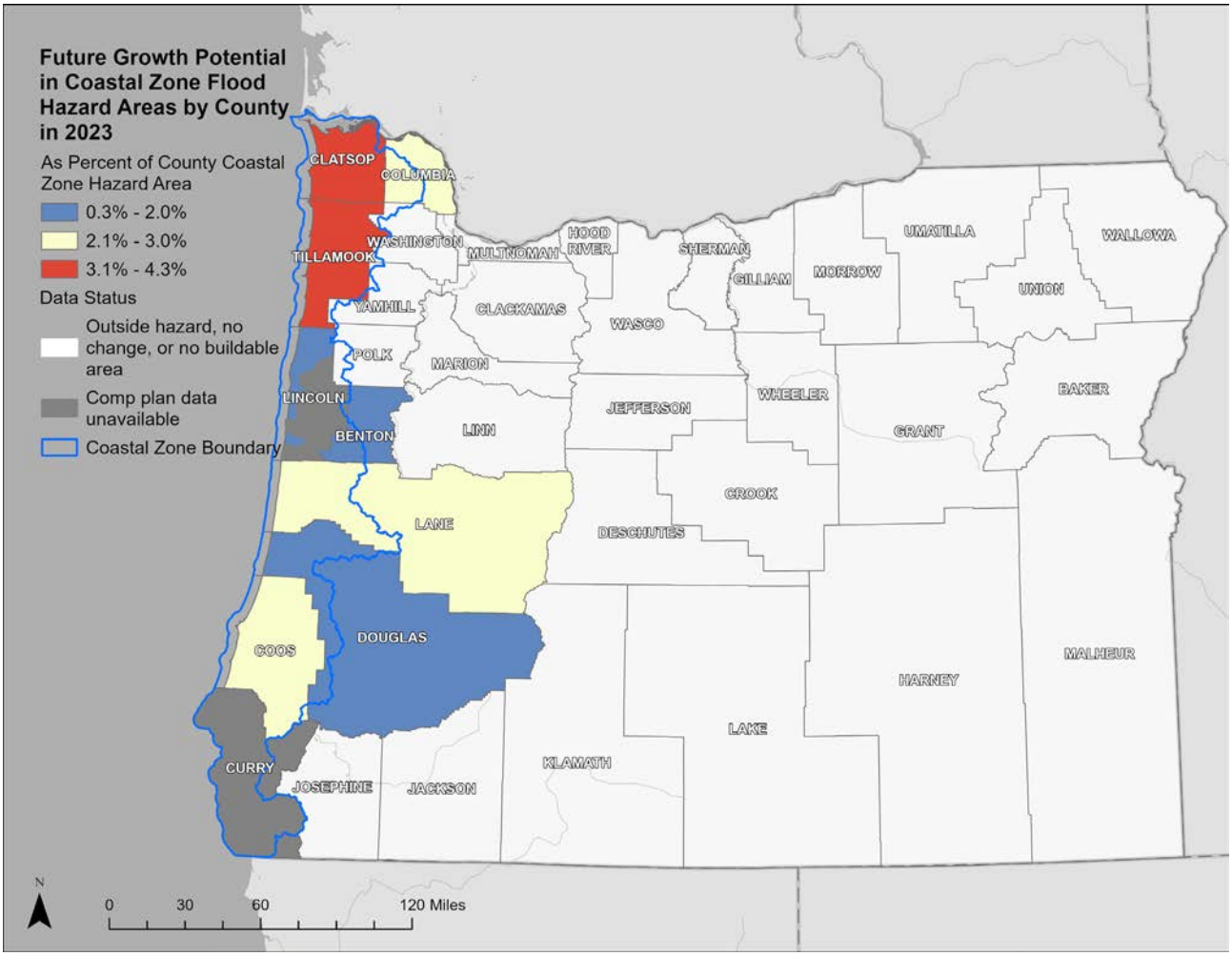


Figure 3.4.3-4: Future growth potential in coastal zone flood hazard areas by county



3.4.3.2 High Hazard Potential Dams

The hazard-prone areas for high hazard potential dams were not available for analysis of changes in development.

3.4.3.3 Drought

For drought there are no specific hazard-prone areas. Drought is a hazard throughout Oregon.

3.4.3.4 Earthquakes

For earthquakes, the hazard-prone areas are areas of moderate to very high susceptibility to liquefaction or moderate to high probability of damaging shaking determined from data in the Oregon Seismic Hazard Database (OSHD) produced by the Department of Geology and Mineral Industries (DOGAMI). Areas subject to earthquake damaging shaking and liquefaction combined cover every county. This broad distribution of

hazard means the proportion of the hazard area that has had increases in development and potential future development are very small.

For earthquakes, the area of the county area within the hazard zone varies greatly and ranges from 2 percent to 100 percent. The past change in development generally ranges from 1-3 percent, with the exception of Washington County at 5 percent and Multnomah County at 6 percent. Potential future development for most counties ranges from 0-2 percent with two exceptions: Multnomah County and Marion County have 6 percent and 3 percent developable land in the hazard zone, respectively.

Table 3.4.3-2: Earthquake changes in development summary table

County	Local Risk Assessment Rating (From Local NHMP)	Total Hazard Area in Acres	Percent of County Within Hazard Area	Percent Haz Area Changed from Perv. to Imperv. (Past Change)	Percent Hazard Zone Developable (Potential Future Change)
Baker	H	261,803	13 percent	0 percent	0 percent
Benton	L	434,750	100 percent	2 percent	2 percent
Clackamas	H	347,918	29 percent	2 percent	0 percent
Clatsop	H	574,258	99 percent	2 percent	1 percent
Columbia	H	437,575	99 percent	2 percent	0 percent
Coos	H	1,043,994	99 percent	2 percent	1 percent
Crook	H	184,046	10 percent	0 percent	0 percent
Curry	H	1,051,074	96 percent	1 percent	0 percent
Deschutes	H	229,579	12 percent	1 percent	0 percent
Douglas	H	1,608,594	49 percent	1 percent	0 percent
Gilliam	M	15,921	2 percent	0 percent	0 percent
Grant	M	378,788	13 percent	0 percent	0 percent
Harney	L	1,644,859	25 percent	0 percent	0 percent
Hood River	M	101,633	30 percent	2 percent	0 percent
Jackson	H	426,904	24 percent	1 percent	0 percent
Jefferson	L	92,910	8 percent	0 percent	0 percent
Josephine	H	1,033,943	98 percent	3 percent	0 percent
Klamath	H	1,207,654	31 percent	1 percent	0 percent
Lake	H	1,463,200	27 percent	0 percent	0 percent
Lane	H	1,262,815	43 percent	1 percent	0 percent
Lincoln	H	637,944	98 percent	1 percent	1 percent

County	Local Risk Assessment Rating (From Local NHMP)	Total Hazard Area in Acres	Percent of County Within Hazard Area	Percent Haz Area Changed from Perv. to Imperv. (Past Change)	Percent Hazard Zone Developable (Potential Future Change)
Linn	M	575,836	39 percent	1 percent	1 percent
Malheur	L	749,155	12 percent	0 percent	0 percent
Marion	H	425,936	55 percent	3 percent	3 percent
Morrow	H	291,640	22 percent	1 percent	0 percent
Multnomah	H	194,437	65 percent	6 percent	6 percent
Polk	H	476,841	100 percent	2 percent	1 percent
Sherman	L	34,060	6 percent	0 percent	0 percent
Tillamook	H	722,612	99 percent	1 percent	2 percent
Umatilla	H	565,893	27 percent	1 percent	0 percent
Union	M	259,801	20 percent	1 percent	0 percent
Wallowa	H	96,286	5 percent	0 percent	0 percent
Wasco	M	220,529	14 percent	0 percent	0 percent
Washington	H	465,233	100 percent	5 percent	2 percent
Wheeler	H	154,462	14 percent	0 percent	0 percent
Yamhill	H	451,797	98 percent	3 percent	0 percent

Figure 3.4.3-5 and Figure 3.4.3-6 show the past changes in development within hazard areas across the state, or the percentage of the hazard area that changed from pervious to impervious between the 2019 and 2023 NLCD data. Figure 3.4.3-5 shows the change at the census tract level. Census tracts with the most change in impervious surface in earthquake areas are clustered around the Portland metro region, the Willamette Valley, Bend, Hermiston, Grants Pass, and the Rogue Valley. Figure 3.4.3-6 shows change at a county level. Multnomah and Washington Counties have the highest change in development in hazard zones.

Figure 3.4.3-5: Change in impervious surface in earthquake hazard areas by census tract

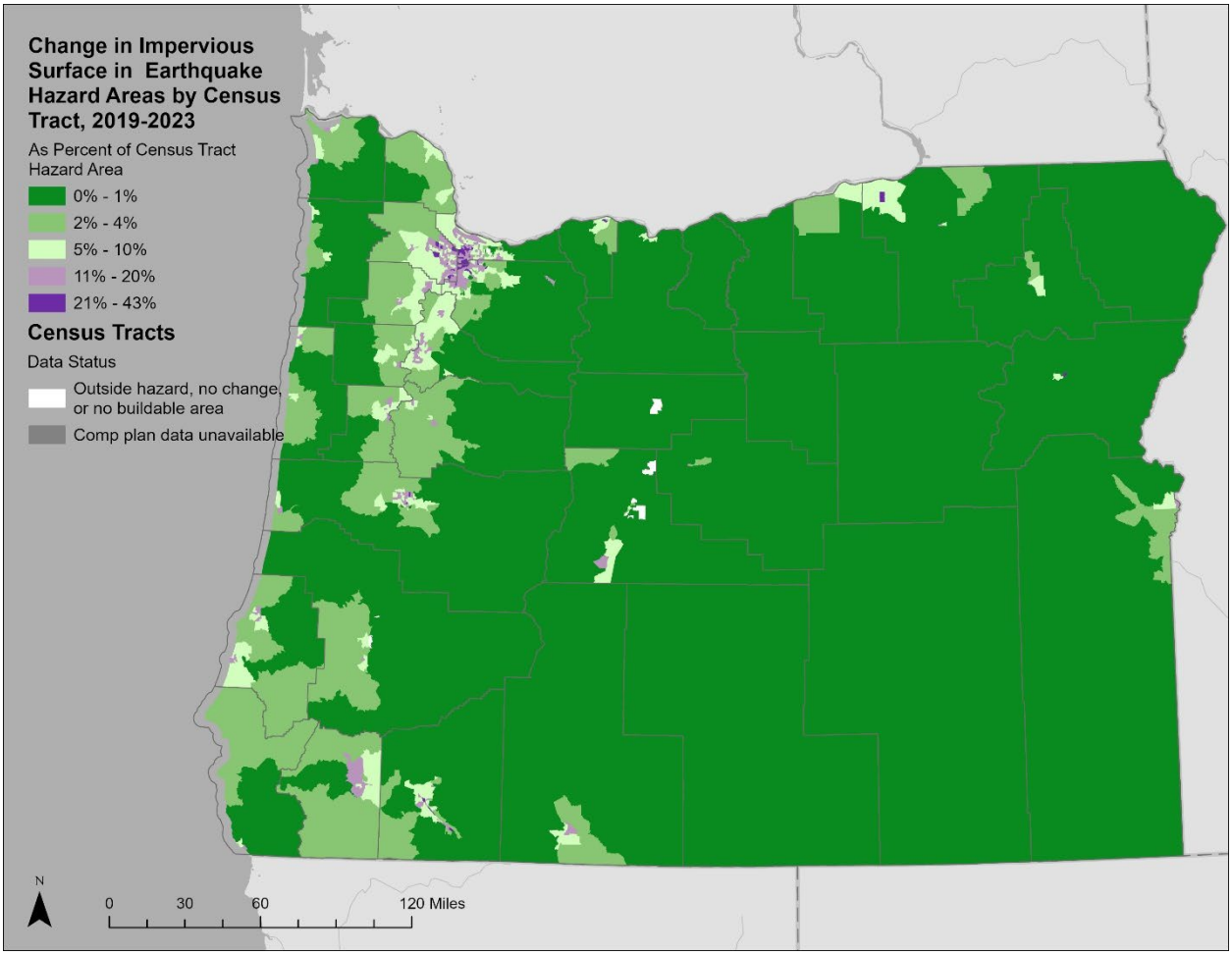


Figure 3.4.3-6: Change in impervious surface in earthquake hazard areas by county

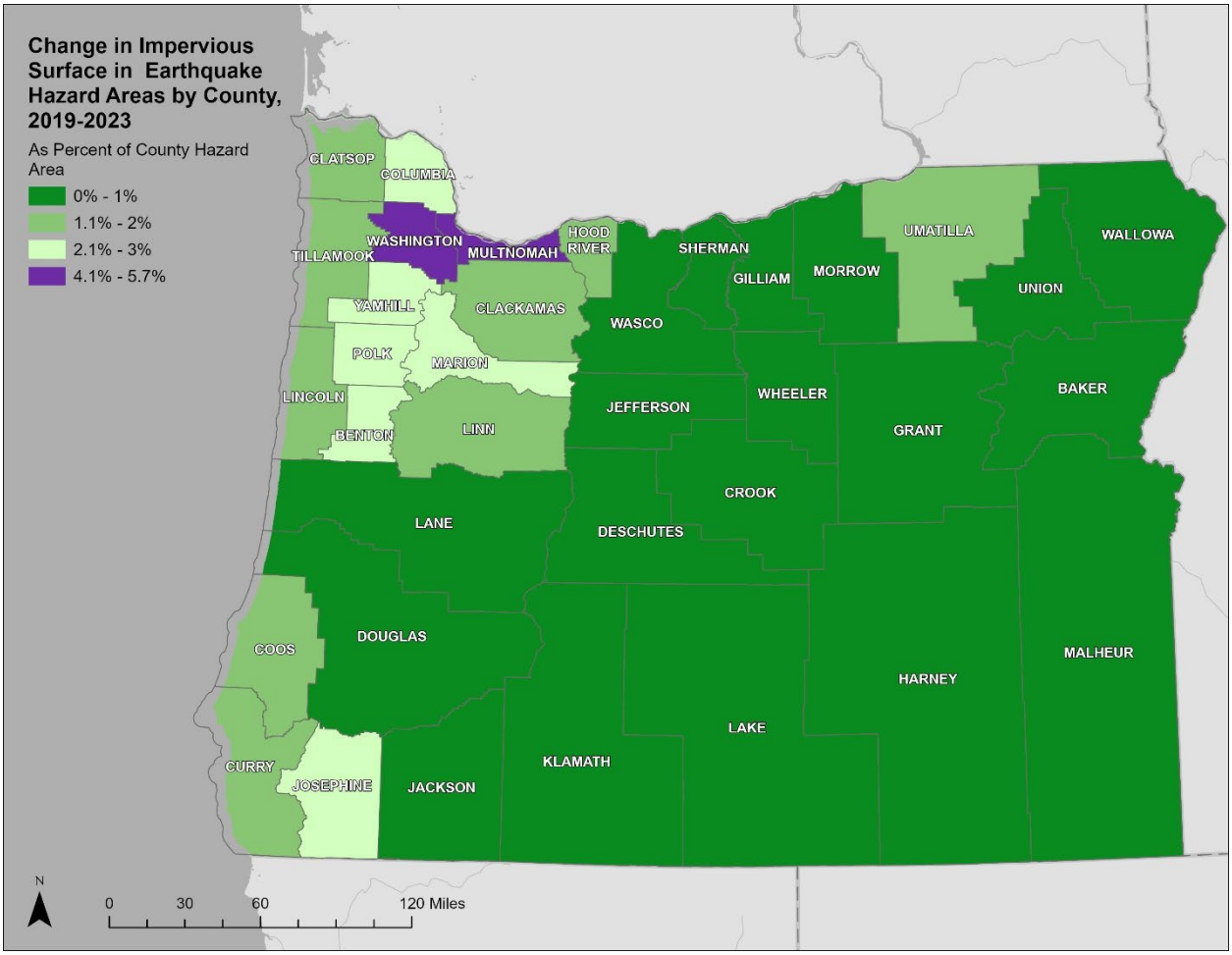


Figure 3.4.3-7 and Figure 3.4.3-8 show the potential future changes in development within hazard areas across the state, or the percentage of the hazard area located in medium or high-density development designations that are not yet developed. Figure 3.4.3-7 shows the potential future change at the census tract level. Census tracts with the most percentage of developable land in earthquake areas are mainly clustered around the Portland metro region and the Willamette Valley. Figure 3.4.3-8 shows change at a county level. Multnomah County has the highest potential change in development in hazard zones followed by Marion County.

Figure 3.4.3-7: Future growth potential in earthquake hazard areas by census tract

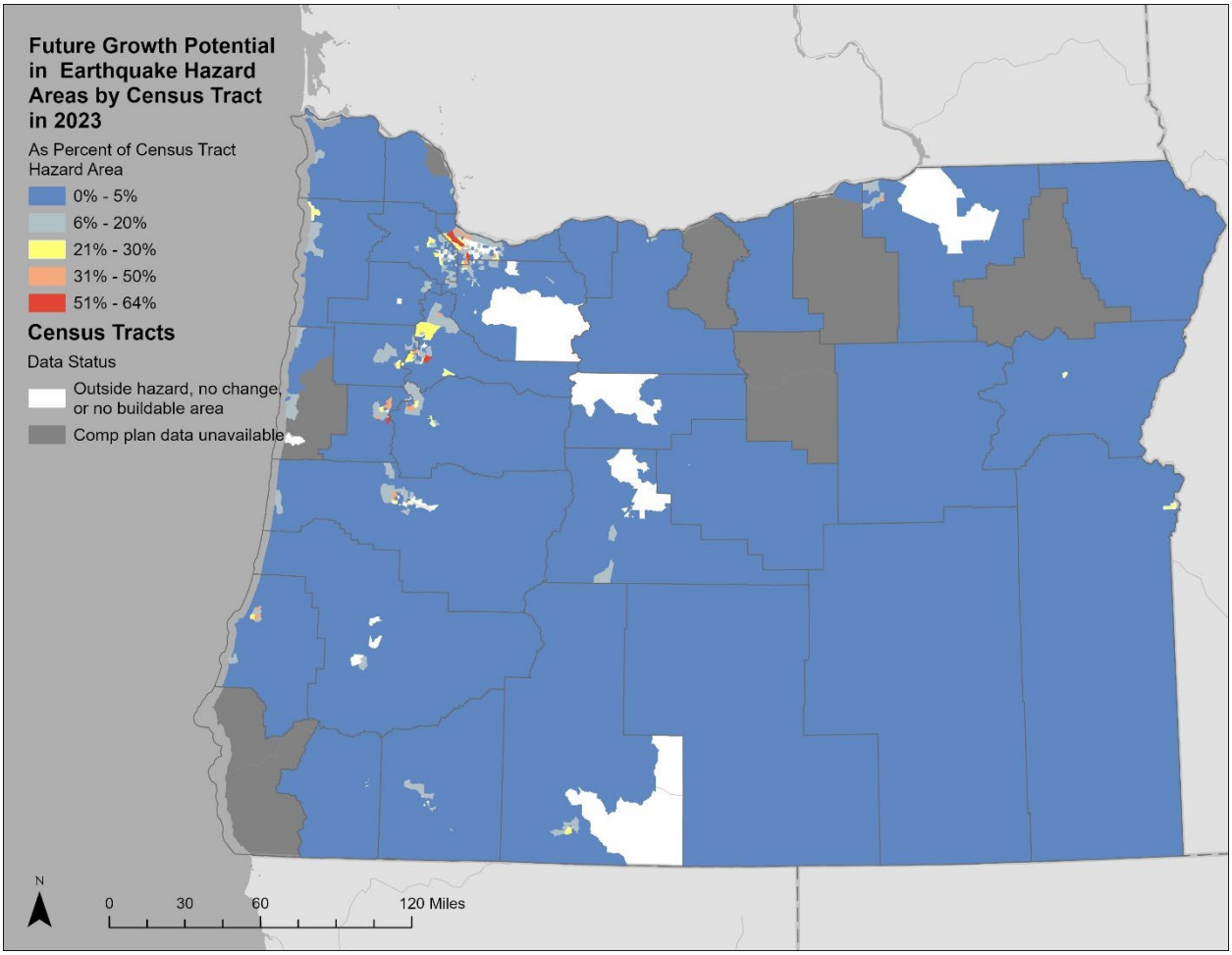
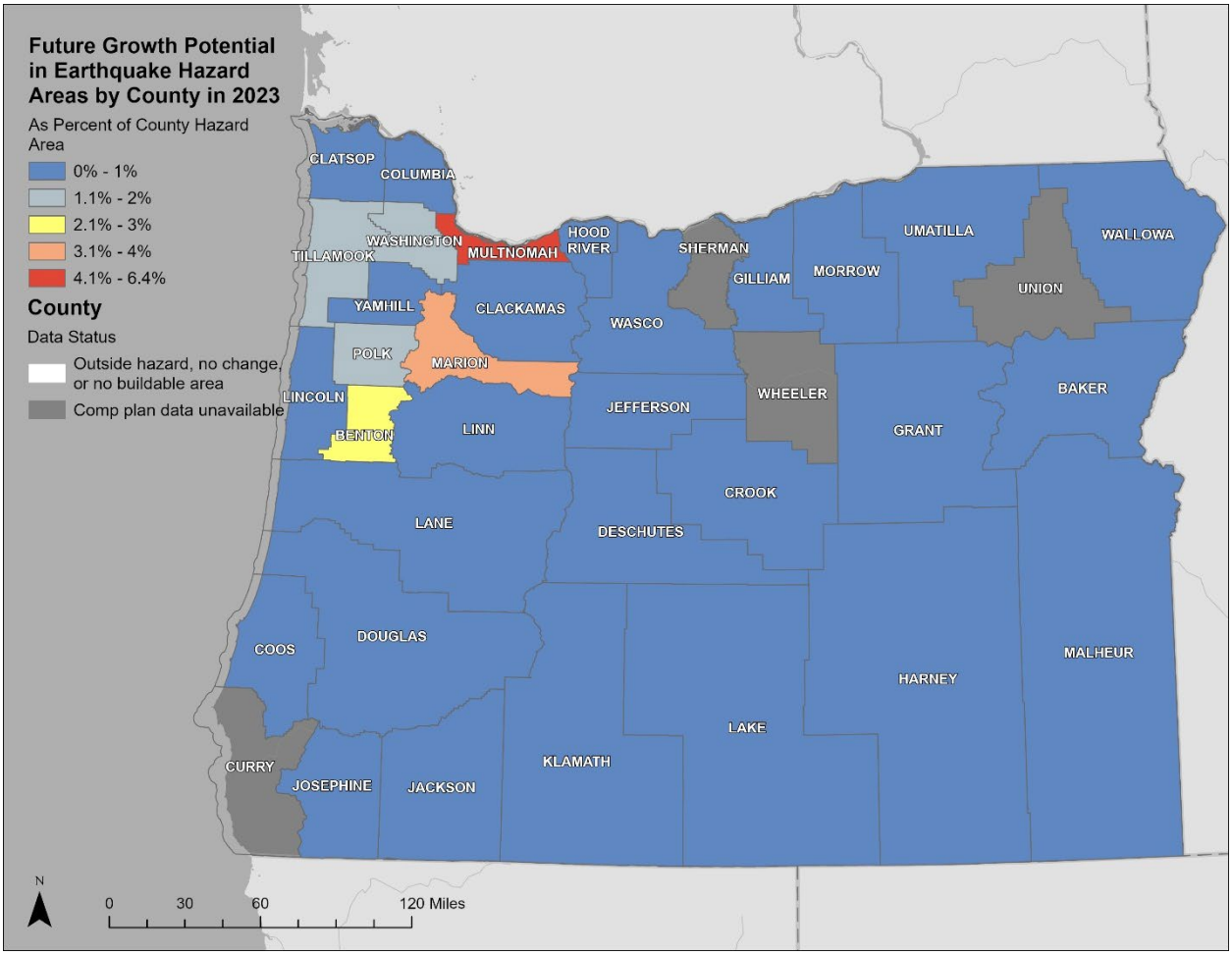


Figure 3.4.3-8: Future growth potential in earthquake hazard areas by county



3.4.3.5 Extreme Heat

For extreme heat there are no specific hazard-prone areas. Extreme heat is a hazard throughout Oregon.

3.4.3.6 Riverine Flooding

For riverine flooding, the hazard-prone areas are areas with a 1 percent annual chance of flood determined from 2024 digital Federal Emergency Management Agency Flood Insurance Rate Maps (D-FIRM). Portions of Oregon do not yet have D-FIRMS and these areas were included using paper FIRMs that were digitized by DOGAMI.

For riverine flooding, past change in development generally ranges from 0-7 percent. Potential future development has a large range with many counties ranging from 0-4 percent with several major exceptions. 23 percent of the hazard zone in Multnomah County is developable land. Eleven percent of Marion County's hazard area and 8 percent of Clackamas County's hazard area are also developable.

Table 3.4.3-3: Riverine flood changes in development summary table

County	Local Risk Assessment Rating (From Local NHMP)	Total Hazard Area in Acres	Percent of County Within Hazard Area	Percent Haz Area Changed from Perv. to Imperv. (Past Change)	Percent Hazard Zone Developable (Potential Future Change)
Baker	M	56,543	3 percent	4 percent	1 percent
Benton	H	58,821	14 percent	2 percent	2 percent
Clackamas	M	23,086	2 percent	8 percent	8 percent
Clatsop	H	29,239	5 percent	2 percent	6 percent
Columbia	H	56,071	13 percent	3 percent	1 percent
Coos	H	65,957	6 percent	2 percent	2 percent
Crook	H	23,793	1 percent	3 percent	1 percent
Curry	M	16,270	1 percent	5 percent	0 percent
Deschutes	L	11,662	1 percent	4 percent	7 percent
Douglas	M	67,322	2 percent	4 percent	1 percent
Gilliam	M	26,506	3 percent	4 percent	0 percent
Grant	H	14,506	1 percent	4 percent	2 percent
Harney	-	246,449	4 percent	0 percent	0 percent
Hood River	L	9,760	3 percent	4 percent	0 percent
Jackson	M	36,110	2 percent	7 percent	2 percent
Jefferson	M	14,734	1 percent	4 percent	1 percent
Josephine	M	22,761	2 percent	6 percent	1 percent
Klamath	M	296,854	8 percent	1 percent	0 percent
Lake	H	212,045	4 percent	0 percent	0 percent
Lane	H	138,531	5 percent	4 percent	2 percent
Lincoln	M	29,426	5 percent	3 percent	1 percent
Linn	M	112,209	8 percent	2 percent	2 percent
Malheur	M	57,558	1 percent	2 percent	2 percent
Marion	H	57,466	7 percent	3 percent	11 percent
Morrow - North	L	26,715	2 percent	3 percent	0 percent
Morrow - South	M				
Multnomah	M	36,533	12 percent	5 percent	23 percent
Polk	M	40,347	8 percent	2 percent	3 percent

County	Local Risk Assessment Rating (From Local NHMP)	Total Hazard Area in Acres	Percent of County Within Hazard Area	Percent Haz Area Changed from Perv. to Imperv. (Past Change)	Percent Hazard Zone Developable (Potential Future Change)
Sherman	L	10,558	2 percent	5 percent	0 percent
Tillamook	H	28,219	4 percent	2 percent	4 percent
Umatilla	H	19,279	1 percent	7 percent	2 percent
Union	M	40,587	3 percent	4 percent	0 percent
Wallowa	M	11,244	1 percent	6 percent	2 percent
Wasco	M	15,638	1 percent	4 percent	4 percent
Washington	M	41,201	9 percent	3 percent	3 percent
Wheeler	H	16,644	2 percent	3 percent	0 percent
Yamhill	H	42,482	9 percent	2 percent	1 percent

Figure 3.4.3-9 and Figure 3.4.3-10 show the past changes in development within hazard areas across the state, or the percentage of the hazard area that changed from pervious to impervious between the 2019 and 2023 NLCD data. Figure 3.4.3-9 shows the change at the census tract level. Census tracts with the most change in impervious in flood zones are clustered around the Portland metro region, Bend, Hermiston, and the Rogue Valley. Figure 3.4.3-10 shows change at a county level. Clackamas County has the highest change in development in hazard zones followed by Umatilla, Josephine, and Jackson Counties.

Figure 3.4.3-9: Change in impervious surface in riverine flood hazard areas by census tract

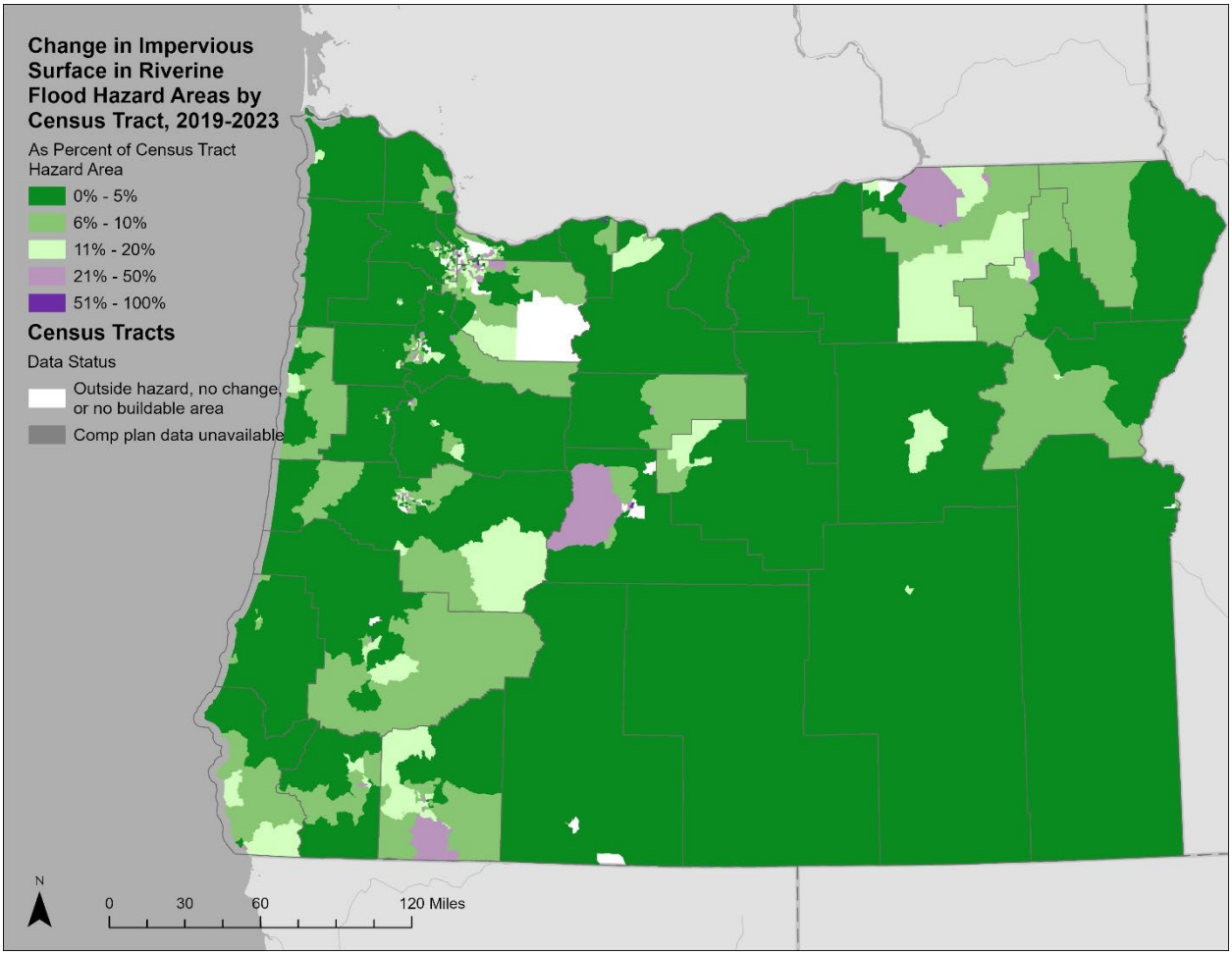


Figure 3.4.3-10: Change in impervious surface in riverine flood hazard areas by county

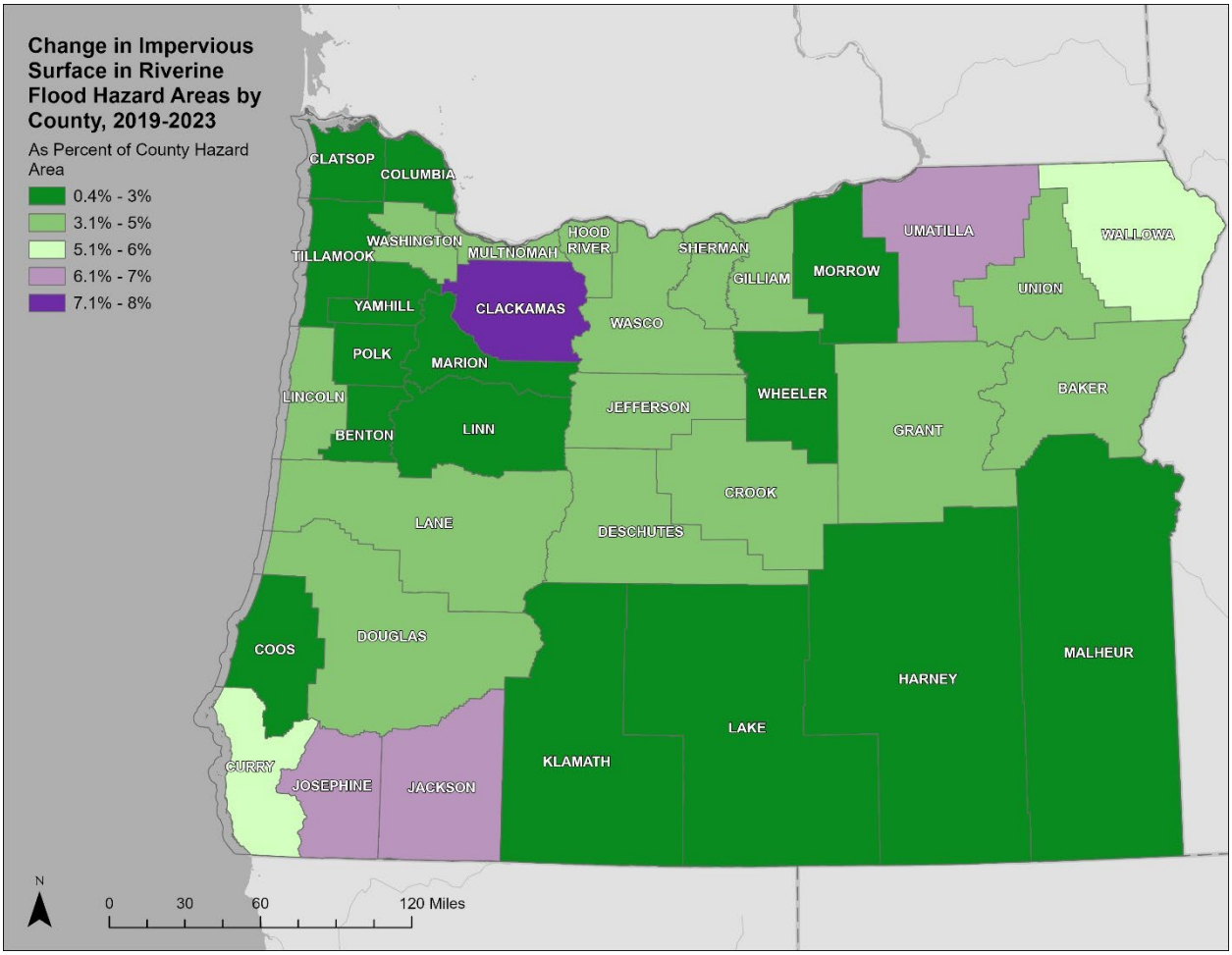


Figure 3.4.3-11 and 3Figure 3.4.3-12 show the potential future changes in development within hazard areas across the state, or the percentage of the hazard area located in medium or high-density development designations that are not yet developed. Figure 3.4.3-11 shows the potential future change at the census tract level. Census tracts with the most percentage of developable land in flood zones are clustered around the Portland metro region, the Willamette Valley, Hermiston, Bend, and Newport. Figure 3.4.3-12 shows change at a county level. Multnomah County has the highest potential change in development in hazard zones followed by Marion County.

Figure 3.4.3-11: Future growth potential in riverine flood areas by census tracts

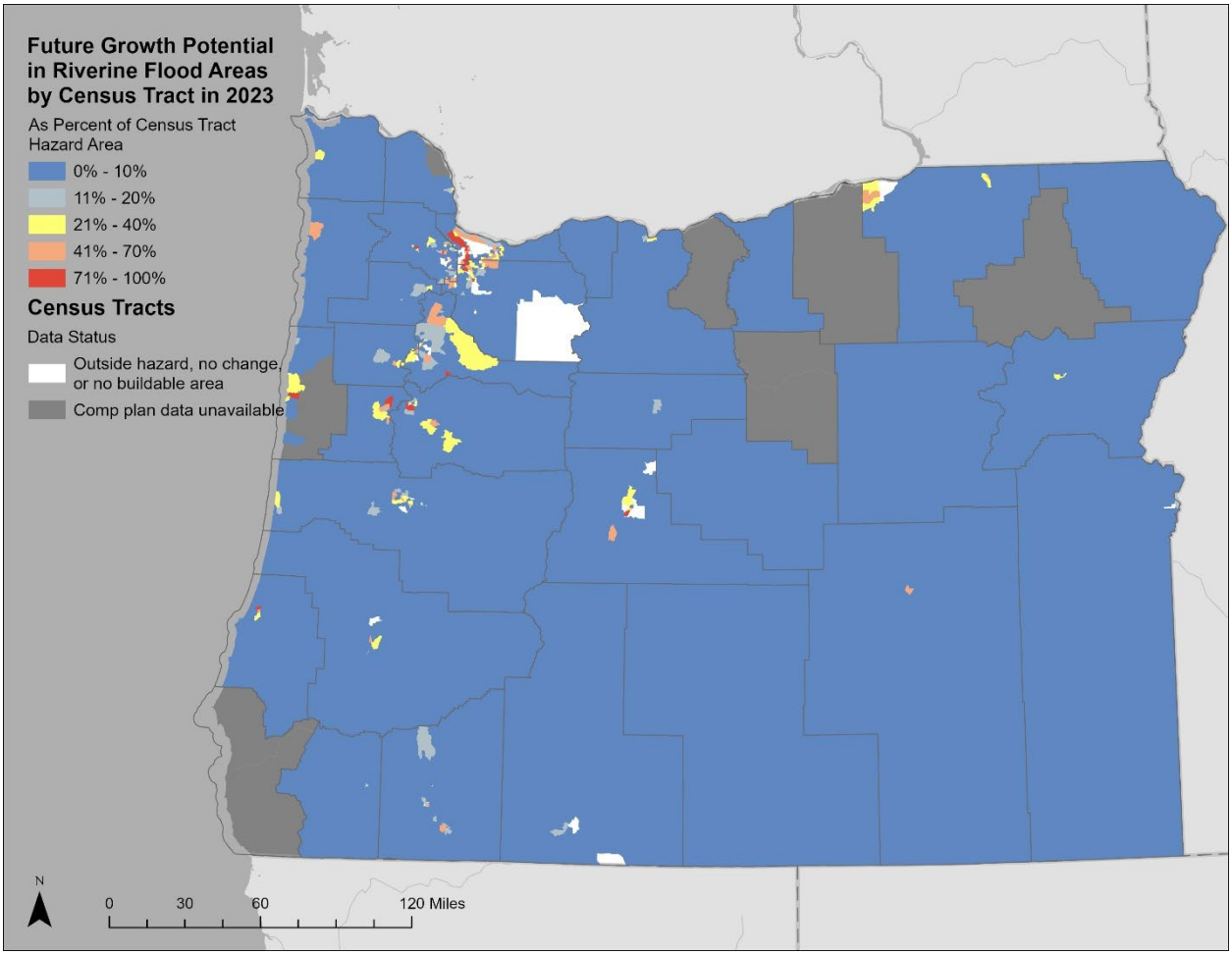
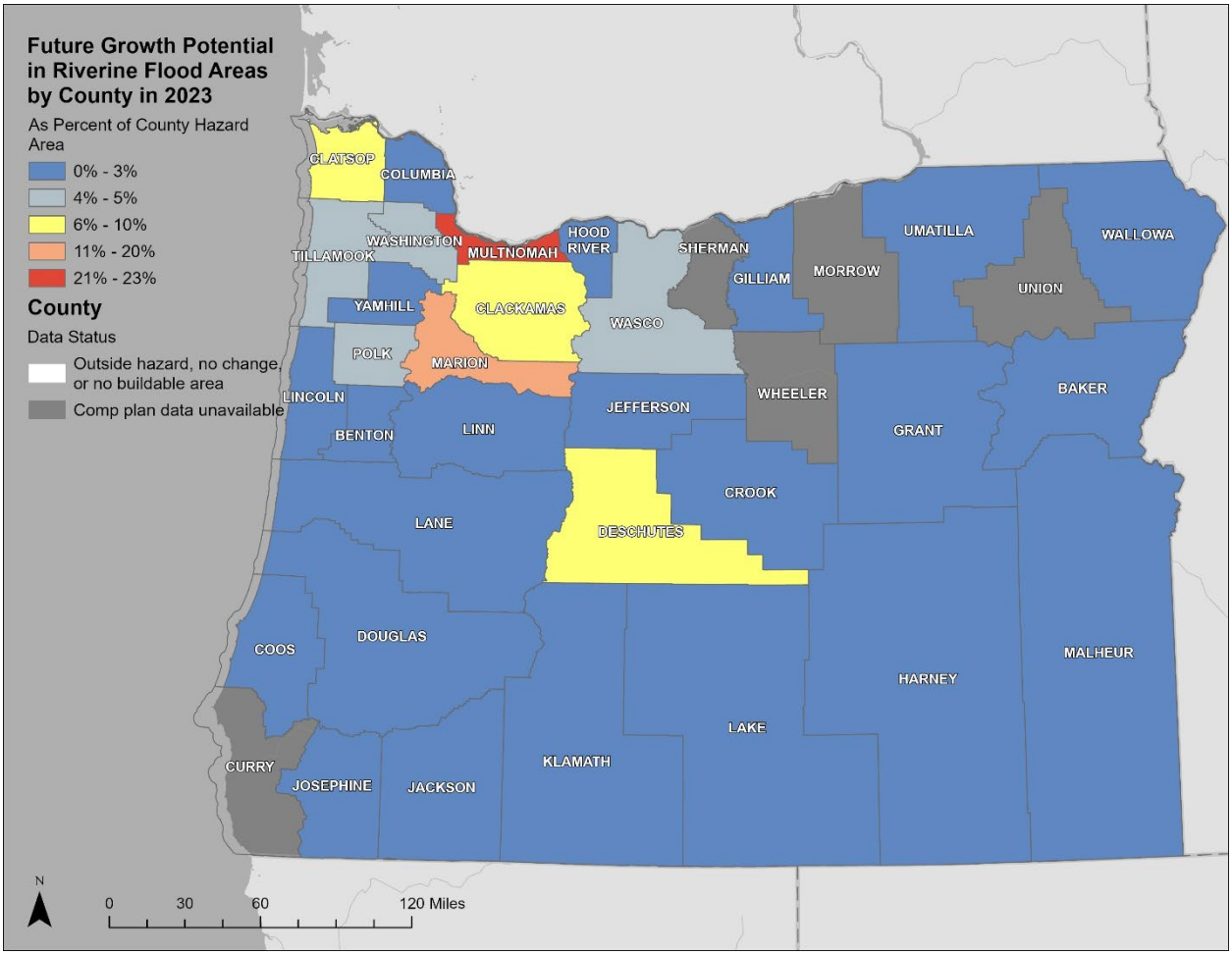


Figure 3.4.3-12: Future growth potential in riverine flood areas by county in 2023



3.4.3.7 Landslides

For landslides, the hazard-prone areas are areas of high and very high susceptibility ratings from the statewide landslide susceptibility data set (SLIDO) produced by DOGAMI.

Changes in development in landslide areas are generally low. Past changes in development generally range from 0-2 percent, except Multnomah County with 4 percent. Potential Future development is generally even lower, mostly ranging from 0-1 percent, except Multnomah County at 9 percent.

Table 3.4.3-4: Landslide changes in development summary table

County	Local Risk Assessment Rating (From Local NHMP)	Total Hazard Area in acres	Percent of County Within Hazard Area	Percent Haz Area Changed from Perv. to Imperv. (Past Change)	Percent Hazard Zone Developable (Potential Future Change)
Baker	L	889,203	45 percent	1 percent	0 percent
Benton	M	162,245	37 percent	1 percent	0 percent

County	Local Risk Assessment Rating (From Local NHMP)	Total Hazard Area in acres	Percent of County Within Hazard Area	Percent Haz Area Changed from Perv. to Imperv. (Past Change)	Percent Hazard Zone Developable (Potential Future Change)
Clackamas	L	547,078	45 percent	2 percent	0 percent
Clatsop	L	405,335	70 percent	1 percent	0 percent
Columbia	-	237,452	54 percent	2 percent	0 percent
Coos	H	708,288	67 percent	1 percent	0 percent
Crook	L	441,660	23 percent	1 percent	0 percent
Curry	H	774,926	71 percent	1 percent	0 percent
Deschutes	L	171,822	9 percent	1 percent	0 percent
Douglas	M	2,175,395	67 percent	1 percent	0 percent
Gilliam	H	239,569	31 percent	0 percent	0 percent
Grant	L	1,319,592	46 percent	1 percent	0 percent
Harney		810,044	12 percent	0 percent	0 percent
Hood River	M	192,521	56 percent	1 percent	0 percent
Jackson	L	916,540	51 percent	1 percent	0 percent
Jefferson	L	368,665	32 percent	0 percent	0 percent
Josephine	L	733,636	70 percent	1 percent	0 percent
Klamath	M	469,629	12 percent	1 percent	0 percent
Lake	L	541,150	10 percent	1 percent	0 percent
Lane	H	1,684,988	57 percent	1 percent	0 percent
Lincoln	H	463,358	71 percent	1 percent	1 percent
Linn	L	735,899	50 percent	1 percent	0 percent
Malheur	L	1,140,120	18 percent	0 percent	0 percent
Marion	H	264,365	34 percent	2 percent	1 percent
Morrow - North	L	263,239	20 percent	1 percent	0 percent
Morrow - South	M				
Multnomah	M	89,120	30 percent	4 percent	9 percent
Polk	L	230,590	48 percent	2 percent	1 percent
Sherman	M	123,343	23 percent	0 percent	0 percent
Tillamook	H	599,242	82 percent	1 percent	1 percent
Umatilla	M	618,868	30 percent	1 percent	0 percent

County	Local Risk Assessment Rating (From Local NHMP)	Total Hazard Area in acres	Percent of County Within Hazard Area	Percent Haz Area Changed from Perv. to Imperv. (Past Change)	Percent Hazard Zone Developable (Potential Future Change)
Union	L	498,749	38 percent	1 percent	0 percent
Wallowa	M	1,167,800	58 percent	0 percent	0 percent
Wasco	L	484,874	32 percent	1 percent	0 percent
Washington	L	182,662	39 percent	2 percent	1 percent
Wheeler	H	576,291	52 percent	0 percent	0 percent
Yamhill	L	241,518	52 percent	2 percent	0 percent

Figure 3.4.3-13 and Figure 3.4.3-14 show the past changes in development within hazard areas across the state, or the percentage of the hazard area that changed from pervious to impervious between the 2019 and 2023 NLCD data. Figure 3.4.3-13 shows the change at the census tract level. Census tracts with the most change in impervious surface in landslide areas are clustered around the Portland metro region, Bend, Hermiston, the Central Willamette Valley and the Rogue Valley. Figure 3.4.3-14 shows change at a county level. Multnomah County has the highest change in development in hazard zones followed by Washington County.

Figure 3.4.3-13: Change in impervious surface in landslide hazard areas by census tract

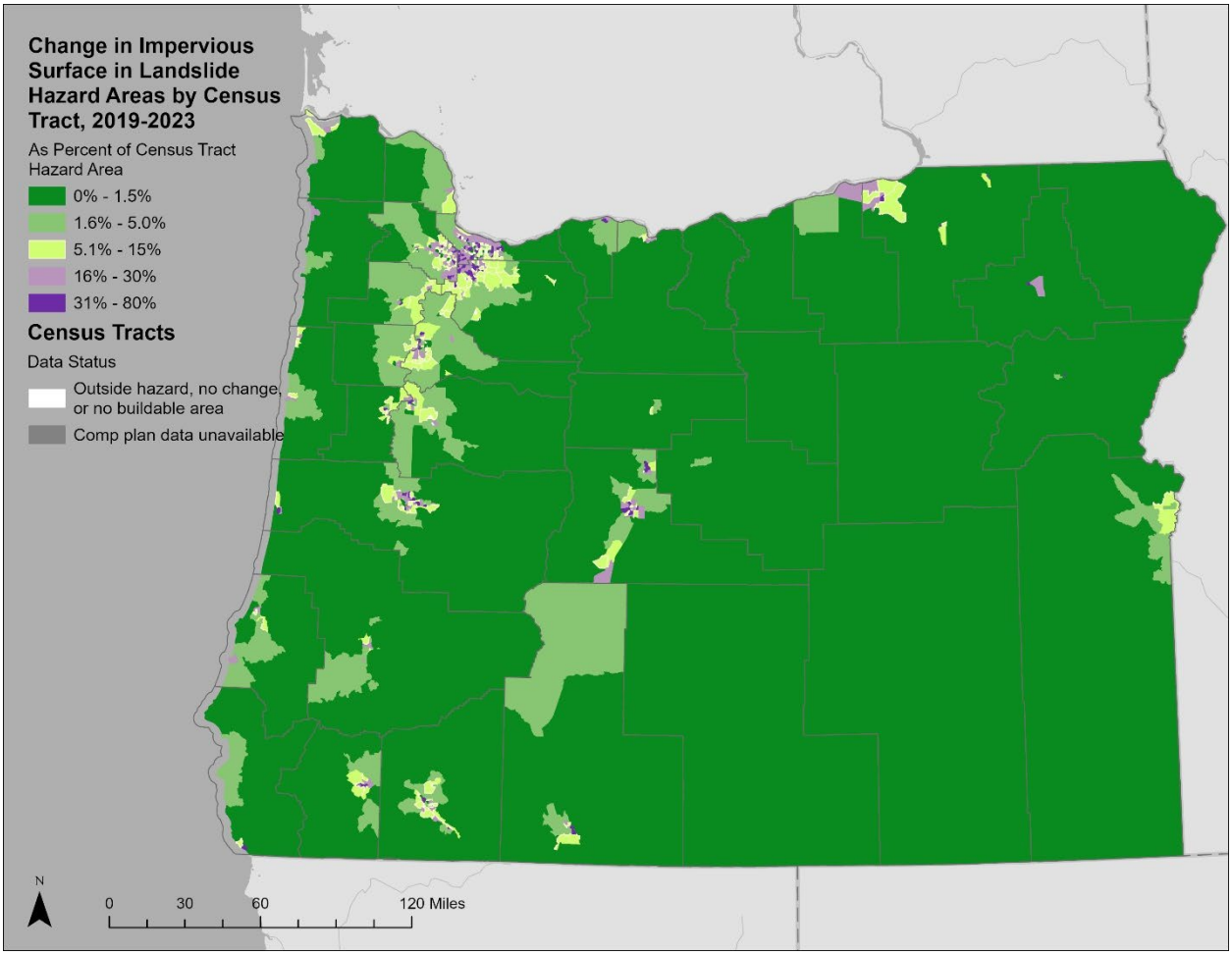


Figure 3.4.3-14: Change in impervious surface in landslide hazard areas by county

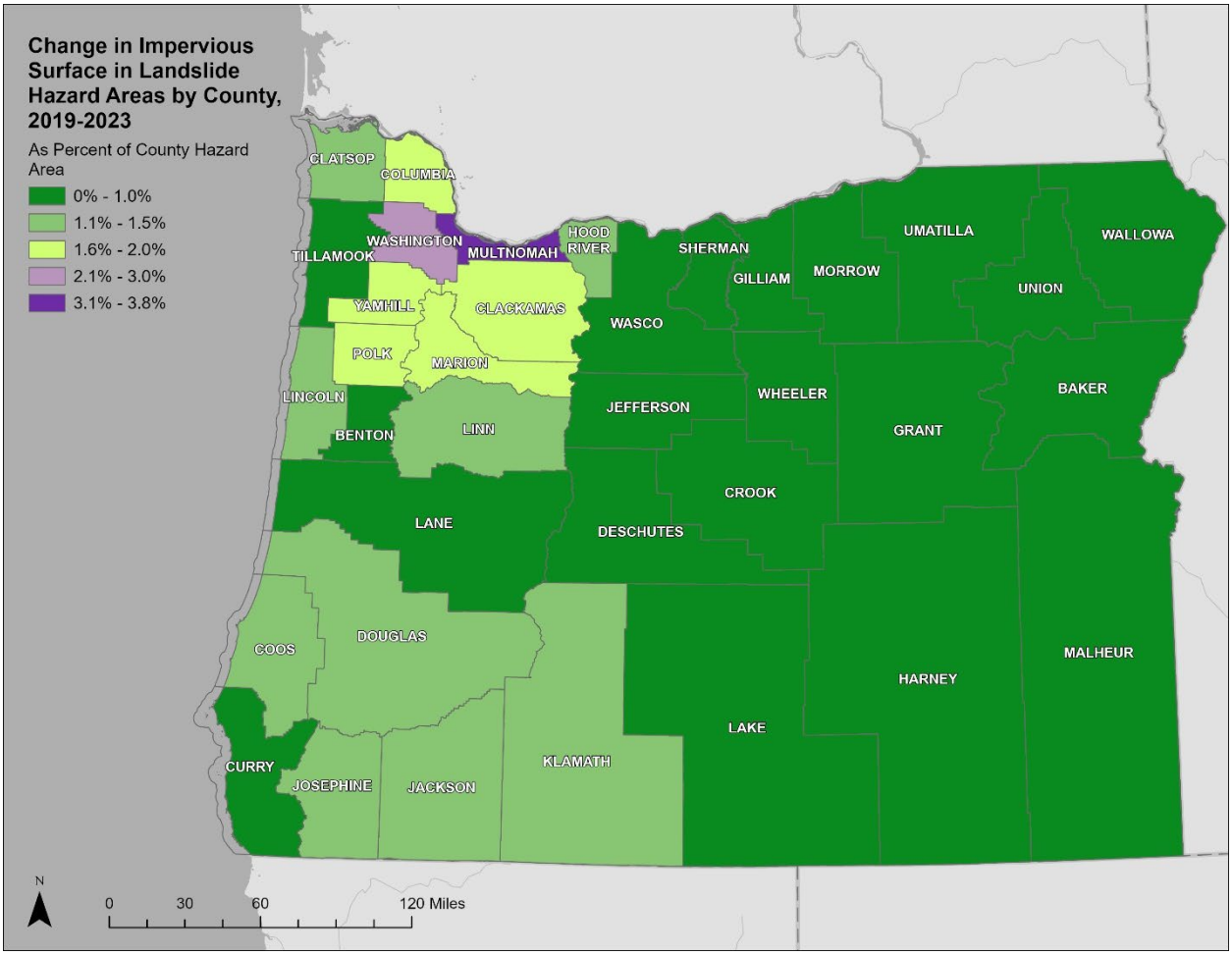


Figure 3.4.3-15 and 3Figure 3.4.3-16 show the potential future changes in development within hazard areas across the state, or the percentage of the hazard area located in medium- or high-density development designations that are not yet developed. Figure 3.4.3-15 shows the potential future change at the census tract level. Census tracts with the most percentage of developable land in landslide areas are clustered around the Portland metro region, Corvallis, and Bend. Figure 3.4.3-16 shows change at a county level. Multnomah County has the highest potential change in development in hazard zones followed by Tillamook County.

Figure 3.4.3-15: Future growth potential in landslide hazard areas by census tract

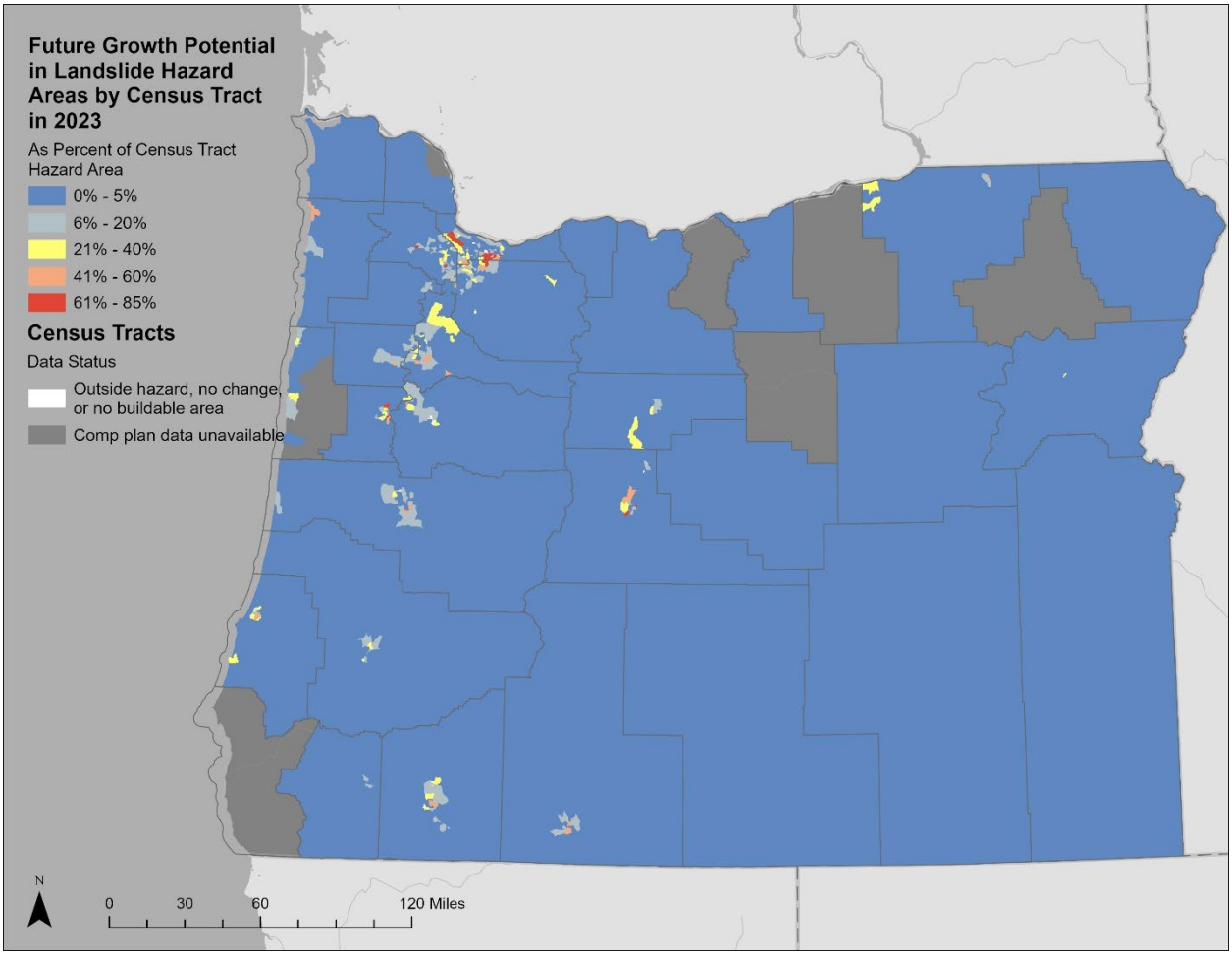
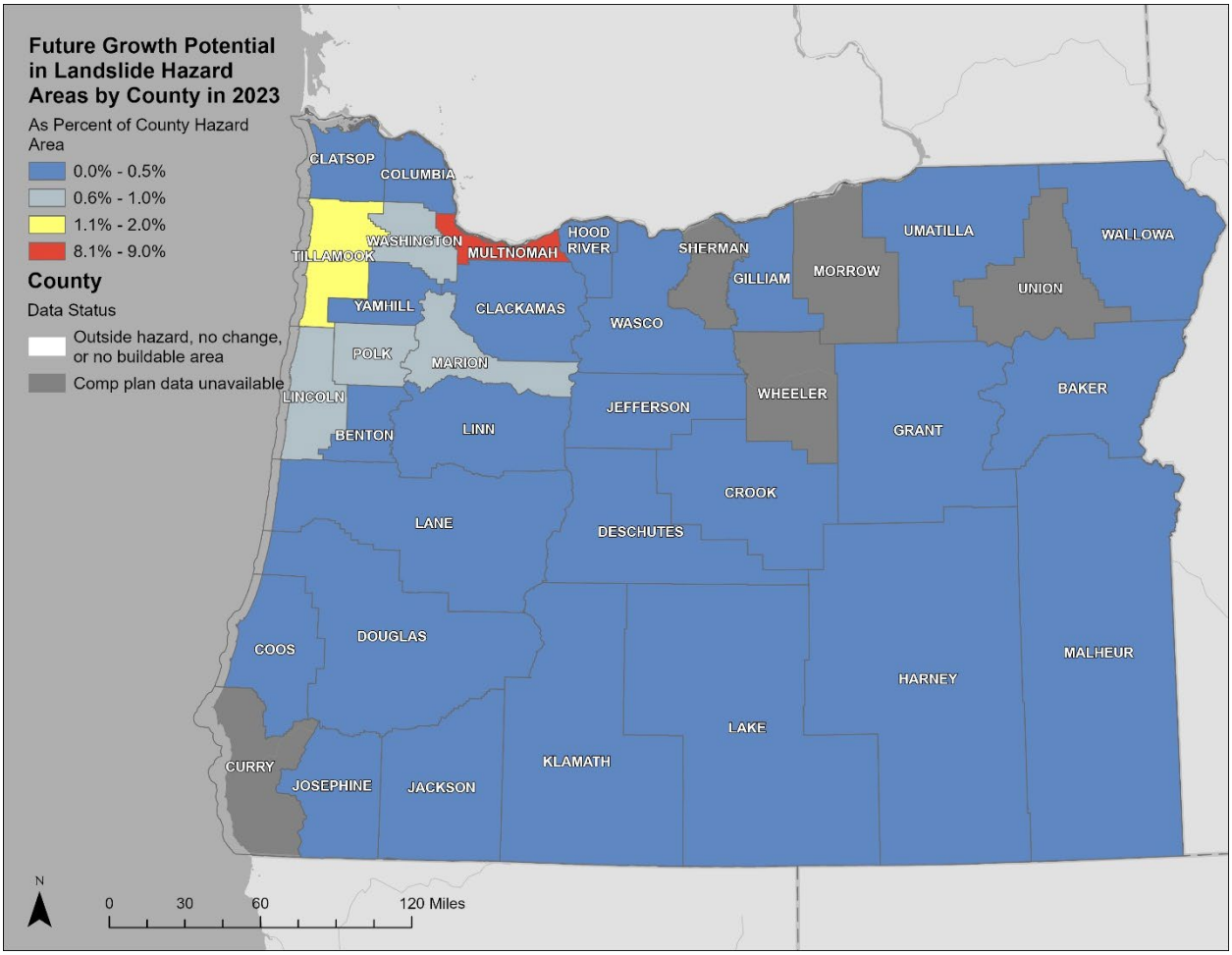


Figure 3.4.3-16: Future growth potential in landslide hazard areas by county



3.4.3.8 Tsunamis

For tsunamis, the hazard-prone areas are areas of exposure to any size (small through extra-extra-large) Cascadia subduction zone tsunami as determined from tsunami inundation data produced by DOGAMI.

For tsunami, past changes in development are a similar range to coastal flooding, 2-5 percent. Potential future changes in development for most coastal counties range from 0-4 percent, but in Tillamook County approximately 9 percent of the hazard zone is still developable.

Table 3.4.3-5: Tsunami changes in development summary table

County	Local Risk Assessment Rating (From Local NHMP)	Total Hazard Area in Acres	Percent of County Within Hazard Area	Percent Haz Area Changed from Perv. to Imperv. (Past Change)	Percent Hazard Zone Developable (Potential Future Change)
Clatsop	H	57,790	10 percent	5 percent	4 percent
Coos	H	85,038	8 percent	3 percent	2 percent

County	Local Risk Assessment Rating (From Local NHMP)	Total Hazard Area in Acres	Percent of County Within Hazard Area	Percent Haz Area Changed from Perv. to Imperv. (Past Change)	Percent Hazard Zone Developable (Potential Future Change)
Curry	H	56,870	5 percent	4 percent	0 percent
Douglas	M	29,606	1 percent	2 percent	1 percent
Lane	M	25,803	1 percent	2 percent	3 percent
Lincoln	H	48,105	7 percent	4 percent	3 percent
Tillamook	H	57,604	8 percent	3 percent	9 percent

Figure 3.4.3-17 and Figure 3.4.3-18 show the past changes in development within hazard areas at the coast that area affected by tsunami, or the percentage of the hazard area that changed from pervious to impervious between the 2019 and 2023 NLCD data. Figure 3.4.3-17 shows the change at the census tract level. Census tracts with the most change in impervious surface in tsunami areas are near Seaside and in areas along the south coast. Figure 3.4.3-18 shows change at a county level. Clatsop has the highest change in development in hazard zones followed by Lincoln, Coos, and Curry Counties.

Figure 3.4.3-17: Change in impervious surface in tsunami hazard areas by census tract

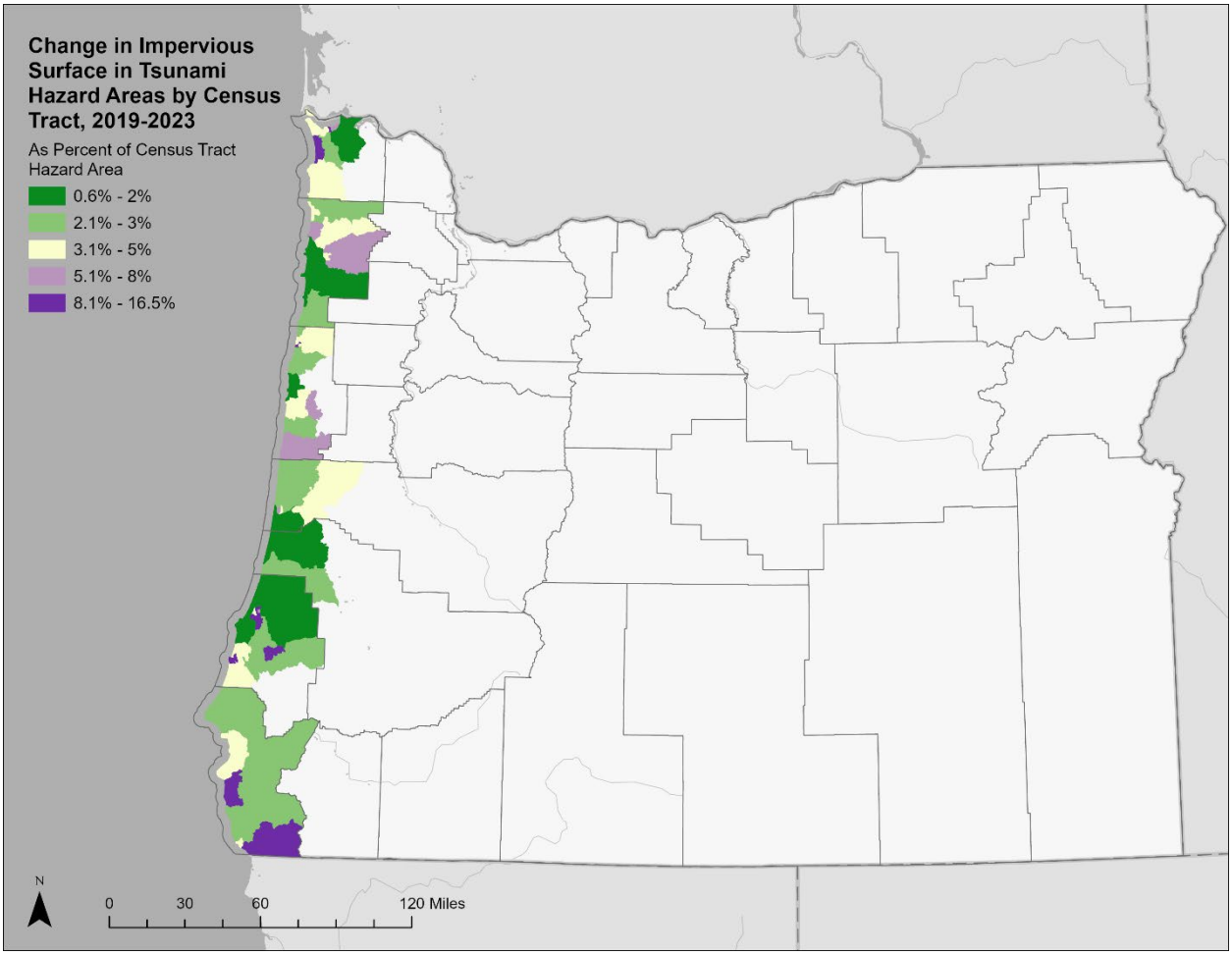


Figure 3.4.3-18: Change in impervious surface in tsunami hazard areas by county

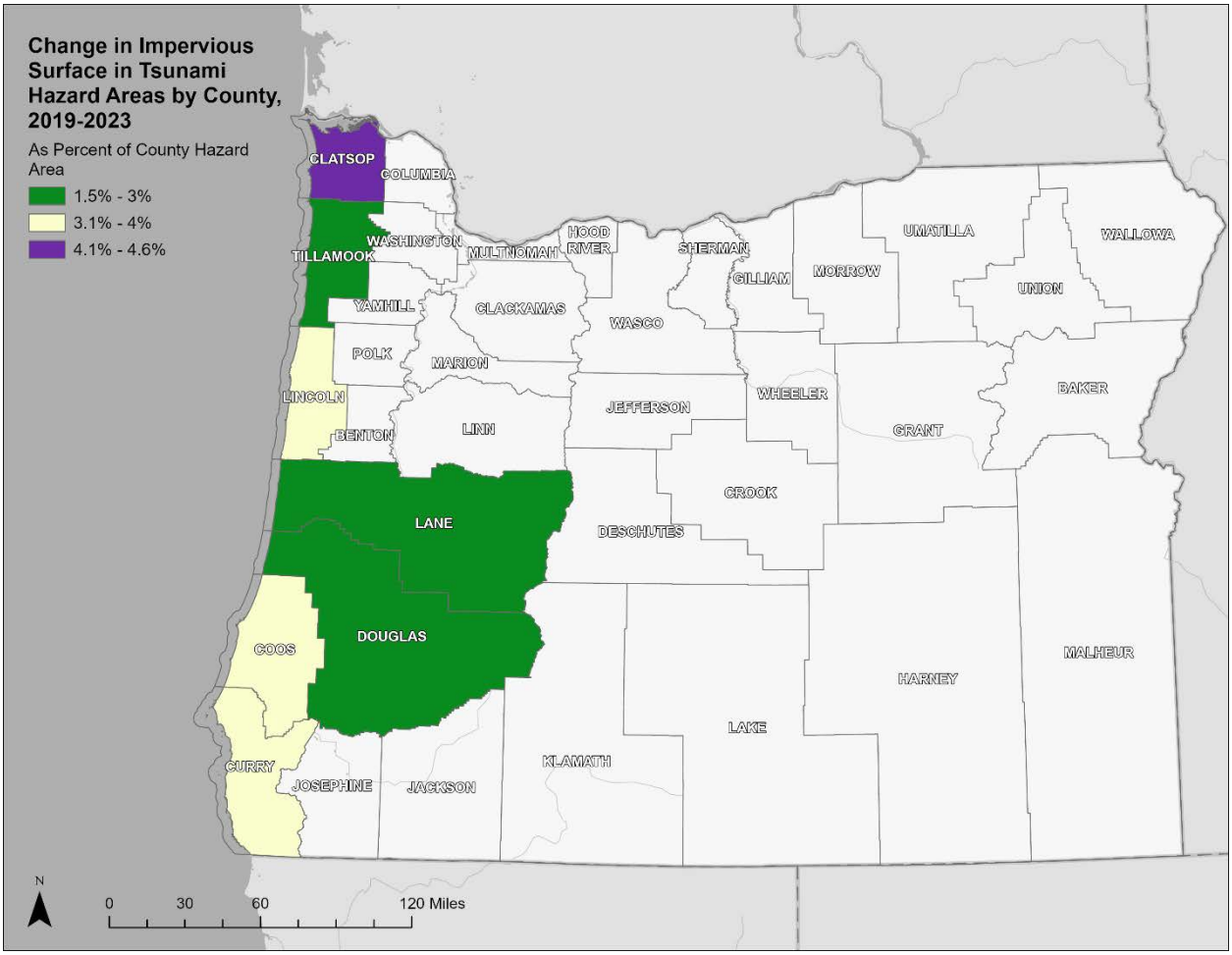


Figure 3.4.3-19 and Figure 3.4.3-20 show the potential future changes in development within hazard areas across the state, or the percentage of the hazard area located in medium- or high-density development designations that are not yet developed. Figure 3.4.3-19 shows the potential future change at the census tract level. Census tracts with the most percentage of developable land in tsunami areas are around Coos Bay. Figure 3.4.3-20 shows change at a county level. Tillamook County has the highest potential change in development in hazard zones followed by Clatsop and Lincoln Counties.

Figure 3.4.3-19: Future growth potential in tsunami hazard areas by census tract

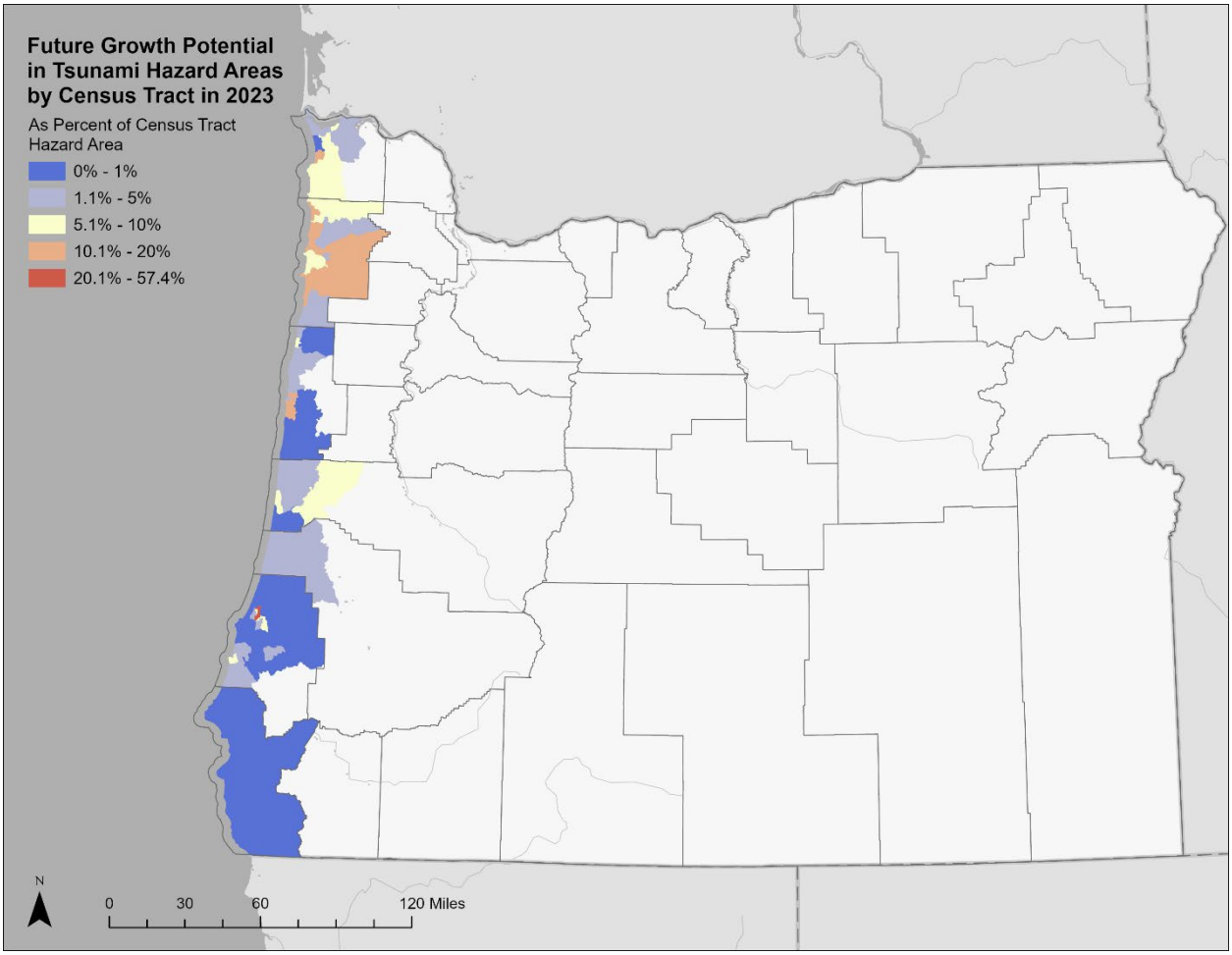
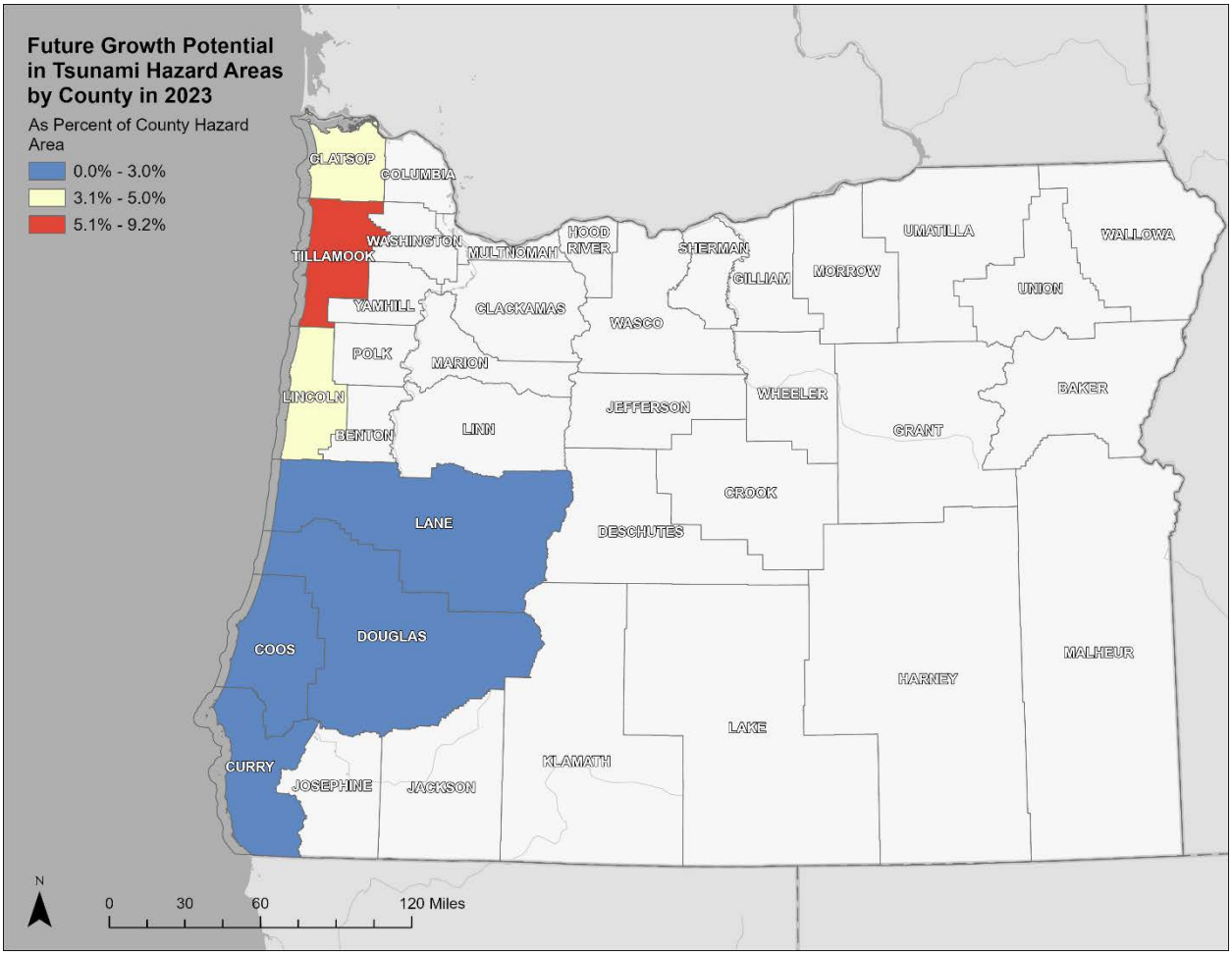


Figure 3.4.3-20: Future growth potential in tsunami hazard areas by county



3.4.3.9 Volcanoes

For volcanoes, the hazard-prone areas are lahar inundation zones from the US Geological Survey (Mt. Jefferson, Sister, and Crater Lake) and from the Oregon Department of Geology and Mineral Industries (Mt. Hood).

Past changes in development in areas at risk of volcano hazard generally range from 0-4 percent, except Multnomah County at 7 percent. Potential future change generally ranges from 0-2 percent except Marion County at 4 percent and Multnomah County at 8 percent.

Table 3.4.3-6: Volcano changes in development summary table

County	Local Risk Assessment Rating (From Local NHMP)	Total Hazard Area in Acres	Percent of County Within Hazard Area	Percent Haz Area Changed from Perv. to Imperv. (Past Change)	Percent Hazard Zone Developable (Potential Future Change)
Clackamas	L	54,065	4 percent	3 percent	2 percent

County	Local Risk Assessment Rating (From Local NHMP)	Total Hazard Area in Acres	Percent of County Within Hazard Area	Percent Haz Area Changed from Perv. to Imperv. (Past Change)	Percent Hazard Zone Developable (Potential Future Change)
Deschutes	H	298,629	15 percent	2 percent	0 percent
Hood River	L	86,055	26 percent	4 percent	0 percent
Jefferson	L	57,338	5 percent	1 percent	0 percent
Klamath	H	66,807	2 percent	0 percent	0 percent
Lake	H	27,278	1 percent	2 percent	0 percent
Lane	L	62,942	2 percent	3 percent	0 percent
Linn	M	39,742	3 percent	3 percent	1 percent
Marion	M	35,948	10 percent	3 percent	4 percent
Multnomah	L	11,029	4 percent	7 percent	8 percent
Wasco	H	7,607	0 percent	4 percent	0 percent

Figure 3.4.3-21 and Figure 3.4.3-22 show the past changes in development within hazard areas across the state, or the percentage of the hazard area that changed from pervious to impervious between the 2019 and 2023 NLCD data. Figure 3.4.3-21 shows the change at the census tract level. Census tracts with the most change in impervious in volcanic lahar zones are clustered in Deschutes County around Bend and La Pine. Figure 3.4.3-22 shows change at a county level. Multnomah County has the highest change in development in hazard zones followed by Wasco County.

Figure 3.4.3-21: Change in impervious surface in volcanic lahar hazard areas by census tract

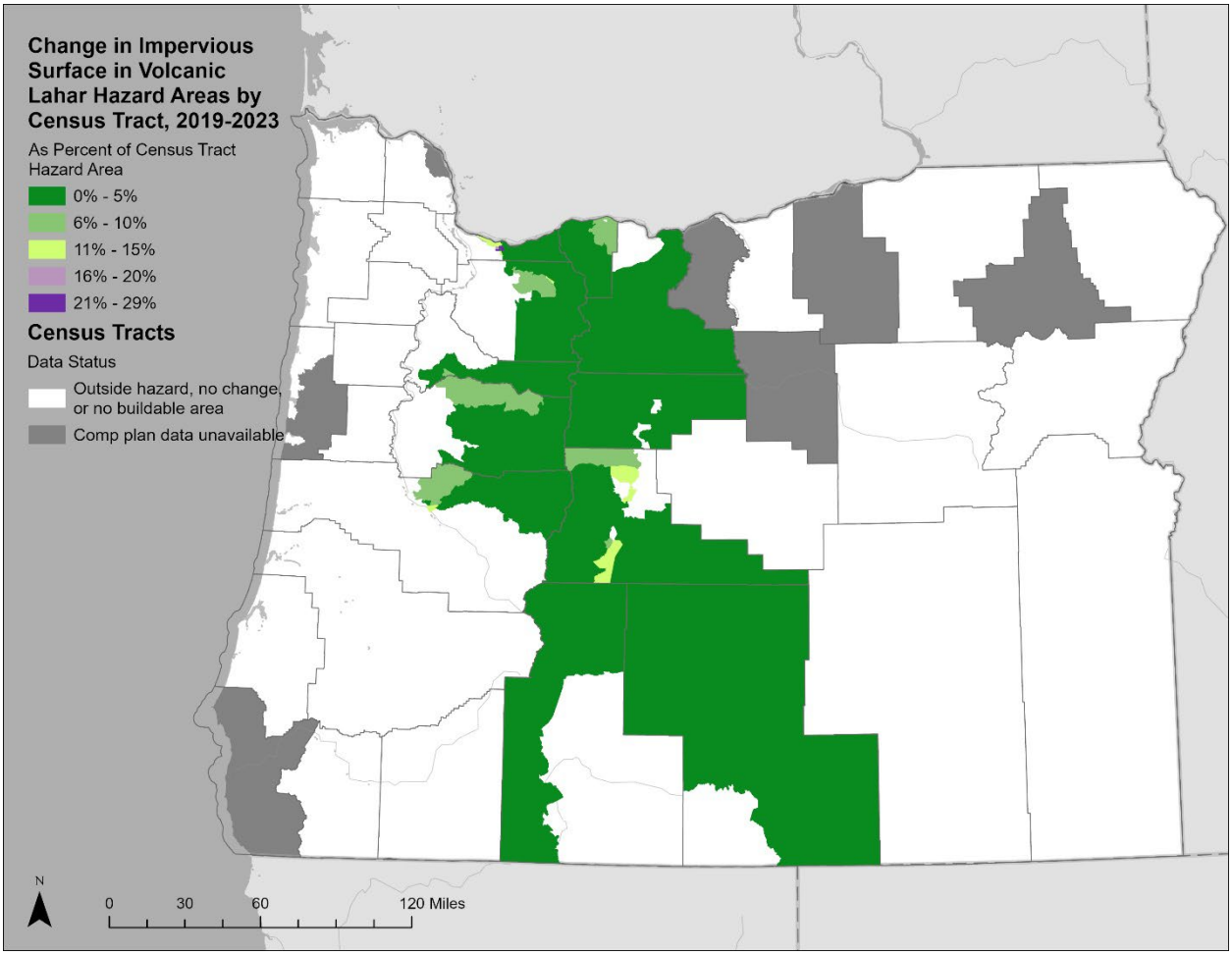


Figure 3.4.3-22: Change in impervious surface in volcanic lahar hazard areas by county

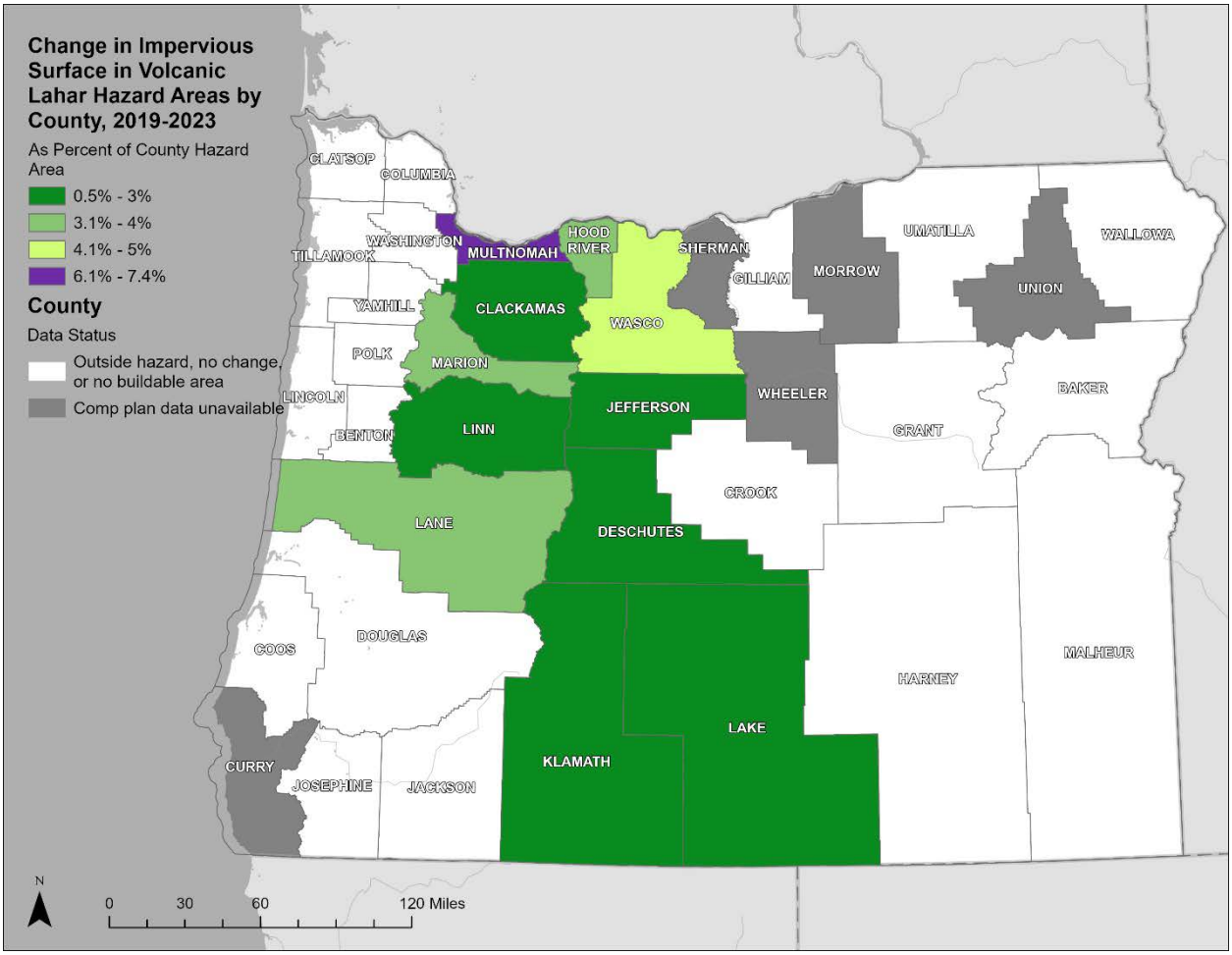


Figure 3.4.3-23 and Figure 3.4.3-24 show the potential future changes in development within hazard areas across the state, or the percentage of the hazard area located in medium- or high-density development designations that are not yet developed. Figure 3.4.3-23 shows the potential future change at the census tract level. Census tracts with the most percentage of developable land in volcano lahar zones are concentrated around Bend. Figure 3.4.3-24 shows change at a county level. Multnomah County has the highest potential change in development in hazard zones followed by Marion County.

Figure 3.4.3-23: Future growth potential in volcanic lahar hazard areas by census tract

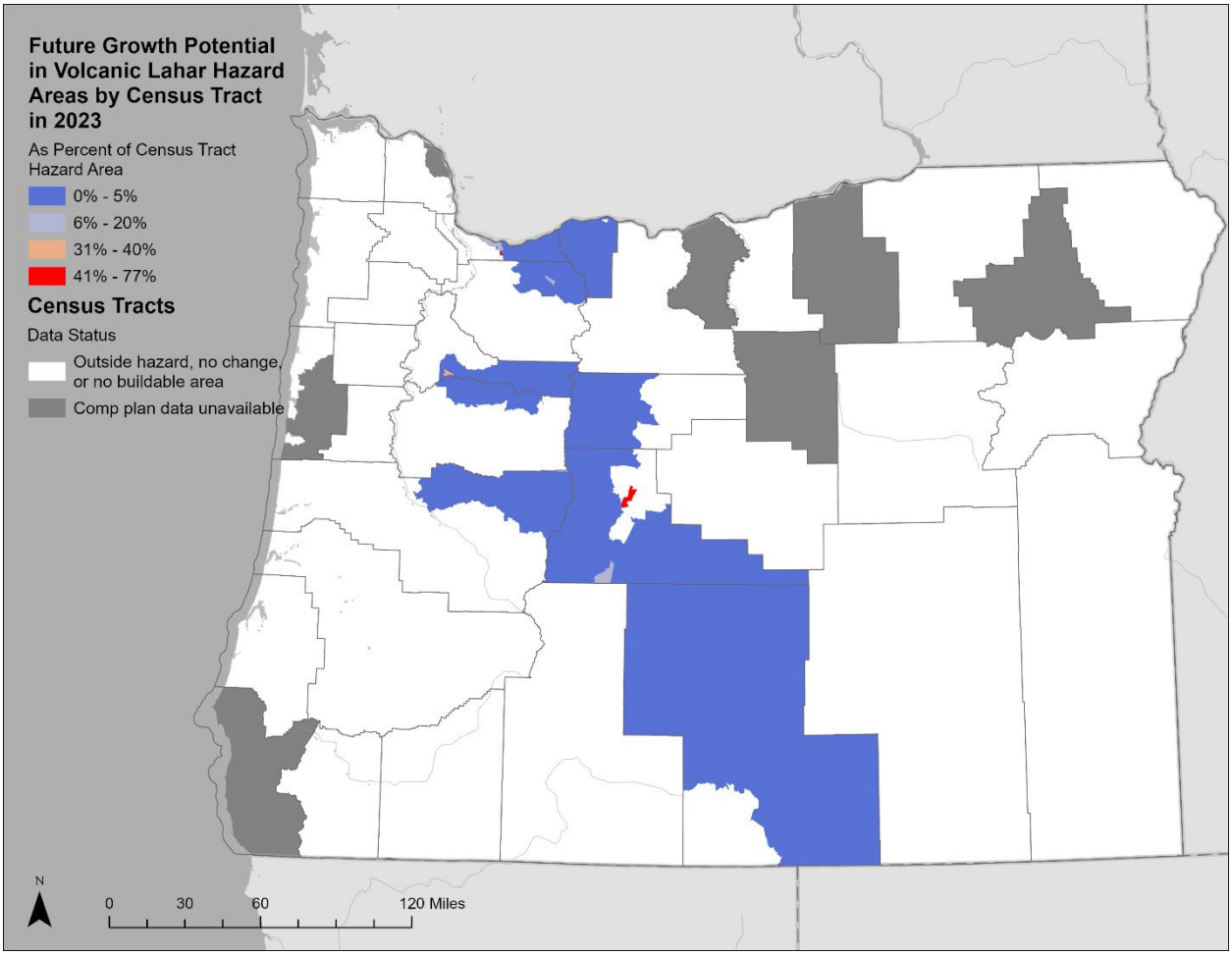
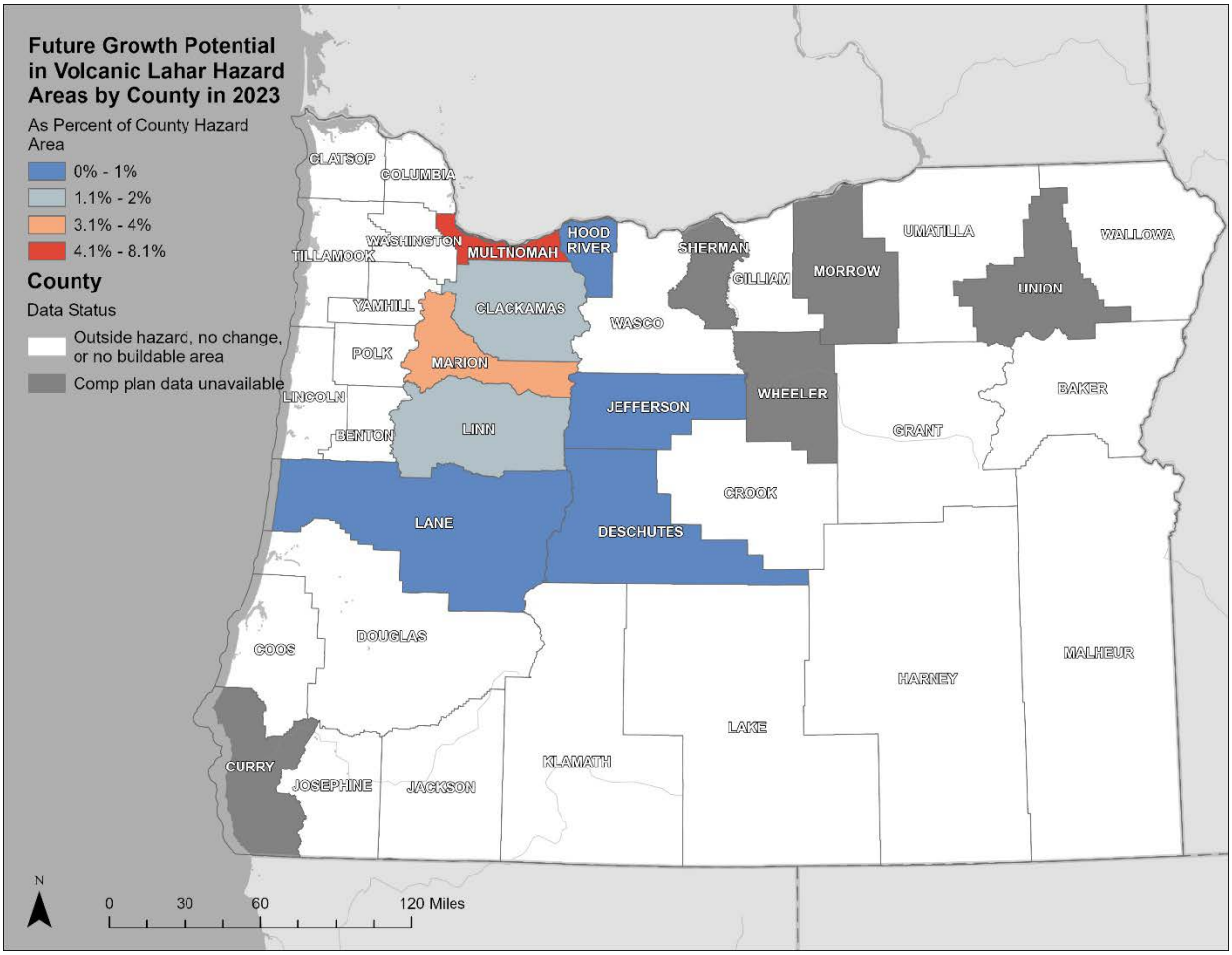


Figure 3.4.3-24: Future growth potential in volcanic lahar hazard areas by county



3.4.3.10 Wildfires

For wildfires, the hazard-prone areas are areas of moderate to high burn probability determined from Wildfire Burn Probability data produced by the Oregon Department of Forestry.

Changes in development for wildfire hazard areas are very low, likely because a large amount of hazard area is within forested areas. The past changes in development range from 0-3 percent, with Hood River having the highest at 3 percent. Potential future changes are very low. The majority of counties have 0 percent of the hazard zone as developable, except Jackson and Jefferson Counties where it is 1 percent, which could translate to a large amount of development and exposure within the much smaller wildland-urban interface.

Table 3.4.3-7: Wildfire changes in development summary table

County	Local Risk Assessment Rating (From Local NHMP)	Total Hazard Area in Acres	Percent of County Within Hazard Area	Percent Haz Area Changed from Perv. to Imperv. (Past Change)	Percent Hazard Zone Developable (Potential Future Change)
Baker	H	1,903,427	96 percent	1 percent	0 percent
Clackamas	M	540,946	45 percent	1 percent	0 percent
Coos	M	79,204	8 percent	1 percent	0 percent
Crook	M	1,426,293	75 percent	1 percent	0 percent
Curry	H	720,662	66 percent	1 percent	0 percent
Deschutes	H	1,210,062	62 percent	2 percent	0 percent
Douglas	H	1,787,965	55 percent	2 percent	0 percent
Gilliam	H	730,520	93 percent	1 percent	0 percent
Grant	H	2,884,905	100 percent	1 percent	0 percent
Harney		6,062,957	93 percent	0 percent	0 percent
Hood River	H	285,691	84 percent	3 percent	0 percent
Jackson	H	1,703,884	95 percent	2 percent	1 percent
Jefferson	H	1,044,310	91 percent	1 percent	1 percent
Josephine	H	1,002,886	95 percent	3 percent	0 percent
Klamath	H	2,240,187	57 percent	2 percent	0 percent
Lake	H	4,461,977	83 percent	1 percent	0 percent
Lane	H	1,169,179	39 percent	1 percent	0 percent
Linn	M	664,935	45 percent	1 percent	0 percent
Malheur	M	6,016,742	95 percent	0 percent	0 percent
Marion	H	135,751	17 percent	1 percent	0 percent
Morrow - North	L	1,060,889	81 percent	1 percent	0 percent
Morrow - South	H				
Multnomah	H	71,828	24 percent	1 percent	0 percent
Sherman	H	472,314	89 percent	1 percent	0 percent
Umatilla	H	1,613,893	78 percent	1 percent	0 percent
Union	M	1,156,237	89 percent	1 percent	0 percent

County	Local Risk Assessment Rating (From Local NHMP)	Total Hazard Area in Acres	Percent of County Within Hazard Area	Percent Haz Area Changed from Perv. to Imperv. (Past Change)	Percent Hazard Zone Developable (Potential Future Change)
Wallowa	H	1,918,723	95 percent	1 percent	0 percent
Wasco	H	1,505,782	98 percent	1 percent	0 percent
Wheeler	H	1,091,643	99 percent	1 percent	0 percent

Figure 3.4.3-25 and Figure 3.4.3-26 show the past changes in development within hazard areas across the state, or the percentage of the hazard area that changed from pervious to impervious between the 2019 and 2023 NLCD data. Figure 3.4.3-25 shows the change at the census tract level. Census tracts with the most change in impervious surface in wildfire zones are clustered around Bend, Mt. Hood and Hood River, Hermiston, and the Rogue Valley and Grants Pass. Figure 3.4.3-26 shows change at a county level. Hood River County has the highest change in development in hazard zones followed by Jackson and Josephine Counties.

Figure 3.4.3-25: Change in impervious surface in wildfire hazard areas by census tract

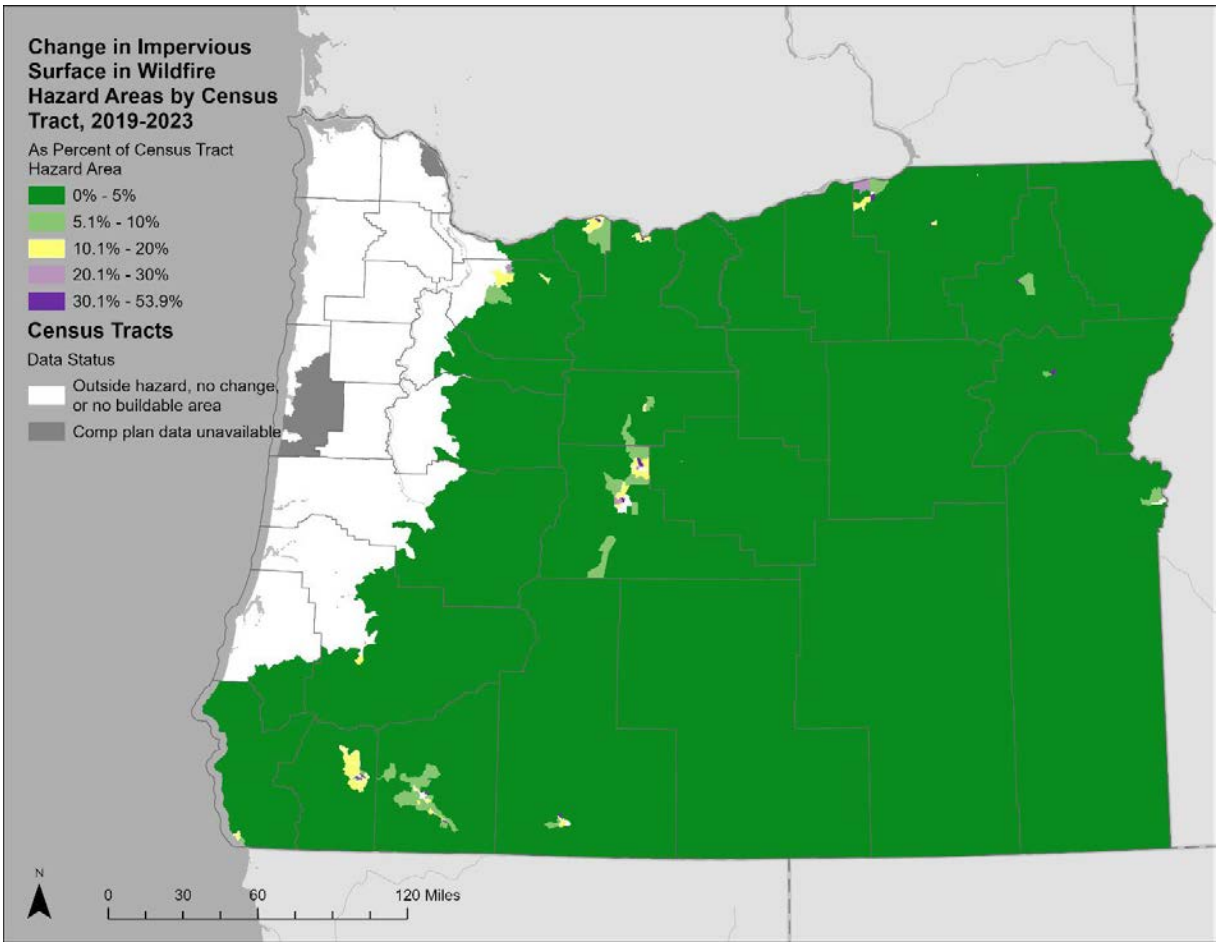


Figure 3.4.3-26: Change in impervious surface in wildfire hazard areas by county

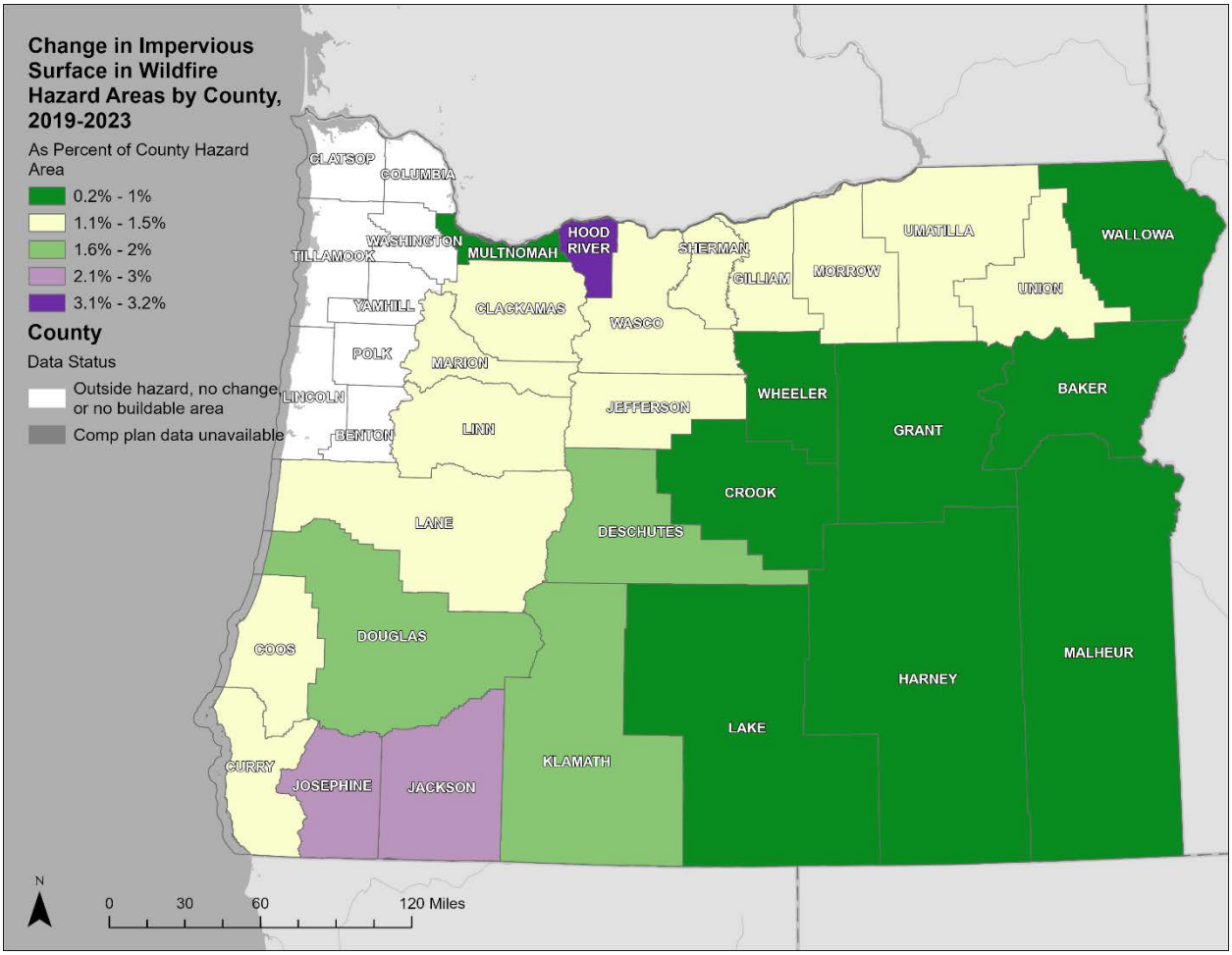


Figure 3.4.3-27and Figure 3.4.3-28 show the potential future changes in development within hazard areas across the state, or the percentage of the hazard area located in medium- or high-density development designations that are not yet developed. Figure 3.4.3-27 shows the potential future change at the census tract level. Census tracts with the most percentage of developable land in wildfire hazard areas are clustered around Bend and Madras, Roseburg, the Rogue Valley, and Klamath. Figure 3.4.3-28 shows change at a county level. Jefferson and Jackson Counties have the highest potential change in development in hazard zones followed by Deschutes County.

Figure 3.4.3-27: Future growth potential in wildfire areas by census tract

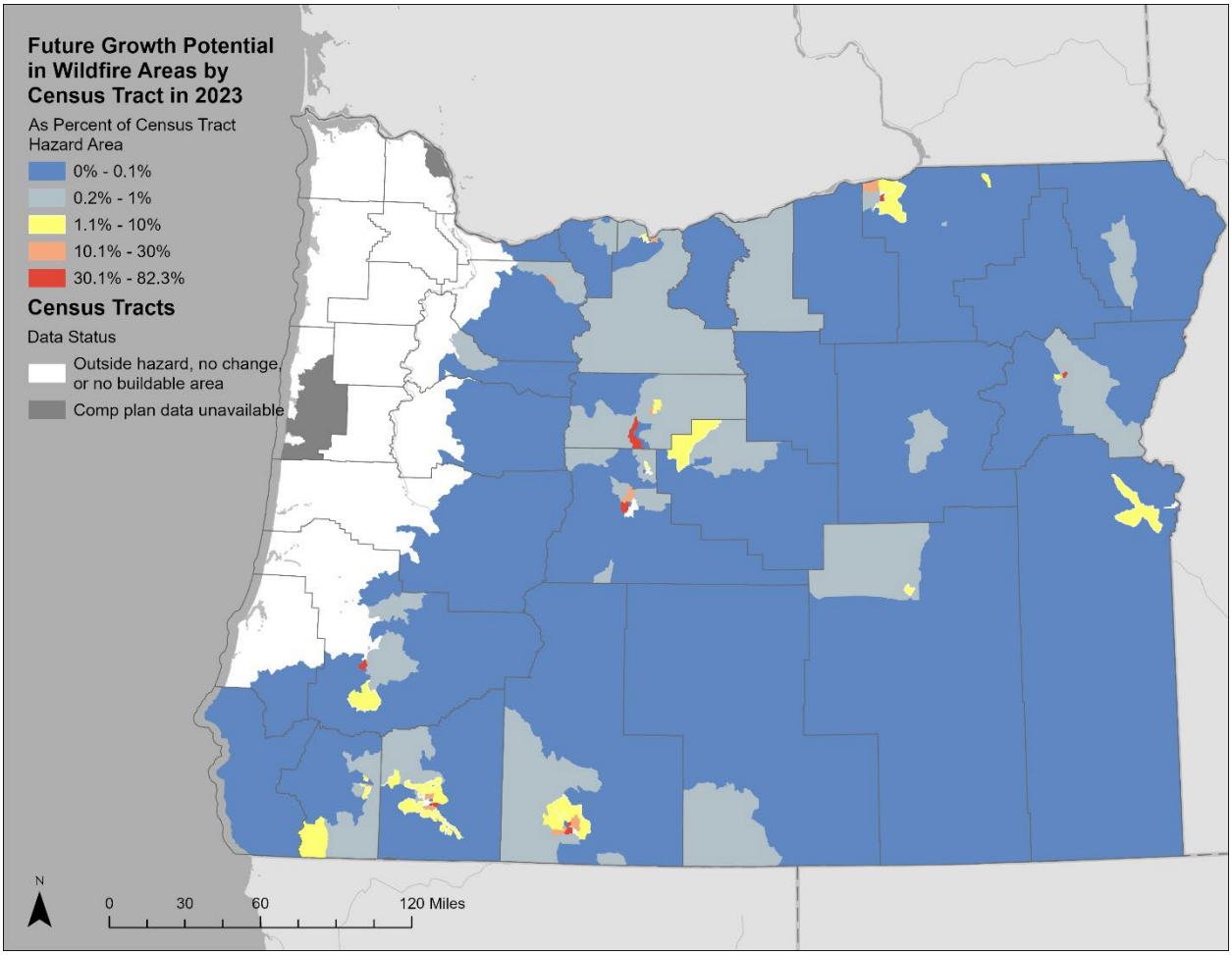
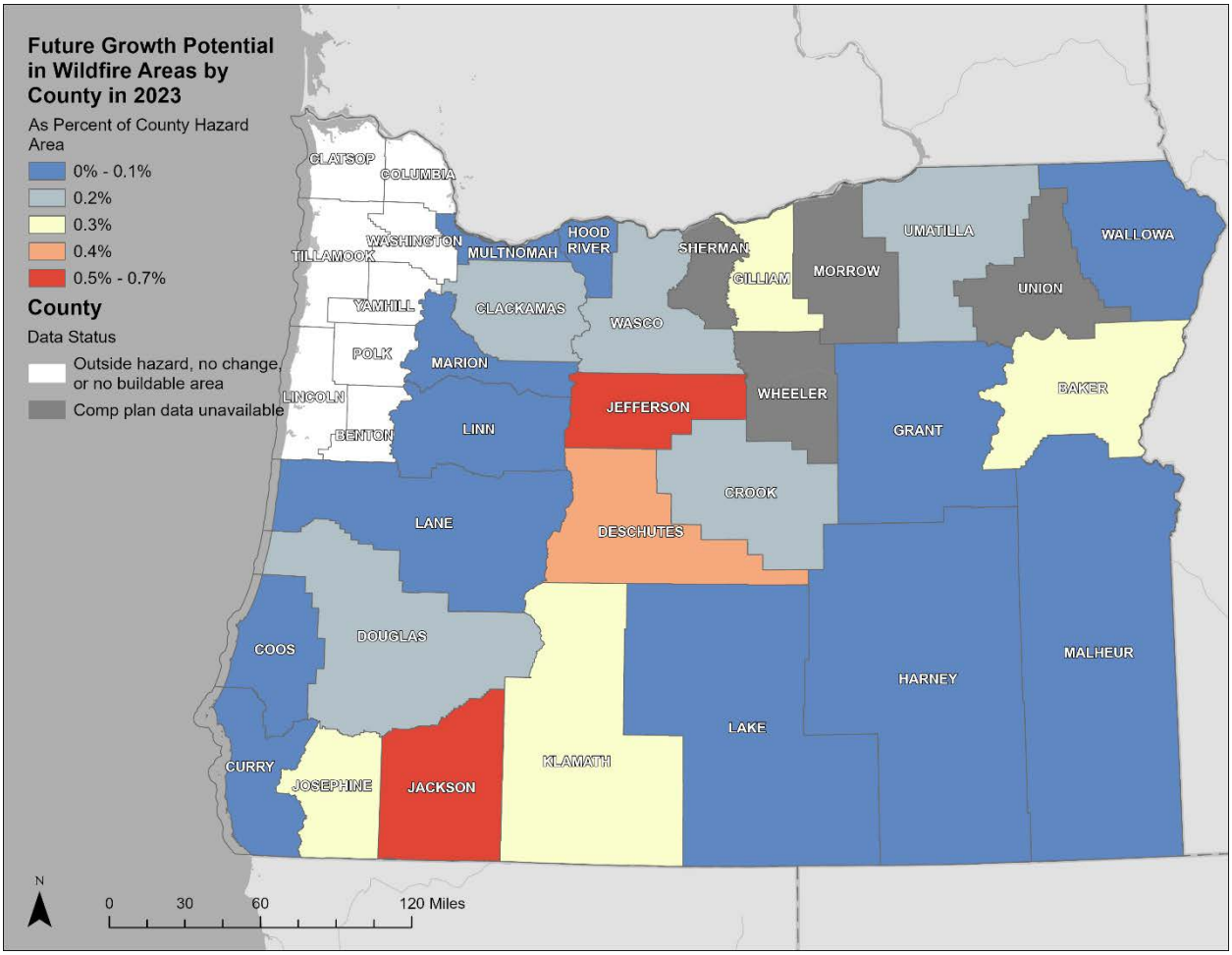


Figure 3.4.3-28: Future growth potential in wildfire areas by county



3.4.3.11 Windstorms

The changes in development analysis did not include areas at risk from windstorms because a windstorm hazard data set was not available.

3.4.3.12 Winter Storms

The changes in development analysis did not include areas at risk from winter storms because there is no comprehensive definition of winter storms that can be mapped.

3.4.4 Change in Population Demographics

In addition to physical changes in development, changes in population and population demographics can affect hazard vulnerability. Understanding whether population has increased or decreased in counties with certain vulnerabilities can help for understanding where to direct mitigation efforts. Understanding

increases and decreases in social vulnerability can similarly help in understanding where vulnerabilities to hazards will be amplified for socially vulnerable groups.

The Social Vulnerability Index (SVI) is a measure used by the Centers for Disease Control and Prevention to identify and quantify communities experiencing social vulnerability. Overall vulnerability is calculated using 16 U.S. Census Variables that identify communities that may need support before, during, and after disasters. The CDC groups these variables into four themes – socioeconomic status, household characteristics, racial and ethnic minority status, and housing type and transportation. The table below shows the change in SVI index scores from the 2016 social vulnerability index to 2022. Both the absolute index score and the change should be considered in understanding changes in vulnerability. The 2016 SVI used 15 variables, including income. The 2022 SVI did not include income. The 2022 SVI included new variables for health insurance and housing cost. Scores in the table are based on a statewide comparison and range from 0 to 1.

Table 3.4.4-1 shows the overall change in population and change in SVI for counties in Oregon

Table 3.4.4-1: Population and Social Vulnerability Index by County

County	2020 Population	2023 Population	Population Change (2020-2023)	2016 SVI Index Score	2022 SVI Index Score	Change in SVI (2022 -2016)
Baker	16,090	16,796	4.4 percent	0.60	0.23	-0.37
Benton	92,168	96,359	4.5 percent	0.17	0.37	0.20
Clackamas	415,084	422,308	1.7 percent	0.06	0.11	0.06
Clatsop	39,656	41,343	4.3 percent	0.20	0.26	0.06
Columbia	52,117	53,178	2.0 percent	0.09	0.00	-0.09
Coos	64,175	64,832	1.0 percent	0.77	0.63	-0.14
Crook	23,733	25,651	8.1 percent	0.46	0.09	-0.37
Curry	22,889	23,463	2.5 percent	0.31	0.31	0.00
Deschutes	191,749	203,026	5.9 percent	0.00	0.03	0.03
Douglas	110,015	111,807	1.6 percent	0.69	0.34	-0.34
Gilliam	1,896	2,002	5.6 percent	0.23	0.29	0.06
Grant	7,174	7,238	0.9 percent	0.29	0.43	0.14
Harney	7,310	7,515	2.8 percent	0.74	0.74	0.00
Hood River	23,270	23,958	3.0 percent	0.40	0.71	0.31
Jackson	218,781	222,563	1.7 percent	0.71	0.57	-0.14
Jefferson	24,048	24,973	3.8 percent	0.94	0.97	0.03
Josephine	87,097	88,069	1.1 percent	0.63	0.77	0.14
Klamath	67,606	69,812	3.3 percent	0.91	0.86	-0.06
Lake	7,896	8,254	4.5 percent	0.83	0.83	0.00
Lane	377,749	382,628	1.3 percent	0.54	0.66	0.11
Lincoln	49,336	50,632	2.6 percent	0.37	0.60	0.23
Linn	127,216	129,794	2.0 percent	0.57	0.49	-0.09
Malheur	30,632	31,701	3.5 percent	1.00	1.00	0.00
Marion	343,742	346,532	0.8 percent	0.89	0.94	0.06
Morrow	11,425	12,249	7.2 percent	0.80	0.80	0.00

County	2020 Population	2023 Population	Population Change (2020-2023)	2016 SVI Index Score	2022 SVI Index Score	Change in SVI (2022 -2016)
Multnomah	809,869	803,863	-0.7 percent	0.43	0.51	0.09
Polk	84,730	88,553	4.5 percent	0.34	0.46	0.11
Sherman	1,686	1,908	13.2 percent	0.03	0.14	0.11
Tillamook	26,782	27,471	2.6 percent	0.49	0.40	-0.09
Umatilla	77,319	80,087	3.6 percent	0.97	0.91	-0.06
Union	26,502	26,192	-1.2 percent	0.51	0.54	0.03
Wallowa	7,065	7,532	6.6 percent	0.11	0.17	0.06
Wasco	26,274	26,603	1.3 percent	0.86	0.89	0.03
Washington	595,761	600,266	0.8 percent	0.14	0.20	0.06
Wheeler	1,417	1,434	1.2 percent	0.26	0.06	-0.20
Yamhill	106,087	108,122	1.9 percent	0.66	0.69	0.03

Source: U.S. Census Bureau American Community Survey 5- Year Estimates; Centers for Disease Control and Prevention (CDC) Social Vulnerability Index

Malheur County has the highest 2022 SVI score (1.0) and has had no change in SVI score between 2016 and 2022. Jefferson County (0.97) and Marion County (0.94) are the next highest. Both had an increase in SVI score from 2016 to 2022. Columbia County has the lowest SVI score of 0, which was a -0.9 change from 2016. Columbia is followed by Deschutes (0.03), Crook (0.09), and Wheeler (0.06) Counties. Deschutes had a slight increase between 2016 and 2022 while Crook and Wheeler had significant decreases.

The county with the highest increase in SVI between 2016 and 2022 is Hood River County (0.31 increase), followed by Lincoln County (0.23 increase) and Benton County (0.20 increase). The counties with the greatest decrease in SVI scores are Baker and Crook Counties (both 0.37 decrease) followed by Wheeler County (0.20 decrease).

Counties with a high social vulnerability index and high growth rate may have higher risk and need more hazard mitigation. The counties with SVI over 0.8 with over 3 percent in population growth are shown in Table 3.4.4-2.

Table 3.4.4-2: High SVI counties with high population growth (over 3 percent population growth in counties with over 0.8 SVI score)

County	2022 SVI Index Score	Population Growth 2020-2023
Malheur	1.00	3.5 percent
Jefferson	0.97	3.8 percent
Umatilla	0.91	3.6 percent
Klamath	0.86	3.3 percent
Lake	0.83	4.5 percent
Morrow	0.80	7.2 percent

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Chapter 4 Statewide Mitigation Capability Assessment

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4.1 Overview

Assessing Oregon capability for mitigation is important for developing an effective mitigation strategy.

This chapter assesses the financial, legislative, and programmatic capabilities of the State of Oregon to carry out mitigation actions both pre-disaster and post-disaster. This assessment also highlights the changes to the mitigation capabilities since the 2020 Oregon Natural Hazard Mitigation Plan.

4.2 State Capability Changes Since 2020

4.2.1 Expansion and restructuring of the Oregon Department of Emergency Management (OEM):

In 2022, the Office of Emergency Management, previously housed within the Oregon Military Department, became a stand-alone cabinet-level department whose director reports to the governor. This change prioritizes emergency management on the state level, and strengthens coordination and response between local, tribal, state and federal governments. The legislature increased OEM's budget allowing for new hires.

The governor hired a new agency director who hired a new deputy director. OEM has hired significantly, and its new director has restructured the department to better support jurisdictions before, during, and after disasters.

4.2.2 Changes in the National Flood Insurance Program (NFIP) in Oregon:

The Oregon Department of Land Conservation and Development (DLCD) hired a new state NFIP Coordinator in 2022, as well as a natural hazards planner focused on flood mitigation and NFIP work. FEMA funds both positions with 75% federal, 25% state split.

The total number of NFIP policies in Oregon decreased by 1.1% between 2023 and 2024.

In 2024, FEMA abruptly announced mandatory pre-implementation compliance measures for Oregon NFIP cities and counties within the six Salmon and Steelhead Recovery Domains (implementation plan area) in response to a biological opinion from the National Marine Fisheries Service. This is one of Oregon's hottest topics currently and the state will continue to support NFIP communities.

4.2.3 New Natural Hazard Mitigation and Resilience Programs, Plans, and Funding:

4.2.3.1 Environmental Justice Council

In 2022, the Oregon Legislature passed House Bill 4077, which renamed and codified the Environmental Justice Task Force as the Environmental Justice Council (EJC). The bill directs the council to develop an environmental justice mapping tool, and to conduct inclusive community engagement that will inform the tool. The purpose of this mapping tool is to provide geospatial information about environmental justice impacts and to develop guidance for state agencies when adopting rules and policies.

4.2.3.2 Climate-Friendly and Equitable Communities

The Land Conservation and Development Commission launched the Climate-Friendly and Equitable Communities rulemaking in 2020 and directed DLCD to draft changes to Oregon's planning system for communities in Oregon's eight most populated areas (regions with populations over 50,000). The goal of this program is to reduce climate pollution, provide more options for transportation and housing, and promote more equitable land use planning. DLCD assists local governments in implementing the program through direct staff-to-staff assistance, and funding for consulting assistance.

4.2.3.3 Community Green Infrastructure Grant Program

In 2023, the Oregon Legislature created the Community Green Infrastructure Grant Program and appropriated $6.5 million to DLCD for the program. The program funds green infrastructure projects across the state that provide social and environmental benefits to local communities. Green infrastructure is meant to mimic natural systems, such as urban green space and parks, trees, rain gardens, and bioswales, among others. It offers a wide array of social, environmental, and economic benefits.

4.2.3.4 Urban and Community Forestry

In 2023, the Oregon Department of Forestry's Urban and Community Forestry (UCF) Program received two domestic grants ($26.6 million, in total) from the U.S. Forest Service to develop and implement two subaward programs. These programs fund urban, rural community, and Tribal forestry projects across the state for social, environmental, and resiliency benefits. The Urban and Community Forestry Program has six priority areas: 1) supporting forestry assessment and planning; 2) supporting culturally responsive forestry education and community-building initiatives; 3) enhancing the urban and community forestry network; 4) expanding urban forestry workforce and career development; 5) expanding tree production, planting, and maintenance; and 6) supporting monitoring, adaptive management, and lesson sharing. These priorities promote resilience in urban and wildland-urban interface areas where communities stand to gain significant benefits from trees and forests.

4.2.3.5 Oregon Natural Hazards Risk Assessment Upgrade

DLCD and OEM are upgrading the Oregon Natural Hazards Risk Assessment. The risk assessment provides the factual foundation for establishing mitigation goals and identifying and making strategic investments needed to reduce risks to people, property, and the natural environment from natural hazard events throughout the state. The assessment is designed to be useful for tribes, cities, counties, special districts, and others for natural hazards mitigation planning.

4.2.3.6 Future Climate Projections for Oregon Counties

The Oregon Climate Change Research Institute (OCCRI) continues to support DLCD and the Oregon Partnership for Disaster Resilience by developing county-level future projection reports, which provide climate change information for local natural hazard mitigation plans (NHMP). As of 2024, OCCRI has developed reports for 27 counties.

4.2.3.7 Resilience Hubs and Networks Grant

In 2023, the Oregon Legislature passed House Bill 3409 Section 86, which appropriated $10 million to the Oregon Department of Human Services (ODHS) Office of Resilience and Emergency Management (OREM) for Resilience Hubs and Networks Grants. The program builds resilience within communities by supporting the development of resilience hubs and resilience networks. During the first round of grant funding, over 700 organizations applied, and 87 organizations received grants.

4.2.4 Enhanced Wildfire Capabilities

4.2.4.1 Wildfire Legislation

In 2021, the Oregon Legislature passed Senate Bill 762 (SB 762), Oregon's first comprehensive wildfire preparedness and resilience bill. This legislation created programs and amended statutes to mitigate the catastrophic impacts of wildfire on lives and property through the three key strategies of the National Cohesive Wildland Fire Management Strategy:

- Creating fire-adapted communities.
- Developing safe and effective responses.
- Increasing the resiliency of Oregon's landscapes.

SB 762 built on recommendations from the Oregon Governor's Council on Wildfire Response.

Since 2021, the legislature passed bills that expand Wildfire Programs, including SB 80 (2023), SB 82 (2023), and House Bill (HB) 4016 (2024). In addition, SB 644 (2023) addresses wildfire mitigation as it relates to accessory dwelling units in areas zoned for rural residential use. During the 2025 legislative session, several bills proposing changes to implementing statutes are currently being considered.

4.2.4.2 The Wildfire Programs Advisory Council

SB 762 created the Wildfire Programs Advisory Council, comprised of 19 members who represent a diverse range of Oregon's geographies and sectors related to wildfire. The Council reviews and recommends policies and programs that help the state prevent wildfire, respond to wildfire, and create more fire resilient communities and landscapes.

4.2.4.3 Community Wildfire Risk Reduction Initiatives

The Oregon State Fire Marshal (OSFM) has been funding response and preparedness programs through one-time funding provided by SB 762. OSFM also supports several wildfire initiatives to prepare and protect people from wildfire:

Fire Adapted Oregon: Supports local coordination, funding, education, and training improve community resiliency to wildfire.

Oregon Defensible Space Program: Offers education, outreach, financial assistance, technical assistance, and free defensible space assessments.

4.2.4.4 20-year Landscape Resiliency Strategy

ODF developed a 20-year strategy to improve forests and rangelands to reduce wildfire risk through prioritized investments in landscape resilience and community risk reduction. ODF developed the plan with private, local, state, and federal partners to target about 13 million high-risk acres. For the 2021-2023 biennium, ODF awarded $19.7 million in landscape resiliency grants, and these investments resulted in $15.8 million of match, and ultimately led to the treatment of 211,915 acres. The legislature appropriated $10 million for the for the 2023-2025 biennium.

4.2.4.5 Small Forestland Grant Program

SB 762 directed ODF to establish a grant program to support small forestland owners in reducing wildfire risk by restoring landscape resiliency and reducing hazardous fuels on their property. For the 2021-2023 biennium, ODF awarded $4.8 million that reached over 6,000 private landowners, leveraged $3 million in match, and treated 3,887 acres. $800,000 of the total awards went to 20 Firewise communities. The legislature appropriated $2.5 million for the 2023-2025 biennium.

4.2.5 Additional initiatives and policies

4.2.5.1 Oregon Design Criteria Hub

The Oregon Design Criteria Hub is an interactive mapping tool that provides site-specific climatic and geographic design criteria for construction projects governed by the Oregon Residential Specialty Code. This includes wildfire hazard mitigation standards in section R327, ground snow load, basic design wind speed, Seismic Design Category, weathering potential, frost line depth, decay potential, and air freezing index.

4.2.5.2 Oregon Building Codes Division Fire Hardening Grant Program

This program helps people affected by wildfires rebuild to a more resilient standard. It provides more than $6,000 to home and business owners who complete qualifying fire hardening improvements on their home or business that was damaged or destroyed in a wildfire since 2020. Senate Bill 5506 (2023) expanded an existing program to include people affected by the 2021 wildfires, and appropriate $6 million for implementation. From 2021-2023, the Building Codes Division collaborated with counties to distribute grants to 621 properties, averaging about $4,100. The program continued into 2024.

4.2.5.3 Electric Utilities

The Public Utilities Commission (PUC) administers Oregon's electric utility wildfire safety and mitigation, which requires investor-owned utilities (PacifiCorp, Portland General Electric, and Idaho Power) to create, and operate in compliance with a PUC-approved wildfire protection plan. Consumer-owned utilities (rural electric cooperatives, people's utility districts, and municipal electric utilities) are required to create, and operate in compliance with, a governing body-approved wildfire mitigation plan.

4.3 Programs, Organizations, & Cooperation

Oregon has a successful track record of implementing and maintaining programs and organizations that support and advance statewide natural hazard mitigation efforts. These programmatic and organizational capabilities aim to protect property and infrastructure, save lives, enhance community resilience, and alleviate the economic burden of hazards. It is through these programs and organizations that the State can effectively contribute to advancing mitigation and enhancing statewide risk reduction and resilience.

The 2025 State NHMP Capabilities Assessment identified 35 mitigation programs and 16 mitigation organizations that support and advance natural hazards planning and mitigation efforts and evaluated their ability to advance and enhance natural hazards mitigation efforts.

Table 4.3.-1 shows the number of mitigation program and organization capabilities made available to communities either before or after a disaster, or in both instances.

Table 4.3-1 Pre- and Post-Disaster Mitigation Programs and Capabilities

	Pre-disaster	Post-Disaster	Both	Type Total
Programs	13	2	20	**35**
Organizations	3	1	13	**16**

Table 4.3-2 shows the number of mitigation programmatic and organizational capabilities administered by a state, federal, joint state and federal, or private entity.

Table 4.3-2 State, Federal, Joint, or Private Mitigation Programs and Capabilities

	State	Federal	Joint	Private	Type Total
Programs	13	4	17	6	**35**
Organizations	8	1	7	4	**16**

Programs include:

- ODF Community Wildfire Protection Plans (Federal, State, and Private);
- OWRD Dam Safety Program (Federal, State, and Private);
- ODF Firewise (Federal, State, and Private);
- OPDR Mitigation Planning Program (Federal, State, and Private).

Organizations include:

- CRESCENT Cascadia Region Earthquake Science Center (Federal, State, and Private);
- DOGAMI Oregon Board of Geologist Examiners (State and Private);

- ODOE Oregon Climate Action Commission (State and Private);
- DOGAMI Oregon Lidar Consortium (Federal, State, and Private).

4.3.1 Highlighted Mitigation Programs

This section highlights some of the evaluated mitigation programs used in Oregon. The evaluations provide a description of the program and how it contributes to mitigation efforts. Also, some evaluations describe challenges and pose potential solutions.

4.3.1.1 Coastal Hazard Mitigation Program

Program Manager: Oregon Department of Geology and Mineral Industries (DOGAMI)

Description: DOGAMI's enabling statute gives the agency broad responsibility and authority for evaluating all geologic hazards statewide, including coastal hazards (i.e., coastal erosion, flooding, and dune sand influx). The agency, in partnership with other state and federal agencies, has undertaken a wide range of programs in Oregon to identify coastal change, including coastal change monitoring at multiple sites on the Oregon coast, development of coastal flood and erosion maps, monitoring of dynamic revetment cobble beaches, and assessment of the impact of storms. FEMA CTP grants provide funding for coastal flood modeling. Additionally, the coastal program performs outreach to coastal communities.

Advances Mitigation: This program effectively advances mitigation efforts by conducting an array of research projects on coastal hazards, as well as publishing numerous maps and reports of its findings. The coastal monitoring program DOGAMI established on the northern Oregon coast in Tillamook County in 2004 has been very successful and expanded to include other counties in the region. The datasets DOGAMI collected from these sites were integral in updating the FEMA coastal flood maps for the Oregon coast between 2010 and 2015. Additionally, DOGAMI has produced coastal erosion maps for Lincoln, Tillamook and Clatsop Counties (and Gold Beach/Nesika Beach). The coastal communities actively use these maps.

Hinders Mitigation: The program relies on federal funding and support (NOAA IOOS and CSC), which can be unreliable and inconsistent. Additionally, apart from core observation sites, many coastal areas have not been observed for coastal monitoring for many years**.**

Potential Solutions: DOGAMI will explore opportunities to expand program capacity to observe and document changes on coastal bluffs that have not been observed in recent years.

4.3.1.2 Community Green Infrastructure Grant Program

Program Manager: Oregon Department of Land Conservation and Development (DLCD)

Description: Established by the Oregon Legislature in 2023 with HB 3409 with an allocated budget of $6.5 million, the program provides funding to communities throughout the state to implement green infrastructure projects. Projects must be developed in collaboration with the community, and must

provide social, environmental, or economic benefits to an environmental justice community (as defined in ORS 182.535). The program also funds native plant nurseries or seed banks and green infrastructure master plans.

Advances Mitigation: Green infrastructure can help mitigate extreme heat, reduce flooding by intercepting and slowing stormwater flow, prevent erosion, and stabilize slopes. Oregon is committed to advancing mitigation efforts through support of this program. Furthermore, Program focuses on providing benefits to members of environmental justice communities, thereby helping enhance equity in mitigation efforts.

Hinders Mitigation: Limited funding constrains the overall program effectiveness.

Potential Solutions: Time will demonstrate the benefits of the green infrastructure projects funded by this program.

4.3.1.3 Dam Safety Program

Program Manager: Oregon Water Resources Department (OWRD)

Description: The Oregon Water Resources Department (OWRD) is the state authority for dam safety and operates under specific state statutory authorities and regulations. As of June 2024, there were 938 state-regulated dams and another 252 federally regulated dams that met Oregon statutory dam safety criteria (at least ten feet high and storing at least three million gallons).

Advances Mitigation: Due to statutory updates in 2019, the new staff are working to address a backlog of dams that are vulnerable to extreme floods, earthquakes and internal erosion.

Hinders Mitigation: Despite efforts to address the backlog of vulnerable dams, it will still take decades for all dam safety concerns to be addressed with the existing resources and community support. In general, dam safety programs for large federal dams have significantly more dam safety staffing while state dam safety staffing is limited.

Potential Solutions: Additional staffing would enable the program to address the backlog of vulnerable dams sooner, as well as provide more technical assistance to dam owners throughout the state. However, hiring new staff will likely require legislative action as well as the allocation of additional funds. Consequently, the Dam Safety Program plans to collaborate with the OWRD management team to explore options for developing a dedicated funding source for dam safety rehabilitation work.

4.3.1.4 Earthquake Hazard Mitigation Program

Program Manager: Oregon Department of Geology and Mineral Industries (DOGAMI)

Description: DOGAMI's enabling statute gives the agency broad responsibility and authority for evaluating all geologic hazards statewide, including earthquake hazards.

Advances Mitigation: DOGAMI has published numerous maps and reports on the earthquake hazards of the state which have helped provide data and research to support and advance mitigation efforts. The agency, in partnership with other state and federal agencies, has also undertaken a wide-ranging

program in Oregon to identify seismic hazards, including active fault characterization, rapid visual screening for earthquake vulnerability of schools throughout the state, as well as earthquake impact estimates, bedrock and soil shaking studies based on material properties, tsunami inundation zone, estimates for co-seismic hazards such as liquefaction, landslides, and permanent ground deformation.

The program also developed the Oregon Seismic Hazard Database in 2021, which is the first comprehensive collection of seismic hazard data for Oregon and provides the most up-to-date information on Oregon's seismic risks and hazards. Both local and state government staff have used this resource to assess earthquake risks and determine the appropriate mitigation measures.

Hinders Mitigation: Even though DOGAMI has developed new data and advanced research on seismic hazards since the last plan update, the program is still working with older datasets, such as the USGS Active Fault database (Q-faults). The Q-faults database has not been regularly updated since before 2017, and includes numerous discontinuous faults, particularly in Eastern Oregon, so that the probabilistic national seismic hazard maps underestimate the hazard.

Potential Solution: The challenges could be addressed by applying for funding to update the QRC-Faults database. This would include developing and maintaining a new active fault database (ORQ-Faults) to ensure that the data accessed through the HazVu system is not out of date. The program would start the update immediately if funding were awarded.

Hinders Mitigation: There is currently no Clearinghouse Plan in place at the state-level to coordinate the scientific mobilization in response to a Cascadia or significant crustal earthquake. A Clearinghouse Plan includes details to guide coordinating data collection efforts, including a platform (e.g. Esri FieldMaps, Survey123), and criteria for data processing and review before publication, release, or inclusion in the clearinghouse databases.

Potential Solution: DOGAMI will look for funding that can be used to draft a clearinghouse plan to coordinate scientific mobilization in response to a Cascadia or significant crustal earthquake. DOGAMI, along with other state agencies and partners, plans to coordinate the development of a post-disaster scientific and technical clearinghouse by working with the emergency coordination center that is established immediately after the earthquake, flood, tsunami, or other disaster.

Hinders Mitigation: There is limited staffing to address all the main components of the program.

Potential Solution: This program would benefit from having three dedicated positions to address three main components of the program: 1. Earthquake Geology - Addressing active fault and co-seismic hazard characterization through mapping and paleoseismic investigations. 2. Seismology and Instrumentation - Addressing seismic data and instrumentation throughout the state, serve as partner with the Pacific Northwest Seismic Network. 3. Earthquake Engineering - A position focused on engaging with new construction and retrofit efforts.

4.3.1.5 Fuel Tank Seismic Stability

Program Manager: Oregon Department of Environmental Quality (DEQ)

Description: In 2022, Senate Bill 1567 gave the Oregon Department of Environmental Quality the authority to develop a program that evaluates the earthquake vulnerability of large-capacity oil and fuel storage and distribution facilities located in Lane, Multnomah and Columbia counties.

Advances Mitigation: The program helps advance mitigation by requiring facilities to conduct a facility Seismic Vulnerability Assessment and develop a Risk Mitigation Implementation Plan to minimize the identified risks. The plan helps minimize the risk of harm to employees, surrounding communities, and the environment due to fires and fuel product releases due to an earthquake. Facilities must address vulnerabilities and risks by complying with one of two options: 1) meet stringent design standards for new facility construction; or 2) modify existing systems or spill containment such that the Maximum Allowable Uncontained Spill is no more than 42 gallons. Thus far, sixteen facilities have submitted the required Seismic Vulnerability Assessment reports. One additional facility signed an enforceable Mutual Agreement and Final Order with DEQ to close oil storage operations instead of working through the regulatory process.

Hinders Mitigation: Even with the most up-to-date comprehensive data currently available, there is still much unknown about many of Oregon's fuel storage facilities, including their capacity, the age of their tanks and equipment, and their seismic code compliance. Also, there are many other fuel storage facilities throughout Oregon that are vulnerable to earthquake damage and would cause significant public health or environmental problems. These are generally located at transportation hubs near communities and waterways and may not be built to adequate seismic resilience standards. Thus, spills from these facilities are expected after an earthquake.

Potential Solutions: Conducting a statewide analysis of the risk posed by smaller facilities could inform additional legislative efforts to protect public health and the environment from seismic-related spills.

4.3.1.6 Landslide Risk Reduction Program

Program Manager: Oregon Department of Geology and Mineral Industries (DOGAMI)

Description: The State of Oregon has a long history of landslide risk reduction accomplished through collaboration with many entities, including but not limited to: DOGAMI, ODF, DLCD, USGS, FEMA, DOGAMI, NOAA, BLM, USFS, Oregon Universities, cities, and counties. The program has undertaken a wide range of projects in Oregon to mitigate landslide risk, including conducting an array of research projects on landslide risks across the state, as well as publishing numerous maps and reports with its findings.

Advances Mitigation: The program aims to address a wide variety of landslide risk, in particular the following priorities: developing landslide inventory and susceptibility maps, evaluating landslide risk, educating communities on landslide hazards and potential risk reduction opportunities, and collaborating with communities to implement risk reduction actions. The program also hosts and maintains the Statewide Landslide Information Database for Oregon (SLIDO), an interactive mapping tool that provides data on identified landslides throughout the state.

Hinders Mitigation: The program relies on federal funding, which can be unstable. Also, this statewide program has a very limited number of staff which constrains its overall impact across the state.

Potential Solutions: Securing funding to support additional staff.

4.3.1.7 Oregon Coastal Management Program

Program Manager: Oregon Department of Land Conservation and Development (DLCD)

Description: The Coastal Zone Management Program is a national program where the federal and state government enters a voluntary partnership to address coastal issues. The program consists of partnerships between multiple agencies, each with authority in the coastal zone. The Oregon DLCD serves as the lead administrative agency, and NOAA provides funds and technical expertise. Coastal tribes, including the Confederated Tribes of Coos, Lower Umpqua and Siuslaw, the Confederated Tribes of Grand Ronde, the Confederated Tribes of Siletz Indians, the Cow Creek Band of Umpqua Tribe of Indians, and the Coquille Indian Tribe, manage coastal resource lands and are critical partners in protecting the natural, cultural, and historic heritage of native people on the Oregon coast.

Advances Mitigation: Authorized by the Coastal Zone Management Act (CZMA) of 1972, the program provides the basis for protecting, restoring, and responsibly developing our nation's diverse coastal communities and resources. In Oregon, the program has been very effective at supporting and implementing natural hazard and community resilience strategies. The OCMP partners with researchers from agencies such as DOGAMI and OSU to share and create tools for coastal jurisdictions to use to better understand the hazards and risks they face and how to best mitigate against them. The program offers technical assistance and resources for hazard mitigation planning, such as updating hazard overlay zones, implementing tsunami evacuation planning, and providing education on coastal hazards such as sea level rise, tsunami, and storm surge.

Hinders Mitigation: In 2015, the EPA and NOAA disapproved the "Oregon Coastal Nonpoint Pollution Control Program" for another agency not implementing additional management measures to protect anadromous fish-bearing streams in forest areas. This led to a 30% reduction in federal funds for the OCMP. This reduction in funding has created lasting financial burdens, as the OCMP has lost staff, had to suspend local planning assistance grants, and more.

Potential Solutions: The program is currently working to regain standing and its prior level of federal funding.

4.3.1.8 Oregon Defensible Space Program

Program Manager: Oregon State Fire Marshal (OSFM)

Description: Launched in 2023 under SB 762, the OSFM provides education, outreach, financial and technical assistance. Additionally, the OSFM and local fire agencies provide free defensible space assessments to assist property owners in complying with the state's defensible space standards. The Governor's Fire Service Policy Council — a group of fire service professionals who advise the governor about fire protection in Oregon — initiated this program and created a list of recommendations for the public to use to assess their wildfire preparedness. These recommendations are based on the draft defensible space code and other best practices for wildfire safety in Oregon.

Advances Mitigation: This program has been very effective in advancing mitigation efforts, especially due to the success of the free defensible space assessments available to homeowners and business owners. These assessments are available by request and are completed by experts who evaluate a property and provide personalized recommendations. The assessment is completed by an OSFM staff member or the local fire agency. As of October 4, 2024, 2,446 assessments were completed statewide, by 406 statewide trained assessors, representing 73 agencies, including two state agencies (OSFM and ODF).

OSFM also provides extensive online guides providing steps that any property owner can take to create defensible space around their structures, as well as collective actions neighborhoods and communities can take to reduce wildfire risk. Additionally, in 2024, OSFM started a one-time incentive program for people living in a high-risk area and who received an assessment. Eligible participants received a $250 one-time payment to offset defensible space improvement costs. Over 231 one-time incentives were paid, for a total of $57, 750.

Hinders Mitigation: The funding for the program and incentives for homeowners can be unstable.

Potential Solutions: A 2024 legislature's budget note directed OSFM and ODF to convene a workgroup to identify future funding options that may help address funding gaps.

4.3.1.9 National Flood Insurance Program – Mitigation Program Evaluation

The Oregon Department of Land Conservation and Development (DLCD) manages the National Flood Insurance Program (NFIP), alongside the Oregon Department of Emergency Management (OEM).

The NFIP provides flood insurance to homes and businesses located in floodplains at a reasonable cost, as well as to promote development in areas outside of floodplains. The program is based upon mapping flood risk areas, which requires local implementation to reduce flood risk, primarily through regulation of new development in floodplains.

Elevation Certificates must be maintained by communities participating in the NFIP when new or substantially improved structures are to be constructed in a high-risk flood area. Accordingly, new development is required to be elevated or otherwise designed to protect against flooding. The NFIP requires local governments to obtain Elevation Certificates for all new construction in floodplains and they must keep the certificates on file. Local governments also must ensure that elevation certificates are filled out correctly for structures built in floodplains.

V-Zone Construction

In many of Oregon's coastal communities, FEMA has mapped "V zones" (velocity zones), which are areas of special flood hazard that are subject to high velocity wave action from storm surges or seismic events. Because of the potential force associated with this wave action, special regulations apply for new construction and substantial improvements in "V zones."

Substantial Damage Policy

Under the NFIP, a building is considered to be substantially damaged when the total cost of repair equals or exceeds 50% of the pre-damage market value of the structure. A substantial damage determination provides opportunities for mitigation through acquisition, relocation, demolition, and elevation. For NFIP-insured properties, timely determinations of substantial damage are critical for meeting the application period for an **Increased Cost of Compliance (ICC)** mitigation claim. If approved for ICC, the ICC payment of up to $30,000 may be used as the property owner's non-federal cost share. Timely substantial damage determination is a standard protocol for all flood disaster declarations in Oregon. DLCD is creating a Substantial Damage Determination Plan to assist communities with this responsibility after a flood event. Local

Floodplain Administrators are responsible for Substantial Damage Determinations after any hazard event impacting structures in the Special Flood Hazard Area.

Community Rating System and CRS Users Groups

The NFIP's Community Rating System (CRS) is a voluntary program that recognizes and rewards local governments that engage in floodplain management activities exceeding the minimum NFIP requirements by discounting flood insurance premium rates to reflect the reduced flood risk resulting from those activities. Other benefits resulting from community participation in the CRS program include:

- Reducing flood damage to insurable property,
- Strengthening and supporting the insurance aspects of the NFIP, and
- Encouraging a comprehensive approach to floodplain management.

As of October 2024, twenty-three of Oregon's communities participate in the CRS Program. CRS is supported primarily by FEMA's insurance specialist and regional contractors, with DLCD providing advocacy and encouragement to local governments to join the program during every CAV and CAC. The Northwest Regional Floodplain Management Association's (NORFMA) invites Oregon jurisdictions to participate in its CRS Users Group, which holds quarterly meetings and trainings for interested staff.

Repetitive Loss (RL) and Severe Repetitive Loss (SRL) Policy and Actions

RL and SRL properties are a top priority for mitigation in Oregon. However, several criteria must generally align for their mitigation to be executable. In addition to meeting the federal statutory criteria for mitigation projects — technically feasible, cost-effective, and environmentally sound — the state will vigorously pursue mitigation of RL and SRL properties if:

- The structure is substantially damaged and eligible for funding under the NFIP's Increased Cost of Compliance provision;
- The structure is located in a community with a FEMA-approved NHMP;
- The structure is located in a community with the ability to manage federal grant funds;
- Elected officials support pursuing flood mitigation projects;
- The structure is located in a county designated by a major disaster declaration and post-disaster mitigation funding is available; and
- The owners of the structure are interested in mitigation through elevation, flood-proofing, relocation, or demolition.

In addition, geographic distribution of properties and alignment of repetitive loss and severe repetitive loss property mitigation with other mitigation efforts (such as restoring natural and beneficial floodplain functions) may play a role. It is the state's policy to distribute mitigation assistance and funding to impacted communities and repetitive loss and severe repetitive loss properties in different areas of the state whenever practicable.

While data obtained from FEMA's PIVOT database indicates 424 properties in Oregon are identified as RL/SRL properties, some of these properties have been mitigated. This list can

fluctuate based upon recent NFIP claims data, intensity of storm events causing damages, and whether structures are mitigated, removed (demolished), or relocated.

NFIP Changes

There are 260 communities participating in the NFIP in Oregon as of November 22, 2024. (Source: Community Status Book report for State OR). From July 2023 to July 2024 the total number of NFIP policies in Oregon decreased by 256, from 24,003 to 23,747 (-1.1%). As of August 11, 2024, the number of NFIP policies in Oregon was 23,690, for a total coverage of $6,568,847,000. Of these, 19,413 were Write-Your-Own (WYO) policies, where private insurance companies are paid to directly write and service NFIP policies. The remaining 4,277 NFIP policies were purchased directly from the NFIP. Total annual payments were $25,449,187. (Source: FEMA's Pivot database)

The market share trend for private flood insurance is growing fast in Oregon, increasing from 11% in 2019 to 22% in 2022 (estimated). An estimated market share of 22% represents 5,785 contracts in force. Private flood insurance is not available to all Oregon communities, and some structures are ineligible for private flood insurance. Nevertheless, while the number of NFIP-issued policies is trending lower as privately issued policies increase, total coverage is holding steady.

NFIP Challenges and Opportunities

Several challenges have arisen for the Oregon NFIP since 2020; however, potential solutions and opportunities have been identified and are currently being further researched and explored.

Biological Opinion (BiOp): In July 2024, FEMA abruptly announced pre-implementation compliance measures for Oregon NFIP communities within the six NOAA Salmon and Steelhead Recovery Domains (implementation plan area). In response, DLCD staff created a Frequently Asked Questions document about FEMA's pre-implementation to assist staff administering their local floodplain programs. The BiOp is one of Oregon's hottest topics currently. Several congressional delegates and Governor Tina Kotek have written letters of concern about FEMA's pre-implementation process and need for more collaboration. DLCD is currently participating as an advisory committee member on FEMA's full implementation process, but did not have the same opportunity to collaborate or offer feedback on FEMA's pre-implementation compliance measures. The state will continue to work with FEMA and NFIP communities as needed.

Federal Flood Risk Management Standard (FFRMS): Two new rules were published under US Housing and Urban Development and FEMA to implement FFRMS policy nationwide in 2024. FFRMS require a greater level of flood protection for new federal projects and structures. FFRMS aims to increase resiliency, reduce the risk loss of human life and property, and minimize disruptions to households across the nation from flooding. HUD is requiring structures to be built 2-ft above the base flood elevation for FHA loans for residential structures. FEMA issued a new rule requiring any federally funded structure in the floodplain to be built to the same standard. This eligibility criterion applies to Hazard Mitigation Assistance programs and all actions subject to FFRMS. However, floodplain management standards have not changed within the Code of Federal Regulations. Therefore, local governments are not required to adopt this

standard. In November 2024, FEMA began to provide NFIP coordinating offices and local government staff with training.

- FEMA's FFRMS website: Federal Flood Risk Management Standard | FEMA.gov
- HUDs FFRMS website: Federal Flood Risk Management Standard | HUD.gov / U.S. Department of Housing and Urban Development (HUD)

Community Rating System (CRS) Redesign: FEMA issued a request for information seeking public input on potential changes to CRS. Comments on the CRS redesign were published September 9, 2024 in the federal register. FEMA is exploring potential changes and improvements to the CRS program through programmatic review and improvement efforts. This FEMA-led effort will likely take several years to complete.

Opportunity – Floodplain Managers Group: After a number of years in hiatus, Oregon re-started its Floodplain Managers Group in 2024.

4.3.1.10 Risk MAP

The Risk MAP (Mapping, Assessment, and Planning) program aims to deliver quality flood data that increases public awareness of natural hazards, leading to mitigation and resilience actions that reduce risk to life and property and supporting a safer future for communities through effective partnerships. The main goal is to increase local resilience by providing communities with flood hazard information and tools they can use to strengthen their ability to make informed decisions about reducing flood risk. A cornerstone of Risk MAP is the collaborative partnerships developed to increase community resilience to natural hazard risks.

The Oregon Department of Emergency Management (OEM) coordinated Risk MAP activities for the State of Oregon for state fiscal years 2023-2025. A Cooperating Technical Partnership between the State of Oregon and FEMA provided sponsorship and all the funding for these activities. FEMA has sponsored Risk MAP studies for many incorporated jurisdictions within Oregon, with projects having just begun, underway, or completed. The studies range from risk and vulnerability assessments to lidar acquisition to physical map revisions.

Twenty-four counties in Oregon currently have access to digital flood hazard data, as found in the National Flood Hazard Layer (NFHL). However, digital flood hazard data is not available for 12 counties. They rely instead on paper maps. Additionally, approximately 83 NFIP counties or communities have effective flood hazard data that is older than 20 years, with some maps going as far back as 40 years. Without up-to-date information and data, communities are unable to effectively understand their exposure to natural hazards. Risk MAP offers opportunities to update data, facilitate public awareness and communication, and help to identify flood mitigation opportunities. This data and information can be incorporated into local hazard mitigation plans.

In Oregon, 12 counties and one tribe are in various stages of completion for Risk MAP projects.

- Active/Ongoing: 10 counties, one Tribe
- Completed: Two counties

FEMA will produce new or updated flood hazard maps in connection with the Risk MAP projects listed in Table 4.3-3.

Table 4.3-3 Status of Oregon Risk MAP Projects

Project Area	Project Status
Benton County	Active/ongoing.
Clatsop County (coastal)	Active/ongoing. Flood Risk Review (FRR) April 16, 2024.
Gilliam County	Active/ongoing. Flood Risk Review Oct 22, 2024.
Grant County	Active/ongoing. Anticipate draft maps Dec 2024, FRR Feb 2025.
Harney County	Completed (Effective Feb 8, 2024).
Burns Paiute Tribe	Completed (Effective February 8, 2024)
Hood River County	Active/ongoing. Revised Preliminary maps were issued Aug 30, 2024. Consultation Coordination Officers (CCO) Meeting held Oct 3, 2024.
Jackson County	Active/ongoing. Discovery report held July 8, 2024.
Klamath County	Completed (Effective Nov 7, 2024).
Lane County	Amazon: Active/ongoing. Revised Draft delivered Oct 10, 2024.
	Central/CF-MF: Active/ongoing. Working on Revised Prelim (anticipated Winter 2024/2025).
	Siuslaw: Active/ongoing. Working on draft updates (delayed).
Sherman County	Active/ongoing. Letter of Final Determination (LFD) anticipated in Winter 2024/25.
Umatilla County	Active/ongoing. Draft maps anticipated Oct 2025.
Wasco County	Active/ongoing. Working on Revised Prelim (anticipated release Spring 2025).

Source: Oregon Department of Emergency Management. (2024). *Oregon Risk MAP State Strategy 2024*. https://www.oregon.gov/oem/Documents/CTP_FEMA_RX_RiskMAP_ORStateStrategy_2024.pdf.

The Risk MAP process requires an extensive level of engagement, knowledge, and coordination with individual communities engaged in a Risk MAP study. To accomplish this, FEMA funds a state-based "Risk MAP Coordinator" (RMC) for each of the states within FEMA Region 10 (AK, ID, OR, WA). The Oregon RMC, housed in OEM, serves as the intermediary and primary point of contact between Oregon's local jurisdictions and FEMA and provides training and technical assistance to Oregon communities.

A priority for the Oregon Risk MAP program is to identify communities and areas where a detailed flood map analysis would benefit the community and guide hazard mitigation efforts to help reduce the impact of a natural disaster in the area. Oregon's RMC collaborates with local jurisdictions to prioritize Risk MAP projects and flood map updates throughout counties and Tribal areas. Additional factors guide outreach efforts with new jurisdictions, including state priorities, community needs and local interest in participation, social vulnerability, new LiDAR data availability, hazard mitigation plan status, and age or format of natural hazard risk data. Table 4.3-4 lists Oregon Risk MAP priorities for federal fiscal year 2024.

Table 4.3-4 Oregon Risk MAP Priorities for Federal FY24

Rank	County	Notes
1.	Wallowa County	Unmodernized flood maps. New LiDAR collection in the area.
2.	Union County	Unmodernized flood maps. New LiDAR collection in the area.
3.	Jackson County	Partially modernized flood map. New LiDAR collection in the area. New Risk MAP project kickoff (Discovery) planned for 2024.
4.	Lane County	Partially updated flood map – modernization underway. Risk MAP projects in progress.
5.	Umatilla County	Modernized flood map (2010). New LiDAR collection in the area, Current flood map update in progress; limited scope (Umatilla River and McKay Creek only).
6.	Gilliam County	Unmodernized flood maps. Risk MAP project in progress.
7.	Wasco County	Unmodernized flood maps. Risk MAP project in progress.
8.	Hood River County	Unmodernized flood maps. Risk MAP project in progress.
9.	Morrow County	Modernized flood map (2007). New LiDAR collection in the area.
10.	Malheur County	Unmodernized flood maps.

Source: Source: Oregon Department of Emergency Management. (2024). *Oregon Risk MAP State Strategy 2024*. https://www.oregon.gov/oem/Documents/CTP_FEMA_RX_RiskMAP_ORStateStrategy_2024.pdf.

More detailed information about the Oregon Risk MAP Program can be found in the State of Oregon's FY2024 Risk MAP Program State Strategy. This document provides a current snapshot of the status of community flood hazard information throughout the state, and lays out a plan for future needs and priorities throughout Oregon.

4.3.2 Highlighted Mitigation Organizations

This section highlights some of the evaluated mitigation organizations in Oregon. The evaluations provide a description of the organization and how it contributes to mitigation efforts. Also, some

evaluations describe challenges related to the implementation or utilization of these mitigation organizations and pose possible solutions.

4.3.2.1 Oregon Drought Readiness Council

Description: The Drought Readiness Council (DRC) is responsible for assessing the impact of drought conditions and making recommendations to the Governor's senior advisors. The council's goal is "to reduce the effects of an impending drought through a coordinated federal, state, local, and voluntary effort, consisting of the development of drought plans, policies, and procedures, and through coordinated state response." (Oregon Office of Emergency Management, 2014 rev.). The Drought Council is, in turn, advised by the Water Availability Committee, a sub-committee of technical people who monitor conditions throughout the state and report these conditions monthly. In this manner the Drought Council keeps up to date on water conditions. Members combine this knowledge with information they bring from their organizations and differing geographical areas of the state to make recommendations for policy, response, and mitigation.

Advances Mitigation: The DRC plays an important role in advancing natural hazards mitigation and community resilience. In addition to supporting the development of drought plans and policies, its primary responsibility is evaluating and making recommendations on state drought declaration requests to the Governor. These declarations provide emergency water rights tools that help manage water supply challenges and improve resilience to drought, although they primarily address short-term needs rather than long-term climate resilience.

Hinders Mitigation: Counties do not fully utilize all the emergency and water rights tools available from a state drought declaration.

Potential Solutions: A possible solution to this problem is to improve the state drought declaration process to make it more efficient and effective. However, updating the process would likely require the state legislature to create or amend statutes and rules. While this could theoretically be accomplished within 5 years, OWRD capacity constraints will likely prevent this change from occurring within that timeframe.

4.3.2.2 Oregon Seismic Safety Policy Advisory Committee

Description: The Oregon Seismic Safety Policy Advisory Committee (OSSPAC) is a state advisory commission charged with promoting earthquake awareness and preparedness through education, research, and legislation. The purpose of the 18-member group, each representing various interests concerning earthquakes, is to reduce exposure to earthquake hazards in Oregon. The mission of OSSPAC is "to positively influence decisions and policies regarding pre-disaster mitigation of earthquake and tsunami hazards, increase public understanding of earthquake hazards, risk, exposure, and vulnerability through education, and be responsive to the new studies and/or issues raised around earthquakes and tsunamis." (OEM OSSPAC, Retrieved Feb. 10, 2024).

Advances Mitigation: While this is a volunteer commission, it has still made a significant contribution to earthquake mitigation and risk reduction in Oregon, including the development and implementation of the Oregon Resilience Plan and the establishment Seismic Rehabilitation Grant Program (SRGP).

Hinders Mitigation: The program is unfunded and organized by volunteers, making consistent administration difficult.

Potential Solutions: Secure funding to maintain consistent administration.

4.3.2.3 Oregon Silver Jackets

Description: Silver Jackets teams are interagency teams that facilitate collaborative solutions to state flood risk priorities. In Oregon, the Silver Jackets team is a sub-committee of State Interagency Hazard Mitigation Team. The Silver Jackets Team is led by the State NFIP Coordinator in the Oregon Department Land Conservation and Development in partnership with the US Army Corps of Engineers Floodplain Management-Portland District. The State Risk MAP Coordinator in the Oregon Office of Emergency Management also participates in the Oregon Silver Jackets Team.

Advances Mitigation: The state-led team brings together multiple state, federal, and sometimes tribal and local agencies from across the state to learn from one another and collaborate to reduce risk from floods and, if necessary, other natural disasters. By applying their shared knowledge, the team enhances statewide preparedness, mitigation, response, and recovery efforts. Each participating agency representative supports the team using its own programs and resources within the constraints of available budgets and agency authorities.

The Oregon Silver Jackets team directly contributes to flood resilience and mitigation by focusing on advancing state flood-related priorities and identifying flood-related action items for the Oregon NHMP.

Hinders Mitigation: The Oregon Silver Jackets team works hard to develop flood-related proposals and initiatives that support the Oregon NHMP. However, these tasks require participation at a high enough level to provide a big picture understanding of how the programs work together, rather than focusing on the details of a single program. Thus, the team needs greater support from state and federal agencies to facilitate participation at the appropriate levels.

Potential Solutions: The Oregon Silver Jackets team needs to conduct more outreach to other federal and state agencies to increase participation and support from more agencies and organizations.

4.3.2.4 Pacific Northwest Seismic Network

Description: The Pacific Northwest Seismic Network operates seismograph stations and locates earthquakes in Oregon and Washington. It is funded by the U.S. Geological Survey, the Oregon Department of Energy, and the State of Washington. The Pacific Northwest Seismic Network (PNSN) website provides information on Pacific Northwest earthquake activity and hazards.

Advances Mitigation: The PNSN has been very effective at advancing mitigation efforts. PNSN has a dense network of seismic instrumentation in western Oregon and offshore and is expanding this network to include central and eastern Oregon. PNSN supports the ShakeAlert system, established in 2021, to provide earthquake alerts to system users. Currently Android mobile users and institutional partners are supported; eventually Apple mobile users will be supported also.

Hinders Mitigation: Most of the funding for PNSN comes from federal grants, which can be inconsistent.

Potential Solutions: Currently, there is no proposed solution.

4.3.2.5 State Interagency Hazard Mitigation Team

Description: The purpose of the State Interagency Hazard Mitigation Team (IHMT) is to provide expert guidance to the State, Tribal and local jurisdictions in matters of hazard mitigation. It is a key state mechanism for interagency coordination and collaboration on natural hazards mitigation. The Team's focus is to understand losses arising from natural hazards, including the secondary losses that occur when natural hazard events impact technological systems and critical infrastructure. It also develops and coordinates recommended strategies to mitigate losses of life, property, economy, and natural resources by maintaining a Governor-promulgated and FEMA-approved Oregon NHMP.

The State Hazard Mitigation Officer (SHMO) convenes, chairs, and facilitates the State IHMT's quarterly meetings and OEM provides staff support. IHMT members are appointed by state agency directors and hold knowledge of natural hazard risk, mitigation actions, mitigation planning, and community resilience needs. Table 4.3-5 identifies the State IHMT agencies, their roles and responsibilities and authorities.

Table 4.3-5 State IHMT Agencies' Hazard Mitigation Roles, Responsibilities, and Authorities

State IHMT Agency	Hazard Mitigation Roles and Responsibilities	Hazard Mitigation Legal Authority
Governor's Office - State Resilience Officer	Advises Oregon Governor Tina Kotek on disaster resilience and emergency response.	Oregon Revised Statutes (ORS) 401.913
University of Oregon, Institute for Policy Research and Engagement (IPRE), Oregon Partnership for Disaster Resilience (OPDR)	OPDR is a coalition of public, private, and professional organizations working collectively toward the mission of creating a disaster resilient and sustainable state. Developed and coordinated by the Community Service Center at the University of Oregon, OPDR employs a service-learning model to increase community capacity and enhance disaster safety and resilience statewide. Primary activities include community plan and project development support; applied research and technical resource development; training programs and capacity building; and the development of strategic alliances.	Oregon Revised Statutes (ORS) 401.913
Department of Administrative Services (DAS)	DAS works to improve safety in the workplace by identifying risks and developing tools to manage risks. DAS also works to protect state-owned property and buildings and sets standards for leasing and constructing state buildings.	No legal authority for hazard mitigation.
Oregon Department of Agriculture (ODA)	Works to exclude or eradicate certain insect pests from becoming established in the state. Using the Insect Pest Prevention and Management program (IPPM), the ODA works to protect Oregon's agriculture, horticulture and timber resources from damaging insect pests, thus preventing the defoliation of vast acreage of trees and reducing fire and erosion hazards; works with soil and water conservation districts to help landowners implement best management practices to reduce erosion, thereby preventing slides, floods, and erosion-related problems; actively involved in watershed health and maintaining natural resources through education, technical assistance, and regulatory programs for landowners.	No legal authority for hazard mitigation, except that which may arise from a claim under self-insurance property coverage.
Oregon Department of Consumer and Business Services-	Works to implement statewide building codes through a permitting program. BCD has adopted construction standards that help create disaster resistant buildings. BCD administers the post-earthquake inspection program for damaged buildings and provides technical	ORS, Chapter 568 provides authority for water quality and soil conservation measures, and Chapter 570

State IHMT Agency	Hazard Mitigation Roles and Responsibilities	Hazard Mitigation Legal Authority
Building Codes Division (DCBS-BCD)	assistance and training for building inspectors, plans examiners, designers, and contractors. A post-earthquake inspector carries out post-earthquake habitability assessments for all structures affected by an earthquake. BCD has compiled an active list of certified post-earthquake inspectors. BCD generally adopts nationally recognized model codes that include various standards to ensure building safety. Technical assistance is provided to designers, contractors, building officials, and the public through its code specialists, its web page, listserv distributions to interested parties and local building officials.	provides authority for pest and disease control programs.
Oregon Department of Consumer and Business Services-Division of Financial Regulation (DCBS-DFR)	Works to perform a major balancing role, protecting the public's interests through ensuring the financial soundness of insurers, the availability and affordability of insurance, and the fair treatment of policyholders and claimants while maintaining a positive business climate. DCBS-DFR helps home and business owners prepare for natural hazards through the provision of insurance-related educational material and trainings. DCBS-DFR also works to help ensure insurance compensation to insurance holders in the wake of a natural disaster.	ORS, Chapter 455 provides legal authority for the Building Codes Division's (BCD) natural hazard mitigation activities including 455.020 (code adoption), .725 (training), .440 (site soil analysis), .446 (construction in tsunami zones), .447 (seismic site hazard analysis), and .448-.449 (entry and inspection of earthquake damaged buildings).
Business Oregon - Infrastructure Finance Authority	Works with the Governor and all state agencies to prioritize programs and modify services that help those affected by natural disasters. Works with current loan customers to address needs during recovery from a natural disaster. Works with communities to prioritize infrastructure needs resulting from a natural disaster, which is used to develop state and federal funding solutions for Oregon communities. Offers Emergency Response Funding Programs. Also supports hazard mitigation by promoting development of new facilities and infrastructure in appropriate locations. Administers the Seismic Rehabilitation Grant Program (SRGP).	ORS Chapter 731 provides authority to DCBS-DFR. House Bill 3605 allows the director of the Department of Consumer and Business Services (DCBS) to modify insurance policy terms in times of emergency.
Oregon Climate Change Research Institute (OCCRI) and the Oregon Climate Service (OCS)	OCCRI, housed at Oregon State University, is authorized to: • Facilitate research by Oregon University System faculty on climate change and its effects on natural and human systems in Oregon • Serve as a clearinghouse for climate change information • Provide climate change information to the public in integrated and accessible formats • Support the Oregon Global Warming Commission in developing strategies to prepare for and to mitigate the effects of climate change on natural and human systems • Provide technical assistance to local governments to assist them in developing climate change policies, practices and programs In addition, at least once each biennium, OCCRI assesses the state of climate change science as it relates to the state of Oregon, and the likely effects of climate change on the state and delivers the assessment to the Governor's Office and the Legislative Assembly. OCS is part of the College of Earth, Ocean, and Atmospheric Sciences at OSU, and has been absorbed by OCCRI. OCS: • Collects, maintains and distributes Oregon weather and climate data;	ORS Chapter 285A-C provides authority to Oregon Business, including 285B.020 (infrastructure).

State IHMT Agency	Hazard Mitigation Roles and Responsibilities	Hazard Mitigation Legal Authority
	• Educates Oregonians on current and emerging climate issues; and • Performs research related to climate issues.	
Oregon Department of Energy (ODOE)	Is the lead state agency for the *Oregon Energy Security Plan*, which identifies and prioritizes mitigation measures that may improve energy security and presents an action plan to work toward increased resilience.	HB 3543 (2007)
Department of Environmental Quality (DEQ)	Works to protect and maintain waters of the state for public health and safety as well as for all future beneficial uses under EPA delegated programs from the Clean Water Act and Safe Drinking Water Act. Emergency actions related to natural hazards must meet environmental protection requirements. If a natural hazard were to result in hazardous materials being released into the environment, DEQ's Emergency Response Program would respond. DEQ's Environmental Cleanup Division acts upon threat of a release, or should a release occur. DEQ assists OEM, DLCD, and FEMA in conducting environmental assessments related to watershed restoration, hazard mitigation projects, and provides matching grants for projects under the Clean Water Act. DEQ plays a central role in the disposal of disaster debris. DEQ also works with Oregon Natural Events Action Plan for Wildfire Smoke. DEQ offers the Wildfire Air Quality Rating to monitor air pollution throughout the state to ensure that air quality standards are being met. OHA contracts source water protection activities for public water systems to DEQ.	ORS 469.064
Oregon Department of Fish and Wildlife (ODFW)	Has a primary role in determining the effects of potential hazard mitigation projects on fish and wildlife habitats and recommending measures that enhance or at least do not degrade such habitats; administers the state's Riparian Tax Incentive Program and Restoration and Enhancement Program, and can provide cost-share funding, grants and technical assistance.	ORS, Chapter 468, water pollution control, enables DEQ to protect all future beneficial uses of waters of the state (surface and groundwater), and allows DEQ to act should there be a threat of release or a spill. ORS, Chapter 468a, enables the DEQ to regulate and monitor air quality. ORS, Chapters 465 and 466 enables the DEQ to respond to hazardous waste and materials that have been released into the environment.
Oregon Department of Forestry (ODF)	Works to protect communities from wildfires through the implementation of the Communities at Risk Assessment Program. ODF Identifies communities and assigns each a low, moderate, or high-risk rating for the following categories: risk, hazard, protection, capability, value, and overall. ODF works with communities to create Community Wildfire Protection Plans (CWPP): a process involving collaboration between communities and agencies interested in reducing wildfire risk. ODF is responsible for all aspects of wildland fire protection on private, state and BLM forestlands. ODF administers regulations, including landslide mitigation, on non-federal lands. ODF does all of the following things which advance natural hazards mitigation: requires landowners to control fires on their lands; controls fires that other landowners cannot control; administers the industrial fire prevention program; investigates wildfires; administers the Forest Practices Act; coordinates with other agencies; maintains technical expertise on	ORS, Chapter 496 (application, administration, and enforcement of wildlife laws), Chapter 497 (licenses and permits), Chapter 498 (hunting, angling and trapping) and Chapter 501 (refuges and closures).

State IHMT Agency	Hazard Mitigation Roles and Responsibilities	Hazard Mitigation Legal Authority
	wildfire sciences, geosciences, and hydrology; completes debris flow hazard mapping for Western Oregon; and leads many aspects of the *Oregon Plan for Salmon and Watersheds.*	
Department of Geology and Mineral Industries (DOGAMI)	Works to develop geologic maps and data to enable Oregonians to understand geology and to mitigate the hazards resulting from earthquakes, tsunamis, landslides, and other hazards; works with project partners, to develop a statewide seismic needs assessment; focuses much effort on risk reduction, often in partnership with other federal, state, and local agencies, and the private sector; provides information which leads to the construction of safer buildings; works on siting of natural gas cogeneration power plants, correctional facilities, gas pipelines using policy decisions related to geologic, seismic and coastal hazards; also works with local partners to develop systematic evaluations of risk to people and property so mitigation efforts can be prioritized.	ORS, Chapter 477 addresses the fire protection of forests and vegetation, including sections on urban interface fire protection, hazard abatement, fire abatement, fire prevention, and related sections. Chapter 527 contains provisions which pertain to timber harvest and road construction regulations in landslide areas.
Oregon Health Authority (OHA) State Public Health Division	The Oregon Health Authority's Health Security, Preparedness and Response (HSPR) Program develops public health systems to prepare for and respond to major, acute threats and emergencies that impact health of people in Oregon. The Program addresses eight of the 11 natural hazards in the Oregon NHMP, extreme heat, and bioterrorism. The Oregon Health Authority's Climate Change and Public Health Program is working with partners to study, prevent, and plan for the health effects of climate change. The OHA Drinking Water Services implements the Safe Drinking Act for Oregon's public water systems.	ORS, Chapter 516 creates and defines the duties; Section 516.030(3) directs DOGAMI to administer on a cooperative basis studies and programs that will reduce the loss of life and property by understanding and mitigating geological hazards.
Department of Land Conservation and Development (DLCD)	Manages the statewide land use planning program; Goal 7 of which addresses development in places subject to natural hazards, requiring that jurisdictions apply "appropriate safeguards" when planning for development there. The goal requires local governments' comprehensive plans to include inventories, policies, and ordinances which will reduce losses. DLCD supports local governments' and tribes' efforts to address natural hazards through technical assistance during periodic plan review, comprehensive plan and zoning code updates, and development and updates of NHMPs; provides workshops and responds to local government requests for information. As of 2013, DLCD is responsible for facilitating updates of the Oregon Natural Hazards Mitigation Plan. DLCD manages the National Flood Insurance Program (NFIP) in the State of Oregon through an agreement with FEMA. DLCD also manages the Oregon Coastal Management Program, which implements a coastal hazards and assessment program.	ORS 431 provides authority for state and local administration and enforcement of health laws including public health emergency planning and response.
Department of State Lands (DSL)	Responsible for a variety of service-related functions relating to land management and implementation of state removal-fill law. DSL's role in hazard mitigation is in the issuing of removal/fill permits or enforcement actions on wetlands waters of the state.	ORS, Chapter 197 provides the basis for comprehensive land use planning in the State of Oregon, including provisions governing development in floodplains and in other areas subject to natural hazards, which are intended to mitigate the effects of such hazards. ORS, Chapter 476 provides the basis for the Conflagration Act.

State IHMT Agency	Hazard Mitigation Roles and Responsibilities	Hazard Mitigation Legal Authority
Oregon Department of Emergency Management (OEM)	Convenes the State IHMT and provides overall coordination of natural hazards mitigation in the State of Oregon. The State Hazard Mitigation Officer (SHMO) is on the staff. Among the agency's related responsibilities are: chairing the Oregon Emergency Response System (OERS) Council; staffing the Oregon Seismic Safety Policy Advisory Commission (OSSPAC); developing and maintaining the state *Comprehensive Emergency Management Plan* (CEMP) and related documents; and providing training and other assistance which help mitigate hazards.	ORS 196 and 390 address wetlands, removal and fill permits or enforcement actions on the beds and banks of the waters of this state. Many of these provisions have a tangential effect on floodplain management and flood hazard mitigation.
Oregon State Fire Marshal (OSFM)	Develop, promote, and maintain protection of life, property, and the environment from fire and other perils through leadership, direct action, and coordination of public safety resources; provides hazard mitigation through programs to educate, inspect, survey, investigate, respond to emergency incidents, and communicate with the public and emergency responders. The Conflagration Act and the State Fire Services Mobilization Plan are coordinated at all levels of state, county, and city government and they foster cooperation in responding to fires and emergency incidents. OSFM employs Regional HazMat Emergency Response Teams to help ensure public safety regarding hazardous materials incidents occurring throughout the state. OSFM provides education and programs, inspections, information, reports, data and brochures, training programs, and emergency responses to incidents for the schools, governments, and the public.	ORS, Chapter 401 Includes many of the state's emergency management statutes. One section states that the general purpose of the law is to reduce the vulnerability of the State of Oregon to loss of life, injury to persons or property, human suffering, and financial loss resulting from emergencies.
Oregon Public Utility Commission (PUC)	A regulatory agency for certain electric, gas, telecommunication, and water utility companies; enforces the National Electrical Safety Code and the Federal Gas Pipeline Safety Regulations, which address utility operations under both normal and emergency conditions; monitors utilities' actions and infrastructure under a wide variety of conditions, including natural hazards, to ensure code compliance and prudent practices. OPUC promotes effective vegetation management practices to improve system safety and reliable service delivery by its ongoing enforcement of Oregon statutes and administrative rules, specifically in Chapter 860, Division 024.	ORS, Chapters 453 and 476-480 authorize the State Fire Marshal to perform a wide variety of education and training programs, inspections, investigative and information reports and other activities related to fire prevention, safety, and management.
Oregon Department of Transportation (ODOT)	Is the road authority for all state highways in Oregon, including interstate highways; works to maintain drainage, open culverts, clean ditches, and perform hydraulic studies; helps prevent or reduce damage to the state highway system caused by floods or landslides. ODOT invites and works with local public works agencies to become participating parties in the Oregon Public Works Emergency Response Cooperative Assistance Agreement. ODOT and local agencies completed a seismic retrofit prioritization study of Oregon's bridges in 1997. As of January 1999, ODOT completed seismic retrofit projects on 124 state bridges.	ORS, Chapters 756-759, 772, and 774 authorize the OPUC to carry out its purpose.
Oregon Water Resources Department (OWRD)	Responsible for allocation of the water produced by watersheds each year; quantifies and provides public notification of flows throughout the state and insures safe operation of certain dams and other hydraulic structures.	ORS, Chapter 810 designates ODOT as the road authority for all state highways and specifies a wide range of maintenance, operations, and analysis activities related to hazard mitigation, for example: drainage maintenance, culvert inventory, and the bridge seismic retrofit program.

State IHMT Agency	Hazard Mitigation Roles and Responsibilities	Hazard Mitigation Legal Authority
Oregon Parks and Recreation Department (OPRD)	Works to provide and protect outstanding natural, scenic, cultural, historic, and recreational sites for the enjoyment and education of present and future generations. OPRD is responsible for land stewardship, marine conservation, rocky shores, several permit programs, department-wide resource policies, and park plants and animals. OPRD strives to provide a safe environment while maintaining the natural beauty and historic importance of our parks. In certain areas providing a safe environment for park users involves planning for natural disasters. OPRD also hosts a wealth of information to protect historic and cultural resources from the impacts of natural hazards.	ORS Chapter 540 provides OWRD statutory authorities for dam safety and a statewide hydrographic program for measuring river and stream flows.
Oregon Watershed Enhancement Board (OWEB)	OWEB manages state-funded grants which can sometimes serve as non-federal match for FEMA HMA Grants when the work proposed meets the mission and interests of OWEB.	ORS Chapter 390 provides deals with the role of OPRD in dealing with state and local parks, recreation programs, scenic waterways and recreation trails

Advances Mitigation: As an interagency organization with a diverse range of partnering agencies, the State IHMT makes recommendations to executive branch agencies, in particular to OEM. To effectively advance and support statewide mitigation, the IHMT's goals are:

1. Coordinate hazard mitigation programs and activities at all levels in Oregon.
2. Describe and evaluate the natural hazards to which Oregon is vulnerable.
3. Describe and evaluate state, local government and private sector hazard mitigation policies, programs and capabilities, consistent with federal codes and regulations.
4. Identify sources of hazard mitigation funding and the procedures that must be followed to obtain such funding; make this information widely available.
5. Identify and evaluate proposed hazard mitigation strategies, projects and legislation to ensure consistency, and to proactively integrate natural resource goals into mitigation activities.
6. Continue to develop, implement, monitor, evaluate and update the Oregon Natural Hazards Mitigation Plan.
7. Provide education and information about natural hazards and steps which can be taken to mitigate against their effects.
8. Facilitate integration of hazard mitigation into the activities and programs of state and local government agencies, and to the extent practical, into the activities of private sector organizations.
9. Strive to integrate into natural hazard mitigation: Natural resource protection and restoration, storm water management, fish and wildlife concerns, federally and state listed threatened and endangered plants and invertebrates, floodplain management and protection of water quality for public use.
10. Promote and facilitate the concept of a disaster resistant economy in Oregon.

Beyond attending and contributing to the collaboration that occurs at IHMT meetings, members help with various mitigation activities such as updating the Oregon NHMP. Members also serve on grant review committees to ensure that grant applications meet all eligibility requirements as well as state

and local mitigation priorities. Further, members serve on the Oregon Silver Jackets and Oregon Landslide Risk Reduction Teams, official subcommittees of the State IHMT.

Hinders Mitigation: Though established in 1997, IHMT lacks formal recognition, constraining its influence and impact.

Potential Solutions: OEM is continuing to work through state channels to establish formal recognition for the State IHMT.

4.3.2.6 Wildfire Programs Advisory Council

Description: Established in 2021 following the passage of Senate Bill 762, the Wildfire Programs Advisory Council (Council or WPAC) is tasked with reviewing Oregon's existing model for wildfire preparation and response, as well as providing recommendations to the state on how to address wildfire risks. The Council is appointed by the legislature and works alongside the State Wildfire Programs Director who is appointed by the Governor. The council is comprised of members from across Oregon representing a variety of interests.

Advances Mitigation: The Council is charged with monitoring the progress of wildfire programs, advising and assisting the Director in wildfire-related activities, closely monitoring and providing feedback on implementation efforts, and handling wildfire-related programmatic responsibilities, such as wildfire hazard mapping, defensible space, building codes, land use, forest management, landscape resiliency, electric utilities, air quality, and public health. The Council also prepares an annual report describing and evaluating implementation progress.

Hinders Mitigation: While the Council is adequately supported and fulfills its mission, its overall effectiveness is limited due to a lack of dedicated and ongoing funding allocated for the implementation of its recommendations. As such, many of the Council-advised programs launched since the passage of SB 762 in 2021 were one-time initiatives or have since been only partially funded or defunded.

Potential Solutions: If sustained funding is provided, many of the Council's recommendations could be accomplished within five years.

4.4 Legislation and Planning

Oregon maintains a natural hazards mitigation planning program, largely informed by the Oregon Statewide Land Use Planning Program's Goals.

Staff reviewed the Statewide Land Use Planning Program's authority and goals and evaluated how they influence state and local hazard mitigation planning in Oregon.

Through the 2025 Oregon NHMP Capability Assessment, staff identified 28 mitigation statutes and 18 mitigation plans and reports that support and advance natural hazards planning and mitigation efforts. Staff evaluated each one's ability to advance and enhance natural hazards mitigation.

4.4.1 Statewide Land Use Planning Program

4.4.1.1 Overview

Oregon's rapid population growth and development during the 1960s prompted concern about the effect rapid growth could have on the environment, natural resources, and community livability. These concerns led to the passage of Senate Bill 10 in 1969, which required all Oregon cities and counties to adopt comprehensive land use plans and zone all land under their jurisdiction by 1971 (*History of Land Use Planning*, N.D.). However, it failed to establish both the means of enforcing the new law and a technical support program to assist communities in developing their comprehensive plans. As a result, most cities and counties refused to develop plans.

In 1973, the Land Conservation and Development Act (comprised of Senate Bills 100 and 101) was passed, which outlined and established a statewide land use planning framework and program. Whereas SB 101 sought to strengthen farmland protection across the state, SB 100 largely maintained SB 10's original goals of directing local governments to adopt and implement comprehensive plans and revise them periodically in accordance with statewide goals (*History of Land Use Planning*, N.D.). However, to address the shortcomings of SB 10, SB 100 outlined procedures and devised structures to implement and enforce the law. Under SB 100, a land use planning, policy, and administrative oversight body was established - the Land Conservation and Development Commission (LCDC) - along with a new state agency, the Department of Land Conservation and Development (DLCD).

Under the LCDC charge, the state developed and adopted state land use goals, which were to serve as the foundation for the statewide land use planning framework. Additionally, the DLCD was to assist the commission and local governments in the implementation and continued compliance with those goals, and support coordinating state agencies in land use matters (*History of Land Use Planning*, N.D.).

4.4.1.2 Statewide Land Use Planning Program

Under the statewide land use planning program, Oregon cities and counties are responsible for adopting comprehensive plans, including zoning land to implement the plan, administering land use regulations, and handling land use permits for Oregon's non-federal land, all in accordance with the 19 statewide planning goals. These planning goals, as developed by the LCDC, are the foundation of the statewide land use planning program (ORS 197.225; OAR 660-015, OAR 660-025). Their purpose is to offer guidance for local land use planning processes, urban development and coastal community asset planning, as well as direct state resource preservation (*History of Land Use Planning*, N.D.).

An effective comprehensive plan contains inventories and technical information, local land use issues, goals, policies, and implementing measures consistent with the statewide land use planning goals. Additionally, any plans and programs carried out by state agencies must comply with local comprehensive plans and zoning regulations.

A major contributing factor to the success of land use planning efforts in Oregon is that each planning goal is treated with equal importance and strength. This position helps ensure that each goal is addressed in a way that complements rather than conflicts with others. This encourages planning entities and stakeholders to collaborate and work cooperatively on land use planning efforts. Through collaboration and consensus, it is possible to address as many of the concerns outlined in the

comprehensive plan as possible and develop solutions that consider a range of perspectives (*History of Land Use Planning*, N.D.).

4.4.1.3 Statewide Natural Hazards Mitigation Program

Oregon maintains a robust and effective natural hazards mitigation planning program through the DLCD. The DLCD engages in efforts that contribute to statewide mitigation and resilience building, such as assisting local governments with developing and updating NHMPs, and providing technical and financial assistance to agency staff, local governments, and individuals.

4.4.1.4 Evaluation of Land Use Planning Goals Related to Natural Hazards

There are several statewide planning goals that pertain to natural hazard management and statewide resilience. Each natural hazard-related goal aims to strengthen and enhance community and state resilience against current and future natural hazard events and conditions, including the effects of climate change.

The primary planning goal related to hazard risk reduction is Goal 7: Areas Subject to Natural Hazards (OAR 660-015-0000(7)). Additional statewide planning goals related to natural hazards mitigation planning include the following (Natural Hazards Mitigation Planning, N.D.):

- Goal 2: Land Use Planning
- Goal 5: Natural Resources, Scenic and Historic Areas and Open Space
- Goal 16: Estuarine Resources
- Goal 17: Coastal Shorelands, and
- Goal 18: Beaches and Dunes.

Goal 7: Areas Subject to Natural Hazards' purpose is "To protect people and property from natural hazards (*Goal* 7, N.D.)." Under Goal 7, local governments must adopt comprehensive plans that contain inventories, policies, and implementation measures to reduce risk to people and property from, at minimum, coastal and riverine floods, landslides, earthquakes and related hazards, tsunamis, coastal erosion, and wildfires. This risk reduction can be achieved through both regulatory and non-regulatory strategies.

The DLCD's Natural Hazards Mitigation Planning Program implements Goal 7 through activities such as leading the periodic updates of the Oregon Natural Hazards Mitigation Plan (NHMP), assisting local governments and tribes directly with developing and updating NHMPs, and providing technical assistance to agency staff, local governments, and individuals with other Goal 7-related projects and questions (*Goal 7*, N.D.). Additionally, this program's staff works collaboratively with DLCD's National Flood Insurance Program (NFIP) staff, Climate Change Resilience Coordinator, and Ocean and Coastal Management Program (OCMP) staff to implement Goal 7 statewide.

Goal 7 establishes a detailed framework and process for local government planning officials to follow when determining the appropriate local response to new hazard information. The process includes evaluating risk, soliciting public comment, and revising policies and implementation measures as appropriate - consistent with outlined principles - and coordinating with DLCD.

Goal 7 also serves as an incentive for all of Oregon's flood-prone communities to participate in the National Flood Insurance Program, as well as the Community Rating System Program (CRS). When a local government adopts measures that exceed the National Flood Insurance Program minimum standards through participation in the CRS, flood insurance policyholders in that jurisdiction will receive discounted premiums.

Despite its positive aspects, Goal 7 is not without challenges. Unlike other statewide land use planning goals, Goal 7 is process-based, and does not include a set of regulations. This makes enforcing it more challenging. Additionally, there is little state funding allocated for Goal 7, constraining implementation.

Goal 2: Land Use Planning requires each local government in Oregon to adopt and adhere to a comprehensive land use plan and implementing regulations and is implemented primarily through the guidance of the DLCD's Community Services Division (*Goal 2*, N.D.). Under Goal 2, cities and counties are required to build their comprehensive plans on a factual foundation and follow the comprehensive plan policies when deciding on appropriate land use designations, zoning, and other implementing actions, including developing in hazards zones (adherence to Goal 7). Comprehensive plans must comply with each applicable Statewide Planning Goal. The Land Conservation and Development Commission (LCDC) reviews each city and county comprehensive plan for compliance with the Statewide Planning Goals. Once LCDC acknowledges a comprehensive plan, the plan drives local land use decision-making.

DLCD staff encourage local governments to incorporate their NHMPs into their comprehensive plans. In this way, hazard risks and vulnerabilities are documented, along with potential mitigation actions that can reduce hazard risks and vulnerabilities. This advances mitigation, as well as encourages the community to continue incorporating the most up-to-date hazard science and data into their planning processes, policies, and regulations.

Goal 5: Natural Resources, Scenic and Historic Areas and Open Space requires local governments to adopt inventories, policies, and implement measures to protect natural resources and conserve scenic, historic, and open space resources for present and future generations (*Goal 5*, N.D.). Implementation of Goal 5 is primarily guided by the DLCD's Natural Resources Planning and Renewable Energy program.

Land use plans can be used to ensure communities have an adequate supply of and access to resources that promote healthy and safe environments. This includes implementing mitigation measures to further reduce risk and enhance community safety. Resource areas and open spaces offer natural hazards mitigation opportunities by buffering development from or absorbing the impacts of natural hazards. Goal 5 implementation can also help jurisdictions determine how to protect historic resources from the potential impacts of natural hazards.

Goal 16: Estuarine Resources provides the principal guidance for the planning and management of Oregon's estuaries. The goal has a twofold purpose: (a) to recognize and protect the unique environmental, economic, and social values of each estuary and associated wetlands; and (b) 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 (*Goal 16*, N.D.). Implementation of Goal 16 is primarily guided by the DLCD's Coastal Management Program.

Comprehensive management programs are used to achieve this goal and are developed by the appropriate local, state, and federal agencies for estuaries. Such objectives can be developed in coordination with a mitigation action.

Goal 17: Coastal Shorelands focuses on the protection and management of coastal shoreland resources, and aims to address the conservation, protection, and as appropriate, development of Oregon's coastal shorelands. It aims to reduce hazards to human life and property, as well as reduce any adverse effects upon water quality and fish and wildlife habitat resulting from the use of Oregon's coastal shorelands (*Goal 17*, N.D.). The implementation of Goal 17 is primarily guided by the DLCD's Coastal Management Program and is implemented through local comprehensive planning and zoning.

Goal 17 advances natural hazard mitigation through active cooperation and collaboration between the DLCD's Coastal Management Program and Natural Hazards Mitigation Planning Program. Through collaboration efforts, Goal 17 supports and advances mitigation efforts focused on protecting natural coastal resources, which can include taking measures meant to reduce natural hazards risk to life, property, and natural resources. Additionally, under Goal 17, jurisdictions are required to maintain inventories that provide information on the characteristics, location, and extent of natural hazards, such as floods and geological hazards.

Goal 18: Beaches and Dunes' purpose is to conserve and protect Oregon's beach and dune resources. It is central to the work of coastal communities when addressing the impacts of coastal hazards and climate change in areas along the ocean shore.

The implementation of Goal 18 is primarily guided by the DLCD's Coastal Management Program. Goal 18 requires coastal communities to inventory beaches and dunes, and describe their stability, hazards, and vulnerabilities. In response, local governments must apply appropriate policies for the use of these areas, including identifying areas where development is permitted or must be prioritized to help restore the resources and benefits of coastal beach and dune areas. Goal 18 also instructs communities to minimize hazard risks to human life and property from any natural or human-induced actions associated with these areas (*Goal 18*, N.D.).

Like Goal 17, the DLCD's Coastal Management Program and Natural Hazards Mitigation Planning Program collaborate on advancing natural hazard mitigation planning to meet Goal 18. This is accomplished by taking measures such as prohibiting development on the most sensitive and hazardous landforms in the beach and dune environment, which includes beaches, active foredunes and other dune areas subject to severe erosion or flooding. Success of this goal is imperative, as Oregon continues to experience significant increases in ocean erosion, in conjunction with climate change and sea level rise. Thus, limiting hard structures along the coast and allowing natural shoreline migration are critical policy tools for conserving and maintaining Oregon's ocean beaches, and advancing mitigation and resilience efforts (*Goal 18*, N.D.).

4.4.1.5 Summary

Throughout its history, the Oregon Statewide Land Use Planning Program and its Planning Goals have had continual success in the protection and management of natural resources and the environment, while still responding to community priorities and reducing community risks and vulnerabilities related to natural hazards. It is through the ongoing collaboration of public and private planning entities and stakeholders that the implementation and maintenance of statewide land use planning goals continue to focus on and advance natural hazard mitigation efforts across the state.

4.4.2 Building Codes

Adoption and adherence to building codes creates stronger and safer buildings, increases sustainability and community resilience, reduces environmental impact, decreases recovery time and efforts following a natural disaster, complies with required guidelines for government assistance, and saves money over the life of a building.

In Oregon, building codes are administered by the Department of Consumer and Business Services' Building Codes Division (BCD). BCD establishes codes according to uniform standards for all residential and commercial buildings across the state, a system that prohibits local governments from enacting conflicting regulations. The BCD adopts, amends, and interprets specialty codes that make up the Oregon State Building Code, as well as provides code development, administration, inspection, plan review, licensing, and permit services, all meant to improve the safe and effective construction of structures in Oregon.

The Building Codes Division strives to ensure safe building construction in Oregon by (a) adopting and administering uniform statewide building codes, (b) providing code and rule interpretation, (c) assisting local government building departments and facilitating dispute resolution, (d) enforcing license, code, and permit requirements, (e) certifying inspectors and licensing trade professionals, (f) facilitating economic development efforts around the state, and (g) conducting inspections where local entities do not.

4.4.2.1 Developing and Adopting Codes and Standards

Oregon building codes are guided by the standards outlined by the International Code Council (ICC), an organization that develops model codes and standards for structure development and construction. Every three years, the ICC updates their model codes to provide guidance on current best practices and standards regarding new construction and updates. The ICC series of model codes includes the following: International Building Code (IBC), International Residential Code (IRC), and International Existing Building Code (IEBC), all of which provide guidance for developing structures and communities built to keep residents and community members safe in the event of a disaster.

Oregon's building codes for commercial structures, called the Oregon Structural Specialty Code (OSSC), was last updated in 2022, and was revised based on the 2021 International Building Code (IBC) and International Existing Building Code (IEBC). With the adoption of the 2022 Oregon Structural Specialty Code (OSSC), building designs in Oregon must comply with the latest building and construction science available.

Oregon is currently in the process of developing the 2025 OSSC, which will include updated building codes for commercial buildings. This update will be informed by the 2024 IBC and 2024 IEBC, as well as the new construction provisions outlined in the 2024 International Fire Code (IFC). The 2025 OSSC is anticipated to be adopted in late 2025.

Building codes for residential structures, called the Oregon Residential Specialty Code (ORSC), was last updated in 2023 and was revised based on the 2021 International Residential Code (IRC). With the adoption of the 2023 Oregon Residential Specialty Code (OSSC), residential building designs in Oregon must comply with the latest building and construction science available.

A number of provisions of the model building codes apply to the design and construction of buildings located in areas prone to natural hazards. The ORSC incorporates several of these model code hazards-related provisions, such as updates to building codes in relation to wildfire. As described in section R327 of the 2021 ORSC, the Building Codes Division (BCD) amended wildfire hazard mitigation building code standards to include standards for additions to existing dwellings and accessory structures, as well as for the replacement of existing exterior elements. Adopting and Enforcing Codes

At the local level, all jurisdictions maintain building codes that they adopt and enforce, but which must be within the state's minimum and maximum standards. Should their local code exceed or conflict with the state's regulations, they must defer to the state's requirements, even if the local code would result in greater structure resilience. Placing a maximum requirement can discourage local governments from pursuing innovative and cost-effective methods of risk reduction.

The issue may be resolved by the state removing the building code maximum requirements, thus allowing local jurisdictions to exceed state requirements. However, removing this requirement would necessitate extensive legislative action at local and state levels of government, a process that may prove difficult to achieve.

4.4.2.2 State Codes and Legislation Relevant to Buildings and Hazards

Table 4.4-1 summarizes state legislation and codes that apply to the design and construction of buildings located in areas prone to natural hazards.

Table 4.4-1 Oregon State Codes and Legislation Related to Buildings and Hazards

Codes /Statute / Legislation	Description	Hazards Addressed
House Bill 2605 (2021): Relating to tsunami risk.	This Bill creates new provisions and amends ORS 455.447. In particular, it a) defines essential facilities and major structures, b) adopts the ASCE tsunami design zone such that Risk Category III and IV structures must now meet minimum standards as described in the ASCE 7-16 (more recently 7-22) tsunami loads chapter, and c) requires DOGAMI to be consulted when designing Risk Category III and IV structures. BCD adopted the tsunami provisions in ASCE-7-16 but put them in an optional Appendix that is only binding if adopted by a city or county. Essentially, it means that communities can decide whether to follow these provisions or not.	Tsunami

Codes /Statute / Legislation	Description	Hazards Addressed
House Bill 3309 (2019): DOGAMI Regulations Reform	The bill removed the prohibition of constructing essential facilities and other defined structures in the tsunami inundation zone, meaning that now all prohibited uses under ORS 455.446-447 become consultation uses. That means that all new essential facilities, hazardous facilities, major structures, and special occupancy structures (as defined in the statute) may now be permitted within the regulatory tsunami inundation line. However, the state adopted an Appendix O in the 2019 Oregon Structural Specialty Code addressing tsunami loading which is available for local adoption.	Tsunami
House Bill 4016 (2024): Additional Home Hardening Grant Program Extension	This bill extended the Department of Consumer and Business Services (DCBS) Building Codes Division's (BCD) home hardening grant program for wildfire survivors and expanded it to include wildfire losses that may occur in the 2024 fire season. It also required BCD and OSFM to write a report to the legislature on what a proactive home hardening grant program would look like by September 15, 2024.	Wildfire
ORS 215.730 (2024): Additional Criteria for Forestland Dwellings	ORS 215.730 (County Planning; Zoning, Housing Codes) provides additional criteria for approving dwellings located on lands zoned for forest and mixed agriculture and forest use. Under its provisions, county governments must require, as a condition of approval, that single-family dwellings on lands zoned as forestland meet certain criteria, such as having a fire-retardant roof, a spark-arrestor for each chimney, and appropriate defensible space maintained around the structure.	Wildfire
R327 (2021): Wildfire Hazard Mitigation – addition to the Oregon Residential Specialty Code (ORSC)	The Building Codes Division (BCD) amended wildfire hazard mitigation building code standards described in section R327 of the 2021 Oregon Residential Specialty Code (ORSC) to include standards for additions to existing dwellings and accessory structures and for replacement of existing exterior elements.	Wildfire

Codes /Statute / Legislation	Description	Hazards Addressed
Section R302 (2023): Fire-Resistant Construction	This chapter is for when fire-resistant construction is required for residential homes and their accessory structure. This is either due to separation between structures on the same property or distance from property line. This type of construction is designed to slow the passage of fire between structures to allow the occupants to safely leave the building and give the fire authority time to stop the spread of the fire. Implementation of this chapter has reduced the spread of fire between buildings.	Wildfire
Section R322 (2020): Flood-Resistant Construction	Buildings and structures constructed in whole or in part in flood hazard areas, including A or V Zones and Coastal A Zones, as established by the floodplain administrator, and substantial improvement and repair of substantial damage of buildings and structures in flood hazard areas, must be designed and constructed in accordance with the provisions contained in this section. Buildings and structures located in more than one flood hazard area must comply with the provisions associated with the most restrictive flood hazard area. Buildings and structures located in whole or in part in identified floodways must be designed and constructed in accordance with ASCE 24.	Flood
Senate Bill 5506 (2023): Extending Fire Hardening Grant Program	This bill expanded an existing BCD program, the Fire Hardening Grant Program, to include people affected by the 2021 wildfires, and allocated an extra $6.3 million for its implementation. With the extension of this initiative into 2024, BCD anticipates a higher level of participation.	Wildfire
Senate Bill 644 (2023): Relating to accessory dwelling units on lands zoned for rural residential use	This legislation amends requirements relating to wildfire hazard mitigation for development of accessory dwelling units (ADUs) on lands zoned for rural residential use. The bill allows, but does not require, counties to permit ADUs in rural residential zones if the ADU complies with the construction provisions of section R327 of the Oregon Residential Specialty Code (wildfire hazard mitigation, also known as home hardening); minimum statewide defensible space standards; adequate access for firefighting equipment, safe evacuation and staged evacuation areas; and other requirements. This legislation has been effective, as at least 13 counties have amended their land use development codes to allow for ADUs in areas zoned for rural residential use.	Wildfire

Codes /Statute / Legislation	Description	Hazards Addressed
Senate Bill 82 (2023): Relating to homeowner insurance for wildfire risk.	Continues the Wildfire Program. Works to partner with Oregon's insurance industry to ensure transparency in rating and underwriting decisions by insurers, as related to wildfire threats. The bill also allows consumers to see how wildfire risk reduction efforts – such as establishing defensible space, hardening homes, and participation in wildfire community preparedness programs – may influence their insurance rating and the availability of insurance. Extends statutory protections found in ORS 742.270 to apply to losses related to a fire subject to an order under ORS 476.510-610.	Wildfire
Senate Bill 96 (1991): Seismic Hazard Investigation	This law requires site-specific seismic hazard investigations before the construction of essential facilities, hazardous facilities, major structures, and special-occupancy structures (e.g., hospitals, schools, utilities and public works, police and fire stations). These requirements are included in the State Building Code. The law also provides for the installation of strong-motion sensors in selected major buildings and mandates that school officials in all public schools lead students and staff in earthquake drills.	Earthquake
Statewide Minimum Defensible Space Requirements (2024)	The purpose of the draft Oregon Defensible Space Code is to establish minimum requirements for protecting life and property. Standards in the code are intended to mitigate the risk to life, structures, and other values from wildfire. Established by the OSFM in consultation with the Oregon Fire Code Advisory Board, these codes are consistent with sections 603 and 604 of the International Wildland-Urban Interface (WUI) Code and best practices specific to Oregon.	Wildfire

Source: Oregon Building Codes

4.4.3 Highlighted Plans and Reports

This section highlights some of the evaluated mitigation plans and reports available in Oregon. The evaluations provide a description of the plans and reports and how they contribute to mitigation efforts. Also, some evaluations describe challenges related to their implementation or use and propose potential solutions.

4.4.3.1 Central Cascades Volcano Coordination Plan (2019) and Mount Hood Coordination Plan (2013)

Author: Oregon Department of Emergency Management (OEM)

Description: Both plans provide vital response and communication information for the areas that will be most affected by a Cascades or Mount Hood volcanic event. These plans play a crucial role in a coordinated effort to enhance the regions' preparedness for emergencies and disasters.

Advances Mitigation: As these plans serve as a coordinated effort to enhance the region's preparedness for emergencies and disasters, they advance planning efforts among impacted communities and counties, multiple state and federal agencies, and Tribes.

Hinders Mitigation: Currently, there is no individual person or agency that oversees either of these plans, so updates will not be pursued unless staff has capacity to convene and facilitate an update process. This can result in updates occurring infrequently.

Potential Solutions: The effectiveness of these plans is in part determined by the frequency of updates and improvements. In an effort to update these plans more regularly and efficiently, OEM is combining the Mt. Hood and Central Cascades Coordination Plans and incorporating them into the Oregon Emergency Operations Plan as an annex.

4.4.3.2 Oregon Climate Assessment (2025)

Author: Oregon Climate Change Research Institute (OCCRI)

Description: The Climate Assessment is a biennial assessment of the state of climate change science as it relates to Oregon and the likely effects of climate change on the state, as well as how it will affect social vulnerability and equity across the state. The most recent update, the seventh Oregon Climate Assessment was published in January 2025.

Advances Mitigation: The assessments have been used to inform natural hazards mitigation and actions to improve community resilience and reduce vulnerability. The assessments generally include sections on changes in climate, climate-related hazards, and effects of climate change on the sectors highlighted in Oregon's Climate Change Adaptation Framework. The assessments are a resource for communicating with the public, decision-makers, and the media.

Hinders Mitigation: The plan is updated on a limited budget. As such, the content included in the assessment is dependent on the availability and generosity of contributors who are not financially compensated.

Potential Solutions: Currently, no solution has been proposed, however, additional funding to support the biennial updates could be pursued in the future.

4.4.3.3 Oregon Resilience Plan (2013)

Author: Oregon Department of Emergency Management (OEM) and Oregon Seismic Safety Policy Advisory Commission (OSSPAC)

Description: House Resolution 3, adopted in April 2011, directed the Oregon Seismic Safety Policy Advisory Commission (OSSPAC) "to lead and coordinate preparation of an Oregon Resilience Plan that reviews policy options, summarizes relevant reports and studies by state agencies, and makes recommendations on policy direction to protect lives and keep commerce flowing during and after a

Cascadia earthquake and tsunami." (OSSPAC 2013) OSSPAC assembled task groups, comprising of volunteer subject-matter experts from the government, universities, the private sector, and the public. An Advisory Group of public- and private-sector leaders oversaw the Task Groups' work, assembled in the portfolio of chapters that make up the plan.

Advances Mitigation: Over the 12 years since the plan was adopted, the plan has served as a valuable resource for seismic risk reduction across the state. Many of its recommendations have been implemented, such as developing a statewide inventory of buildings critical to the basic functioning of the public and private sectors.

Hinders Mitigation: OSSPAC has not updated the Plan since its adoption, as there has been no funding allocated to support an update.

Potential Solutions: There are currently no plans to secure dedicated funding for an update. However, OSSPAC has an effort underway to assess and analyze progress of the 2013 recommendations. This tracking will help the state understand where resilience has advanced and where more attention is needed.

4.4.3.4 Oregon's Integrated Water Resources Strategy (2025)

Author: Oregon Water Resources Department

Description: The IWRS provides a statewide inter-agency framework to better understand and meet Oregon's instream and out-of-stream water needs, which will support resilient communities, local economies, and healthy environments.

Advances Mitigation: The IWRS includes about fifty recommended actions, including three that address natural hazards (drought, floods, and earthquakes), referred to in the 2017 IWRS as "Extreme Events." The IWRS includes many other actions that, if implemented, could support climate resilience.

Hinders Mitigation: Due to limited staffing capacity and funding resources, the engagement and coordination with other agencies and partners needed to accomplish the IWRS's goals and objectives are very limited. As such, there is limited familiarity with or use of the tool across agencies. Additionally, there is limited funding to carry out water management duties, which include developing the water data needed to guide water management decisions.

Potential Solutions: The effectiveness and awareness of the strategy would significantly benefit from hiring 1 FTE at OWRD for the purpose of guiding the Strategy's implementation. Also, additional funding would enable partnering agencies to adequately fund water management responsibilities at all scales (e.g., engagement and technical assistance capacity, planning, data collection and analysis, regulation and enforcement).

4.4.3.5 Wildfire Communities Recommendations Report (2022)

Author: Oregon Department of Land Conservation and Development (DLCD)

Description: DLCD's Wildfire Adapted Communities Recommendations Report, prepared in response to Senate Bill 762 (2021), identified six recommendations for changes to state and local land use planning

programs to reduce risk from wildfire to protect Oregon communities. DLCD provided the report to the Legislature, the Wildfire Programs Director, and the Wildfire Programs Advisory Council on October 1, 2022.

Six recommendations reflect what DLCD heard from community members and leaders about the role land use can play in addressing and mitigating wildfire risk in communities, informed by best practices, including strategies some Oregon communities are already implementing. How and where the built environment exists and expands directly affects how effectively communities can increase their resilience to wildfire. DLCD's recommendations focus on land use and transportation planning actions at a regional, community, or neighborhood scale.

Advances Mitigation: The recommendations included in the report have high potential to be very effective in increasing community resilience by reducing risk from wildfire hazards. Some of the recommendations that are within the DLCD's authority can be accomplished with existing funding and staff capacity are being advanced, such as working with local and state partners to better integrate the planning process for updating Community Wildfire Protection Plans with that of Natural Hazards Mitigation Plans.

Hinders Mitigation: The legislature has not provided DLCD with direction or funding to pursue any of the recommendations included in the report.

Potential Solutions: A potential solution would be to obtain dedicated funds for implementing recommendations.

4.5 Funding

Oregon has been proactive in pursuing funding for hazard mitigation projects available through federal and state sources with the intention of improving statewide hazard mitigation capabilities and further advancing hazard mitigation goals.

The 2025 NHMP State Capability Assessment identified 59 mitigation funding capabilities that support and advance natural hazards planning and mitigation efforts and evaluated their ability to advance and enhance natural hazards mitigation efforts.

4.5.1 State Use of State Mitigation Funds

The state pursues a variety of funding opportunities other than federal mitigation funding, such as state, local, and private sources. While state funding for hazard mitigation and risk reduction remains limited, Oregon has an excellent track record of leveraging limited state resources to successfully complete mitigation planning and projects.

The following section highlights some of the evaluated state mitigation funds available in Oregon. The evaluations provide a description of the funding and how it contributes to mitigation efforts. Also, some evaluations describe challenges related to the implementation or use of these mitigation funding and propose potential solutions.

4.5.1.1 Community Wildfire Protection Plan Investments

Funding Source: Oregon State Fire Marshal (OSFM) and Oregon Emergency Management (OEM)

Description: In 2023, OSFM made a strategic, one-time $2.7 million investment at the local and county levels through funding the development and implementation of community wildfire protection plans (CWPP) to promote wildfire hazard mitigation community resilience across the state.

In 2023, several state agencies, academia, and local emergency managers met to discuss the relationship between CWPPs and natural hazard mitigation plans (NHMP). NHMPs have a chapter covering wildfire hazards, which is also the purpose of CWPPs. The workgroup unanimously agreed that NHMPs and CWPPs are distinct, and they should remain separate documents. The workgroup wrote recommendations for coordinating CWPPs and NHMPs and shared it with the members of the Inter-agency Hazard Mitigation Team.

OEM discussed grant programs with OSFM and the Oregon Department of Forestry (ODF) and then changed priorities in the Hazard Mitigation Grant Program (HMGP) and the Hazard Mitigation Grant Program – Post Fire (HMGP-PF). OEM decided, with agreement from OSFM and ODF, that when Oregon receives HMGP-PF funding, OEM will prioritize CWPPs to update and wildfire plans. HMGP funding from other disaster declarations will prioritize NHMP updates. This ensures that Oregon supports both types of plans because they are both important.

Advances Mitigation: This funding supported numerous wildfire mitigation projects in 25 counties: Baker, Benton, Clackamas, Coos, Crook, Curry, Deschutes, Douglas, Gilliam, Hood River, Jackson, Jefferson, Josephine, Lake, Lane, Lincoln, Linn, Malheur, Marion, Morrow, Multnomah, Polk, Wallowa, Wheeler, and Yamhill. These projects included promoting wildfire-specific community risk reduction efforts, community education, defensible space projects, home assessments, media campaigns, signage, fuel mitigation programs, and grant funds. Awards were announced in February 2023.

Hinders Mitigation: The funding was a one-time investment in 2023-2025 biennium; the legislature may consider continuing it in the 2025-2027 biennium.

Potential Solutions: Currently, no solution has been proposed.

4.5.1.2 Landscape Resiliency Program

Funding Source: Oregon Department of Forestry (ODF)

Description: Led by ODF, the Landscape Resiliency Program was established through Senate Bill 762, Section 18 (2021) to improve forest restoration and resiliency. This grant program funds landscape-scale projects aimed toward reducing wildfire risk on public and private forestlands and rangelands, and in communities near homes and critical infrastructure through the restoration of landscape resiliency and reduction of hazardous fuels. It funds cross-boundary strategic landscapes that may or may not include WUI areas. The Oregon Legislature appropriated $20 million from General Funds for the program. The funds were to be to be spent by the end of the 2021—2023 biennium by the Oregon Department of Forestry (ODF). Any funds from other funding streams may be used as match, but Oregon General Fund may not be used as match.

Advances Mitigation: The program is highly effective in reducing wildfire risk on a landscape scale through cross-boundary collaboration with federal, state, tribal, and local partners. It excels in leveraging federal funds to achieve significant, large-scale impacts and is recognized as one of the 40 critical programs identified in Oregon's 20-Year Landscape Resiliency Strategy. For the 2021-2023 biennium, ODF awarded $19.7 million in landscape resiliency grants to nine cross-boundary projects through 30 individual agreements. This work was completed by June 30, 2023. These investments resulted in $15.8 million of additional matching dollars leveraged, and treatment of 211,915 acres.

Hinders Mitigation: Funding challenges persist. The 2023-2025 biennium saw funding cut in half to $10 million, with uncertain prospects for the 2025-2027 biennium. A recent assessment under the 20-Year Landscape Resiliency Strategy determined that $100 million per biennium is necessary to fully leverage federal funding and achieve Oregon's landscape resiliency and wildfire risk reduction goals.

Potential Solutions: The 2024 Wildfire Programs Advisory Council's annual report contains a recommendation for increasing funding in the next biennium and establishing reliable state and federal funding for resilience projects.

4.5.1.3 Oregon Watershed Enhancement Board

Funding Source: Oregon Watershed Enhancement Board (OWEB)

Description: OWEB provides grants that protect and restore watersheds in Oregon. Grant offerings include: 1) Engagement, which provides funding for grantees to recruit landowners and land managers to implement restoration or protection activities; 2) Technical Assistance, which provides funding for assessment and design work leading to restoration or protection; 3) Restoration, which provides funding for on-the-ground activities that restore watersheds; 4) Acquisition, which provides funding for acquisitions of land or water; and 5) Monitoring, which provides funding for tracking status, trend, or effectiveness of restoration activities. The focus of these grant offerings is fish and wildlife habitat restoration and the protection of water quality, but activities often have community and climate resiliency benefits as well.

Advances Mitigation: OWEB grants have been effective at engaging landowners and land managers across the state to participate in voluntary restoration and conservation actions that improve watershed health. In addition to benefits to fish and wildlife habitat and water quality, restoration actions often have climate adaptation and ecosystem resilience benefits along with opportunities to sequester and store carbon.

Hinders Mitigation: The pace and scale of needed restoration is large, and projects have become increasingly complex and expensive.

Potential Solutions: Increases in leveraged funding and coordination between and amongst funding entities and restoration implementors will be imperative.

4.5.1.4 Resilience Hubs and Networks Grant

Funding Source: Oregon Health Authority (OHA) and Oregon Department of Human Services (ODHS)

Description: The Oregon Legislature approved the Resilience Hubs and Networks Grant program through House Bill 3409, with $10 million allocated to fund the grant. The grant is meant to fund projects that combat environmental justice issues affecting people in Oregon, and to provide resources to communities disproportionately impacted by climate change. This grant aims to support communities to establish places where people can come together daily to share related resources, help people build communities, and store resources that can be distributed in times of emergency.

Advances Mitigation: This capability advances natural hazards mitigation and community resilience by addressing environmental justice and supporting communities impacted by climate change. It enhances resilience through daily resource sharing and emergency support and empowers local networks for climate adaptation. During the 2024-2025 grant cycle, over 700 organizations applied, with 87 organizations from across the state awarded funding.

Hinders Mitigation: Since the allocated $10 million was distributed to the 87 organizations for the purpose of establishing resilience hubs and networks, approximately 600 organizations remain without funding for resilience-building activities. Also, despite over 700 applicants, there remains limited awareness of the grant in communities across the state, which may contribute to an inequitable distribution of funds. Moreover, the $10 million allocated to the program was for the 2023-2025 biennium, with future funding dependent upon the allocation for the 2025-2027 biennium.

Potential Solutions: This grant program would benefit from a dedicated and sustainable funding source, as well as the hiring of specialized staff to provide technical assistance to communities. OHA has proposed enhancing outreach efforts to encourage more communities, such as those that are more rural and those with less capacity, to apply. Enhancing outreach efforts would help the program foster stronger partnerships with local groups for the purpose of enhancing collaboration and resource sharing.

4.5.1.5 Seismic Rehabilitation Grant Program

Funding Source: Business Oregon (BO)

Description: Through Business Oregon, the state's economic development agency, the Seismic Rehabilitation Grant Program (SRGP) is a competitive grant program that provides state funds meant to help enhance the resilience of Oregon's critical public facilities through seismic rehabilitation. The SRGP pays particular attention to public schools and emergency services facilities. Eligible mitigation activities include structural improvements, project management, and engineering.

Advances Mitigation: A requirement for SRGP projects is to ensure the life-safety of the building occupants and the continuity of the facilities' operations as an essential consideration. It also requires that seismic upgrades for emergency services facilities ensure their continued operation and allow for immediate occupancy following a seismic event.

Over the past 4 years, the SRGP has provided almost $389 million in funding, and functions very well as a program. Table 4.5-1 summarizes the breakdown of total funds allocated to schools and emergency services each year.

Table 4.5-1 SRGP Awarded Funds 2020-2024

	2020	2021	2022	2023	2024
Schools	$64,897,165	$47,857,624	$59,423,322	$59,697,462	$55,842,944
Emergency Services	$9,581,669	$17,791,376	$21,428,477	$25,657,281	$26,111,710
Grand Total					**$388,289,030**

Source: Oregon Seismic Rehabilitation Grant Program.

4.5.1.6 Wildfire Season Staffing Grant

Funding Source: Oregon State Fire Marshal (OSFM)

Description: The Wildfire Season Staffing Grant provides funds for local fire agencies to hire firefighters for the fire season. This additional capacity allows fire agencies to respond to more calls, improve response times, and ultimately save more lives.

Advances Mitigation: Between 2023 and 2024, OSFM provided $6 million in one-time funding for local fire agencies to hire firefighters for the fire season. Local agencies could apply for up to $35,000 to hire additional firefighters. In 2022 and 2023, the grant increased capacity by 3,476 firefighters in 220 communities.

Hinders Mitigation: 2024 is the last year for which funding is allocated for this grant.

Potential Solutions: Priority is to secure funding to continue the $6 million wildfire season staffing grant for 2025 and beyond.

4.5.2 State Use of FEMA Mitigation Funds

FEMA Hazard Mitigation Assistance (HMA) grants figure prominently in the state's mitigation funding strategy. The HMA program includes:

- Non-disaster grants
  - *Building Resilient Infrastructure and Communities (BRIC)
  - Flood Mitigation Assistance (FMA)
- Legislative pre-disaster mitigation (LPDM) grants
- Post-disaster
  - Hazard Mitigation Grant Program (HMGP)
  - Hazard Mitigation Grant Program- Post Fire (HMGP-PF)
  - Fire Management Assistance Grants (FMAG)

The state also receives grants from FEMA programs not directly connected to disasters:

- High Hazard Potential Dams (HHPD)
- Emergency management Performance Grants (EMPG)
- Cooperating Technical Partners (CTP)

- Community Assistance Program – State Support Services Element (CAP-SSSE)

The state also uses post-disaster Public Assistance (PA) grants to mitigate natural and dam hazards across Oregon.

As the State Administrative Agency (SAA) for FEMA mitigation grants, OEM is the only entity in Oregon eligible to submit applications and subapplications to FEMA for mitigation grants. In this role, OEM is responsible for managing and administering financial services and grant funding to subapplicants. OEM has been successful in administering and leveraging these federal mitigation grants and programs.

The growing success and positive impact that OEM has had across Oregon is largely due to the significant growth of the OEM Mitigation Team from two staff in 2020 to 15 in 2025. Because of this increase, OEM Mitigation Team now has dedicated staff solely focused on administering non-disaster and post-disaster funding. OEM also uses some of the federal funds it receives as state management costs to contract with consultants to reach out to potential subapplicants, to help subapplicants with benefit-cost analysis (BCA), and to help subapplicants prepare subapplications.

Table 4.5-2, Table 4.5-3, and Table 4.5-4 summarize the number of FEMA mitigation funds for non-disaster (*BRIC and FMA) and post-disaster (HMPG, HMPG-Post Fire) grants that Oregon has been awarded or applied for since 2020, and the FEMA share (75%) of the total project cost allocated to the projects.

Table 4.5-2 Total FEMA Mitigation Grants and Requested FEMA Share of Funds by Phase

Phase	Number	FEMA Funds
Awarded	136	$129,581,730
In Closeout	12	$2,476,087
Subapplication Review	105	$563,526,983
Grand Total	**253**	**$695,584,799**

Source: Oregon Department of Emergency Management.

Table 4.5-3 Number of FEMA Mitigation Grant Funds by Phase and Grant Type

Grant	# Awarded	# In Closeout	# In Review	Total / Grant
***BRIC**	7	1	62	70
FMA	2	-	8	10
HMGP	90	4	23	117
HMGP-PF	29	2	11	42
LPDM	4	-	-	4

Grant	# Awarded	# In Closeout	# In Review	Total / Grant
PDM	4	5	1	10
Grand Total	**136**	**12**	**105**	**253**

Source: Oregon Department of Emergency Management.

Table 4.5-4 Requested FEMA Share of Funds by Grant Type and Phase

Grant	$ Awarded	$ In Closeout	$ In Review	Total / Grant
***BRIC**	$18,004,811	$127,500	$479,808,691	$497,941,002
FMA	$584,145		$21,501,912	$22,086,057
HMGP	$88,732,423	$781,423	$54,441,261	$143,995,107
HMGP-PF	$12,194,099	$608,730	$3,775,119	$16,577,948
LPDM	$6,572,563	-	-	$6,572,563
PDM	$3,493,689	$958,434	$4,000,000	$8,452,122
Grand Total	**$129,581,730**	**$2,476,087**	**$563,526,983**	**$695,584,799**

Source: Oregon Department of Emergency Management.

4.5.2.1 FEMA Non-Disaster Mitigation Funds and Programs

FEMA's non-disaster grant funds, such as *BRIC, FMA, and HHPD, which are made available on a regular basis rather than in response to major disasters (such as FEMA HMGP-Post Fire or FEMA Public Assistance Grants) are an integral component of OEM's mitigation funding strategy. Non-disaster funding covers proactive mitigation actions and measures, which are intended to reduce or eliminate risk to people and property from future natural hazards, ultimately enhancing community resilience.

These non-disaster grant programs and projects are administered through the collaborative efforts of the OEM Agency Director, Deputy Director, Mitigation Section Manager and SHMO, Deputy SHMO for non-disaster grants, Facilities Engineer (Public Assistance Officer), Seismic Grants Coordinator, and financial support staff. Additionally, OEM employs Regional Coordinators, who live and work in designated regions of the state to support local jurisdictions and operations both during and after disasters. The OEM Mitigation and Recovery Regional Coordinators provide their regions with technical and coordination assistance in pursuing mitigation grant opportunities and assist in effectively leveraging state and federal dollars to maximize community risk reduction and be better positioned to recover from disasters. They also collaborate with local jurisdictions to identify, develop, and implement mitigation planning activities that align with community and statewide mitigation efforts.

Although OEM has limited staff to support non-disaster mitigation planning and project implementation activities, the state continues to successfully secure and manage FEMA's *BRIC and FMA grants. In fact,

since 2020, Oregon has been awarded almost $19 million in FEMA non-disaster funds, funding 10 mitigation projects across the state.

*Building Resilient Infrastructure and Communities (BRIC):

Since it replaced the Pre-Disaster Mitigation program in 2020, OEM has leveraged *BRIC funds to implement and effectively manage mitigation projects, securing funding for non-construction planning and pre-construction scoping activities, and introducing innovative programs and new technology applications.

Table 4.5-5 Total *BRIC Applications and FEMA Share of Funds by Phase

Phase of *BRIC Grant	Number of Projects	FEMA Funds
Awarded	7	$18,004,811
In Closeout	1	$127,500
In Review	62	$479,808,691
Total	**70**	**$497,941,002**

Source: Oregon Department of Emergency Management.

Mitigation projects in Oregon funded by *BRIC include:

- NHMP updates
- Code and ordinance updates
- Hazard risk reduction studies
- Seismic retrofit of essential facilities and community lifelines
- Structure hardening
- Relocation of essential facilities out of hazard areas

**On April 4, 2025, FEMA issued an Advisory and related Memorandum officially ending the BRIC Program. On April 16, 2025, FEMA issued a clarifying Advisory canceling the FY 2024 BRIC funding opportunity; canceling FY 2020-2023 BRIC applications for which funds had not yet been obligated or distributed; and canceling fully obligated projects for which funds had not yet been spent. FEMA will determine whether to complete or end obligated phased projects on an individual basis. The unspent funds will be returned either to the Disaster Relief Fund or the US Treasury. The April 16, 2025 Advisory also states, "FEMA is working to develop a new approach to mitigation that is more responsive to state and local requirements, achieves clear mitigation goals, and results in more-timely obligation of funding." Simultaneously, a federally appointed committee is discussing FEMA's future as an agency altogether; its recommendations are due by November 14, 2025. As demonstrated in this subsection, 4.5.2 State Use of FEMA Mitigation Funds, ending the BRIC Program will severely limit the state's and local governments' abilities to reduce risk from natural hazards.*

Flood Mitigation Assistance Program (FMA):

The State has effectively leveraged FMA program funds to support flood mitigation efforts statewide. Successes include implementing projects on priority community flood mitigation measures, securing funding for individual/residential flood mitigation acquisitions and non-construction/demolition scoping activities, and other tangible mitigation products meant to reduce or eliminate risk and damage from future flooding and increase community resilience.

One challenge for the FMA program in Oregon is that at the state level it is underutilized. As seen in Table 4.5-6, only two FMA projects have been awarded since 2020. This lack of utilization could be addressed by combining FEMA mitigation program awareness, information access and resource availability, and targeted outreach to the least participating state jurisdictions to facilitate increased participation.

Table 4.5-6 Total FMA Applications and FEMA Share of Funds by Phase

Phase of FMA Grant	Number of Projects	FEMA Funds
Awarded	2	$584,145
In Closeout	0	$-
In Review	8	$21,501,912
Total	**10**	**$22,086,057**

Source: Oregon Department of Emergency Management.

Mitigation projects in Oregon funded by FMA have been only acquisition of properties in the floodplain.

Rehabilitation of High Hazard Potential Dam (HHPD) Grant Program:

FEMA's Dam Safety Program awards technical, planning, design and construction assistance in the form of grants for rehabilitation of eligible high hazard potential dams. The Oregon Water Resources Department, the state authority for dam safety with specific authorizing laws and implementing regulations, is eligible to apply to HHPD grant.

Oregon has 25 dams eligible for HHPD, and the state was allocated $3,599,417 during Fiscal Year 2024. The State has used these funds to conduct risk level analysis and to draft designs to reduce risk.

In 2022, OWRD was awarded $1,279,408 for rehabilitation of the Big Creek Dam #2, owned by the City of Newport, and Wallowa Lake Dam, owned by the Wallowa Lake Irrigation District. These projects were selected based on the level of risk each dam poses to public safety and the owner's readiness to complete the work.

4.5.2.2 FEMA Post-Disaster Mitigation Funds and Programs

An integral component of OEM's mitigation funding strategy is FEMA post-disaster funding - such as HMGP, HGMP-Post Fire, and Public Assistance Grants - which is only made available following a major disaster declaration. Post-disaster funding supports reactive mitigation actions and measures and facilitates the recovery and rebuilding of a disaster-affected community through constructive mitigation efforts aimed at reducing future risk and preventing future loss of life, property, damages, and costs.

These post-disaster grant programs and projects are administered through the collaborative efforts of OEM's Agency Director, Deputy Director, Mitigation Section Manager and SHMO, Deputy SHMO for post-disaster grants, Facilities Engineer (Public Assistance Officer), Seismic Grants Coordinator, and financial support staff. Through this collaboration, post-disaster mitigation grant programs and project activities have been successfully administered and managed, despite limitations in staffing and available technical assistance.

Furthermore, since 2020, Oregon has experienced more disasters that have resulted in a presidential disaster declaration than in years past. This has opened more post-disaster funding opportunities and has enabled Oregon to use these funds to support more local and statewide hazard mitigation planning as well as supporting numerous local mitigation projects.

Hazard Mitigation Grant Program (HMGP):

HMGP grants improve resilience and help communities reduce both risk and vulnerability. Grant projects contribute to climate resilience. Priority is given to grant proposals that clearly identify and articulate the proposal's benefits and risk reduction to underserved or disadvantaged communities.

Table 4.5-7 Total HMGP Applications and FEMA Share of Funds by Phase

Phase	Number of Projects	FEMA Funds
Awarded	90	$88,732,423
In Closeout	4	$781,423
In Review	23	$54,441,261
Total	**117**	**$143,995,107**

Source: Oregon Department of Emergency Management.

Mitigation projects in Oregon funded by HMGP include:

- NHMP updates.
- Disaster planning for community resources.
- Infrastructure and essential facilities vulnerability assessments.
- Wildfire fuels reduction.

Hazard Mitigation Grant Program – Post Fire (HMGP-PF):

FEMA's Hazard Mitigation Grant Program (HMGP) also provides Post Fire assistance which is available to help communities implement hazard mitigation measures after wildfire disasters.

Table 4.5-8 Total HMGP-Post Fire Applications and FEMA Share of Funds by Phase

Phase	Number of Projects	FEMA Funds
Awarded	29	$12,194,099
In Closeout	2	$608,730
In Review	11	$3,775,119
Total	**42**	**$16,577,948**

Source: Oregon Department of Emergency Management.

Mitigation projects in Oregon funded by HMGP-PF include:

- Backup generators for essential facilities
- Defensible space, and fuels treatment and reduction

Fire Management Assistance Grants (FMAG):

Since 2020, Oregon has had 36 Fire Management Assistance Declarations, with 16 declarations made during the 2020 wildfire season and 12 declarations made during the 2024 wildfire season. As the effects of climate change continue to exacerbate wildfire risk across the state, the FMAG Program continues to be a critical component of helping communities mitigate against future wildfires.

Public Assistance (PA) Grant Program

FEMA’s Public Assistance Program provides supplemental assistance to state, tribal, territorial, and local governments, and certain types of private non-profits so communities can quickly respond to and recover from major disasters or emergencies. Section 406 of the Stafford Act specifically authorizes the assistance FEMA provides under the Public Assistance providing financial support for Repair, Restoration, and Replacement disaster-damaged facilities. Unlike HMGP, the Section 406 funding provides discretionary authority to fund mitigation measures in conjunction with the repair of the disaster-damaged facilities, so it is limited to Public Assistance designated areas/counties and eligible damaged facilities located in those areas.

Section 406 is applied to the parts of the facility that were damaged by the disaster, and the mitigation measure must be intended to directly reduce the potential of future, similar disaster damages to the eligible facility.

FEMA has authorized Section 404 and Section 406 funds seven times between January 2020 and December 2024 under the Presidential Major Disaster Declarations for Oregon, with one identified as a Tribal Declaration.

The Oregon PA program is managed by the state's Public Assistance Officer, who works to identify early mitigation opportunities immediately following a disaster declaration that can frequently be implemented quickly as a component of Section 406 disaster assistance. Oregon has been successful in distributing millions of dollars in reimbursements.

4.5.2.3 State Use of Other FEMA Funds

Cooperating Technical Partners (CTPs):

In Oregon, OEM is a Cooperating Technical Partner (CTP) with FEMA and coordinates the Risk MAP program. DOGAMI and Oregon Partnership for Disaster Resilience (OPDR) are also CTPs. The Oregon RiskMAP program has been successful and effective, providing improved data and mapping products, with 24 out of 36 Oregon counties now having access to digital flood hazard data. Other successful CTP projects include DOGAMI-led debris flow, channel migration, county-level risk assessments, and numerous other projects.

Community Assistance Program — State Support Services Element (CAP-SSSE)

The CAP-SSSE program is part of the NFIP and provides grants to states at shared costs to evaluate local governments' NFIP performance and provide technical assistance to help communities successfully implement the various facets of the NFIP. The CAP-SSSE program provides funds to employ the state's floodplain coordinator.

To fairly assess and evaluate the state floodplain management program performance and capacity to manage the state's NFIP, FEMA uses the Tiered State Framework (TSF). Through the TSF process, states are assigned performance grades based on each state's capability, capacity, performance, and statewide coordination of duties and responsibilities set forth in CFR 60.25(b). TSF grades influence the state's annual statement of work and funding, and FEMA requires a full TSF assessment to be conducted every three years.

Oregon currently is graded as "proficient" by the TSF, which has provided the state with additional funding, expanded funding opportunities, and more autonomy over workplans. This additional funding has allowed the Oregon NFIP to increase capability by providing funds to hire additional staff.

4.5.2.4 State Use of Other Federal Mitigation Funds

Lastly, the state does seek other federal funding opportunities outside of FEMA Mitigation Funds to support hazard mitigation and risk reduction. These funds have helped the state implement mitigation planning and projects.

Community Wildfire Defense Grant Program

Funding Source: United States Forest Service (USFS)

Description: The CWDG is intended to help at-risk local communities and tribes plan for and reduce the risk of wildfire through developing Community Wildfire Protection Plans and enhancing wildfire mitigation efforts and projects.

Numerous Oregon projects located in high fire risk areas were selected for funding through the CWDG Program. This funding has enabled many communities, especially those that are located in high wildfire risk areas and are socially vulnerable, to enhance community wildfire resilience and mitigate against future wildfire risks.

During Round One of Funding in 2023, 10 projects across the state were funded. In Grant County, ODF successfully secured $681,041 in funds to conduct defensible space projects across the county. Projects included conducting fuels reduction treatment on 300 acres of land for Grant County landowners living in the WUI, installing Firewise communities, and conducting outreach and education in high-risk communities, including John Day, Mt. Vernon, and Canyon City.

During Round Two of Funding in 2024, 12 projects across the state were funded.

Continued financial support offered through the grant program is unstable as the funding is slated to end in 2026. If additional funding is added, ODF will continue to support the program through staffing and project coordination.

Community Assistance and Protection Program

Funding Source: United States Bureau of Land Management (BLM)

Description: This program helps individuals and communities to adapt to, prepare for and respond to wildfire. The program offers assistance in developing wildland fire ecology and prevention education materials, assisting communities develop and update wildfire protection plans, and more.

Oregon has not seen significant funding related to projects in Community Assistance Programs. Several projects which have received funding have been associated with fuel treatments on federal lands adjacent to high-risk communities to reduce wildfire impacts in these areas. Coordination with federal partners encourages collaboration and relationship growth.

Limited funding has been available through the competitive process, and Oregon has not seen significant funding related to projects in Community Assistance Programs. It is unlikely that these challenges can be adequately addressed in the next 5 years.

4.6 State Mitigation Strengths, Challenges, and Potential Solutions

Oregon has many strengths in natural hazards mitigation and also faces significant challenges.

4.6.1 State Capability Strengths

The strengths of Oregon mitigation capabilities include a commitment to climate adaptation, expanding financial and technical capacity, and legislation that enhances statewide resilience. The sections below describe examples of these strengths.

4.6.1.1 Strength: Climate Change Adaptation

Description: Since 2020, the state has strengthened capabilities for climate change adaptation. These capabilities include new funding sources, updated building codes, and enhanced technical support.

How it Advances Mitigation: In 2022 DLCD began work on a Climate Change Social Vulnerability Assessment. The department partnered with the Institute for Policy Research & Engagement at the University of Oregon to hold 12 regional workshops around Oregon in the fall of 2022 and the spring of 2023. In 2024 DLCD published a draft of the Climate Change Social Vulnerability Assessment for public review.

The Community Green Infrastructure Grant Program, established in 2024, provides funding to communities to implement green infrastructure projects, such as implementing green stormwater infrastructure or planting native trees. This increases tree cover, which will reduce the risk from extreme heat.

The Resilience Hubs and Networks Grant program funds local communities to establish resilience hubs and networks, which provide resources to communities disproportionately impacted by climate change to enhance community resilience.

4.6.1.2 Strength: Increased Staffing

Description: Since 2020, the state has increased staffing for technical assistance to local communities, outreach, helping applicants apply for federal grants, and managing grants.

How it Advances Mitigation: OEM has added staff and now provides more technical and financial assistance to communities. OEM added Regional Mitigation and Recovery Coordinators to assist local and tribal emergency managers.

Since 2020, the Dam Safety Program has hired additional staff, increasing the pace that it addresses the backlog of vulnerable dams.

In 2022, DLCD hired a new position to focus on wildfire mitigation and implement elements of SB 762 and SB 80.

4.6.1.3 Strength: Legislation

Description: Since 2020, the Oregon Legislature has enacted new and revised legislation to reduce risk. Departments of state government have worked to implement the legislation.

How it Advances Mitigation: In 2021, the Oregon Legislature passed House Bill 2605. This bill imposes new tsunami design standards for certain buildings and structures. Also, the bill requires that these structures be evaluated for vulnerability to seismic geologic hazards or designated as having specified tsunami risk for design. Additionally, designers must consult with DOGAMI when designing Risk Category III and IV structures.

In 2021, the Oregon Legislature passed Senate Bill 762, which appropriated approximately $195 million to wildfire programs that significantly mitigated the risk from wildfires.

Prior to 2021, the OSFM could only mobilize mutual aid resources to wildfires when the governor invoked the Emergency Conflagration Act. SB 762 gave OSFM the authority to mobilize without a declaration from the governor. This has resulted in much quicker response times and makes it much easier to address wildfires before they get out of hand.

The legislature created the Resilience Hubs and Networks Grant program through House Bill 3409, Section 86 in 2023 and appropriated $10 million. The grant program received over 700 applications in its first grant cycle and awarded grants to 87 organizations.

4.6.2 State Capability Challenges and Solutions

Even with Oregon's many mitigation strengths, challenges persist, some of which mirror the strengths.

For instance, while Oregon has expanded its disaster mitigation financial and technical capacities, the state still faces funding constraints and staffing shortages which hinder its ability to implement and provide ongoing support and maintenance of these capabilities. Oregon is learning to prioritize and apply equitable strategies to its processes and activities, particularly regarding resource and funding distribution among higher- and lower-capacity jurisdictions. With time and continued effort, Oregon will be successful in developing strategic solutions and opportunities that build resilience, reduce vulnerabilities, and enhance equity across the state.

Several of the most prominent challenges are described below, with potential solutions.

4.6.2.1 Challenge: Limited Mitigation Support Staffing

Description: Though staffing capacity has increased in some areas since 2020, others still lack staff capacity. This limits technical assistance and outreach to partnering organizations.

How it Hinders Mitigation: OWRD updated the Oregon Integrated Water Resources Strategy in 2025. However, due to limited staffing, coordination with partners was very limited, which limits the benefits.

While new staff at the OWRD Dam Safety Program have made progress in addressing the backlog of vulnerable dams, it will still take decades to address all the dam safety concerns. Additionally, while staff focus on the backlog, they have limited ability to support dam owners**.**

Potential Solutions: Seek funding to hire more technical staff.

4.6.2.2 Challenge: Lack of Consistent and Reliable Funding

Description: Lack of funding for hazard mitigation is a significant obstacle, especially lack of funds for the non-federal share of projects receiving federal grants.

How it Hinders Mitigation: Almost all federal grants require the recipient to provide non-federal funds for a significant share of the project costs, often 25 percent. This is consistently a significant barrier for potential recipients. In 2021, the legislature passed House Bill 5006 in response to the 2020 wildfires. The bill appropriated $20 million to OEM to provide the non-federal cost share for mitigation grants. It helped many recipients, but it was a one-time appropriation. When it is spent, recipients will again struggle to provide the non-federal share.

The legislature provided funding for the Community Wildfire Defense Grant Program, but it ends in 2026.

During the 2023-2025 biennium, funding for the ODF Landscape Resiliency Program declined by 50 percent, from $20 million to $10 million, and funding remains uncertain for the 2025-2027 biennium. The 20-Year Landscape Resiliency Strategy determined that $100 million per biennium is necessary to fully leverage federal funding and achieve Oregon's goals for landscape resiliency and reducing wildfire risk.

Potential Solutions: Seek funding.

4.6.2.3 Challenge: Inequitable access and distribution of resources

Description: Some tribes, counties, and cities lack the ability to apply for mitigation funding, to plan for hazard mitigation, or to implement hazard mitigation projects. These communities apply at lower rates and receive fewer funds than higher-capacity communities.

How it Hinders Mitigation: The subapplication process for the FEMA Flood Mitigation Assistance grant (FMA) is a complex process. This gives larger and higher-capacity jurisdictions a competitive advantage, while lower-capacity jurisdictions are less likely to apply.

Potential Solutions: Simplify application processes.

Hire more staff to provide technical assistance and outreach to lower-capacity jurisdictions so they can apply for grants.

Invest in technology that makes it easier to apply for grants.

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Chapter 5 Mitigation Strategy

Chapter 5 Mitigation Strategy 1

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5.1 Introduction

This chapter contains Oregon's goals for mitigating natural hazards, a prioritized list of mitigation actions supporting those goals, and the status of progress on mitigation actions in the 2020 Oregon NHMP.

The goals are purposefully aspirational, providing the foundation for Oregon's overall mitigation strategy. Oregon has often led in developing innovative and progressive strategies to address issues that impact our residents, economy, natural environment, and built environment. The Oregon Beach Bill (1967), the Oregon Bottle Bill (1971) and the Oregon Land Use Program (1973) are but three historical examples of Oregon's visionary spirit.

Oregon is no less visionary in natural hazard mitigation. The state adopted its first natural hazards mitigation plan in 1992, then updated the plan in 2000, 2004, 2006, 2009, 2012, 2015, 2020, and now 2025. Hazard mitigation planning is a foundation for risk reduction projects and is a high priority for Oregon for state funding, post-disaster FEMA mitigation grants, and non-disaster FEMA grants. Oregon will continue planning for mitigation and implementing mitigation projects to reduce losses from natural disasters.

5.2 Mitigation Goals

The following Oregon natural hazard mitigation goals link the risk assessment and mitigation actions, guiding the direction of future natural hazard risk reduction and loss prevention activities.

1. Develop and implement a comprehensive, statewide natural hazards mitigation program and strategy.
2. Prioritize and direct state mitigation resources and investments to build resilience in the populations and communities indicated by the risk assessment to be the most vulnerable.
3. Align natural hazards mitigation and climate adaptation efforts based on the evolving understanding of the relationships between climate change and climate-related natural hazard events.
4. Minimize loss of life and reduce injuries resulting from natural hazards or high hazard potential dams.[1]
5. Minimize property damage from natural hazards and significant or high hazard potential dams.
6. Minimize damage to historic and cultural resources from natural hazards.
7. Reduce "repetitive" and "severe repetitive" flood losses as defined by the National Flood Insurance Program (NFIP).[2,3]
8. Eliminate development within mapped hazardous areas where the risks to people and property cannot be practicably mitigated.
9. Minimize mitigation project impacts to the environment.
10. Facilitate adoption of the most informative, reliable natural hazards mapping and other information available into local and tribal government planning policy.
11. Increase the resilience of critical or essential conventional (gray) and green infrastructure and services, whether publicly, privately, or investor-owned or non-profit, from natural hazards.
12. Integrate natural features and processes into natural hazard risk reduction actions where possible and practicable to protect people, property, and the environment from natural hazards.
13. Assist local and tribal governments to diversify and strengthen their economies in ways that will make their communities more resilient to natural hazards.
14. Develop and strengthen relationships among governments, community-based organizations, businesses, and others to ensure that people, especially those most vulnerable, can access goods and services during and after natural hazard events.
15. Motivate the whole community[4] to build resilience and mitigate against the effects of natural hazards through engagement, listening, learning, information-sharing, and funding opportunities. Use engagement tools and best practices to reach the people and communities indicated by the risk assessment to be the most vulnerable.
16. Enhance communication, collaboration, and coordination among agencies at all levels of government, sovereign tribal nations, the private sector, community-based organizations, and non-

profits to mitigate natural hazards in the communities indicated by the risk assessment to be the most vulnerable.

[1]"Dams assigned the **high hazard potential classification** are those where failure or mis-operation will probably cause loss of human life." (Federal Guidelines for Dam Safety: Hazard Potential Classification System for Dams, FEMA and Interagency Committee on Dam Safety, 2024)

[2]"**Repetitive loss structure** means a structure covered under an NFIP flood insurance policy that (1) has incurred flood-related damage on two occasions, in which the cost of repair, on average, equaled or exceeded d25% of the value of the structure at the time of each such flood event; and (2) at the time of the second incidence of flood-related damage, the contract for flood insurance contains increased cost of compliance coverage. (44 CFR 77.2, Definitions)." (State Mitigation Planning Policy Guide, FEMA. (2022, eff. 04/19/2023)

[3]"**Severe repetitive loss structure** means a structure covered under an NFIP flood insurance policy and has incurred flood-related damage (1) for which four or more separate claims have been made under flood insurance coverage, with the amount of each claim (including building and contents payments) exceeding $5,000 and with the cumulative amount of such claims payments exceeding $20,000; or (2) for which at least two separate flood insurance claims payments (building payments only) have been made, with the cumulative amount of such claims exceeding the value of the insured structure (44 CFR 77.2, Definitions)." (State Mitigation Planning Policy Guide, FEMA. (2022, eff. 04/19/2023).

[4]FEMA defines "**whole community**" as: "[A] focus on enabling the participation in national preparedness activities of a wider range of players from the private and nonprofit sectors, including nongovernmental organizations and the general public, in conjunction with the participation of all levels of government in order to foster better coordination and working relationships." (State Mitigation Planning Policy Guide, FEMA. (2022, eff. 04/19/2023).

5.3 Prioritized Five-Year Mitigation Actions

The State Interagency Hazard Mitigation Team (IHMT) updated the status of the mitigation actions in the 2020 Oregon NHMP, retaining actions that are in progress or intended for completion. This constituted the initial list of mitigation actions for the 2025 Oregon NHMP. DLCD invited a large group of people – those who indicated interest or participated in the Risk Assessment Upgrade project, IHMT members, tribal representatives, and others – to participate in meetings to review and revise the initial list. The group subjected the list to a number of criteria to yield a final list that meets FEMA requirements and could potentially be accomplished within the five-year life of the Plan. DLCD invited the same large group to prioritize the final list of actions. The result is the following table of prioritized mitigation actions and the hazards they address.

These actions would help mitigate the statewide risk from natural hazards. They focus on actions that would benefit the entire state, a large region, or areas throughout the state. They do not include specific local actions listed in natural hazard mitigation plans adopted by tribes, counties, cities, and special districts. The priority ranking in this list does not preclude an agency from implementing a lower ranked project based on available funding, agency mission, or updated information.

See Chapter 7, Planning Process for further detail about the process of developing the following mitigation action table. See Chapter 3, Risk Assessment for descriptions of each hazard.

Table 5.3.1 Oregon NHMP Five-Year Mitigation Actions

2025 OREGON NHMP FIVE-YEAR MITIGATION ACTIONS					
Priority	**Mitigation Action**	**Contribution to Goal(s)**	**Lead/** Support **Agencies**	**Potential Funding**	**Target Date**
1	Conduct an earthquake risk analysis that focuses on natural hazards' impacts on sites containing hazardous materials. The state does not understand the risks that earthquakes, whether originating inside or outside of Oregon's boundaries, pose to sites with hazardous materials, and the state does not have location specific awareness or emergency plans. The State Mitigation Planning Policy Guide, effective 4/19/23, indicates that the NHMP must address hazardous materials (one of the Federal Emergency Management Agency (FEMA) Lifelines). Integration through Oregon Resilience Plan (ORP).	Determining potential impacts and risk of earthquakes destabilizing hazardous materials would advance **Goals 4 and 5** by providing the information necessary to determine appropriate mitigation actions to minimize loss of life, injuries, and property damage. This action would advance **Goal 11** by providing the information necessary to increase the resilience of critical or essential infrastructure such as tank farms, warehouses, ports and railyards. Further it would advance **Goal 16** because mitigation of the risk(s) identified would require communication, collaboration, and coordination among, at minimum, agencies at all levels of government, sovereign tribal nations, and the private sector.	**DOGAMI/** DEQ, ODOT, DSL	HMGP, BRIC, NEHRP, US EPA Pollution Prevention Grants, US DOT Pipeline and Hazardous Materials Safety Administra-tion Grants	2030
2	Prioritize mitigation and retrofit projects on seismic lifelines. Oregon Department of Transportation (ODOT) Seismic Lifelines Evaluation, Vulnerability Synthesis and Identification Report provides recommended priority corridors but does not provide sufficient detail to prioritize retrofit investment packages. Engineering evaluations and cost estimation are ongoing on a funding-available basis and will inform that prioritization process. Initiatives for integration include the Oregon Highway Plan (OHP) and the Oregon Resilience Plan (ORP).	**Goals 4 & 5** would be met by minimizing loss of life and property damage in seismic lifeline corridors. Prioritizing mitigation and retrofit projects on seismic lifelines advance **Goal 6** by reducing the extent of damage to our infrastructure by a high magnitude earthquake, especially historic structures. **Goal 11** is advanced by increasing the resiliency of essential infrastructure. **Goal 16** is met by integrating multiple plans in coordination of this mitigation action with the potential to bring in local stakeholders in the priority corridor.	**ODOT**/ OEM, OSSPAC	BRIC, HMGP, PDM, NEHRP, ISEA	2030
3	Update the Statewide Hazards-United States (HazUS or HAZUS) analyses for earthquakes. The state needs an updated analysis to understand and improve its resilience. The state conducted the last analysis in 2013 for the Oregon Resilience Plan. Conduct a probabilistic analysis and a magnitude 9 Cascadia Subduction Zone (CSZ) earthquake and tsunami analysis that includes soil types, co-seismic landslides, and liquefaction.	Updating HazUS analysis for earthquakes could meet **Goal 8** with work towards eliminating development within a hazardous area when considering tsunamis, landslides, and liquefaction. **Goal 10** can be achieved by the development of updated mapping of earthquake hazards.	**DOGAMI/** DLCD	ISEA, NEHRP	2030

2025 OREGON NHMP FIVE-YEAR MITIGATION ACTIONS					
Priority	**Mitigation Action**	**Contribution to Goal(s)**	**Lead/** Support **Agencies**	**Potential Funding**	**Target Date**
4	Identify funding to support public transportation providers, counties, cities, special districts, and Tribes in conducting comprehensive vulnerability assessments of their transportation facilities and services. In the 2013 Oregon Resilience Plan, the Oregon Seismic Safety Policy Advisory Council (OSSPAC) identified a near-term need to inventory and assess vulnerability and mitigation opportunities for local street networks, transit assets, ports, airports, and railroads. The Oregon Resilience Task Force in its October 2014 report to the Oregon Legislature suggested ongoing funding inventory, assessment, and mitigation. These activities would reduce vulnerability to a CSZ event. Integration through the Oregon Highway Plan (OHP) and Oregon Resilience Plan. DLCD's Wildfire Adapted Communities Recommendations Report to the legislature (SB 762, 2021) includes an action related to inventory of transportation infrastructure for safe and efficient evacuation and response.	Conducting a comprehensive vulnerability assessment of transportation facilities would be a strong leg in developing a statewide natural hazard mitigation program, **Goal 1**. **Goals 4 & 5** would be addressed by reducing vulnerability, and thus loss of life and property, by reducing transportation and access vulnerability in a CSZ event. **Goal 13** is met through strengthening economies during natural hazard. **Goal 14 & 16** can be advanced through strong collaboration amongst stakeholders and governments.	**OEM/** ODOT	ISEA, PDM, BRIC, FTA Emergency Relief Program	2030
5	Create lidar-based channelized debris flow hazard maps in five communities and assist those communities with post-fire landslide risk reduction. After a wildfire there is an increased potential for landslides, especially life-threatening debris flows. The Oregon Department of Geology and Mineral Industries (DOGAMI) is modeling areas of potential channelized debris flow hazards. The Oregon Department of Land Conservation and Development (DLCD) is assisting the communities with using the mapping to determine mitigation actions they can take to reduce risk.	**Goal 2** is met by this action through investing resources into communities that have already been affected by wildfire with the opportunity of resilience investments based off the mapping. **Goal 3** is met by advancing adaptation actions with the understanding that wildfire, and post-wildfire debris flow and landslide can build resilience based on the evolving understanding from the lidar mapping. **Goal 8** can be advanced by reducing redevelopment in areas that show to be high-hazard debris flow. Debris flow hazard maps in wildfire affected communities can achieve **Goal 9** by reducing redevelopment in areas prone to landslides, thereby reducing debris flow impacts to the environment. **Goal 10** will be aided by the development of flow hazard mapping.	**DOGAMI/** DLCD, ODF	PDM, BRIC	2030

2025 OREGON NHMP FIVE-YEAR MITIGATION ACTIONS					
Priority	**Mitigation Action**	**Contribution to Goal(s)**	**Lead/** Support **Agencies**	**Potential Funding**	**Target Date**
6	Provide technical assistance to tribes, counties and cities to integrate hazard mitigation plans with comprehensive plans. Counties and cities often adopt NHMPs separately or as an appendix to the comprehensive plan and therefore in practice do not use the NHMPs to their full potential. By integrating the two plans, hazard mitigation will be more easily and meaningfully implemented in local land use planning under Statewide Planning Goal 7.	Providing technical assistance, such as directing state resources and staff capacity to local jurisdictions to integrate Natural Hazards Mitigation Plans (NHMPs) with comprehensive plans would build community resilience by advancing **Goal 2**. As NHMPs include the most informative and reliable data and mapping this action will also advance **Goal 10.** By enhancing collaboration and coordination at all levels of government, especially through technical assistance relationships between state government and city, county, special district, and tribal governments, this action supports **Goal 16**.	**DLCD/** OEM	DLCD Technical Assistance Grants, DLCD Voluntary Periodic Review Grants, DLCD Coastal Grants, Oregon Metro, League of Oregon Cities	2030
7	Evaluate the impact of climate change on landslides. Climate change may have multiple effects on landslides in Oregon including increased probability after wildfire and increased intensity and duration of rainfall. Understanding these factors better will help us understand the change to the landslide hazard and how to mitigate. Precipitation-triggered landslides will increase or decrease with changes in climate. Evaluation of this change will be important for the future of Oregon. Integration may be through the Climate Change Adaptation Framework and the Oregon Climate Change Research Institute.	**Goal 3** is directly related to how climate change impacts landslides. **Goal 4 & 5** can be addressed with greater landslide awareness, understanding, and action. **Goal 9** could be addressed regarding how landslides affect the natural environment, particularly green infrastructure, along with water and wastewater facilities (**Goal 11**).	**DOGAMI/** OCCRI, DLCD	USGS-CLHMAP, HMA	2030
8	Update DOGAMI's Rapid Visual Survey database on emergency service buildings. Update the Rapid Visual Survey data for the emergency service buildings in DOGAMI 2007 statewide seismic needs assessment. Include data to assist with conducting benefit cost analyses and for prioritization of mitigation. Integration through Oregon Resilience Plan.	Updating DOGAMI's Rapid Visual Survey database on emergency service buildings will support **Goal 4 and 5** as it identifies where potential risk of injury/death and damage exist, so mitigation action can be taken. It will also advance **Goal 10** by producing more informative, reliable, and comprehensive earthquake risk information which can provide support when applying for mitigation funds and projects, and can be incorporated into local planning policies and guidance. By updating the database on emergency service buildings, it will support **Goal 11** by identifying the buildings that need enhanced resilience.	**DOGAMI**	CTP, NEHRP	2030

2025 OREGON NHMP FIVE-YEAR MITIGATION ACTIONS					
Priority	**Mitigation Action**	**Contribution to Goal(s)**	**Lead/** Support **Agencies**	**Potential Funding**	**Target Date**
9	Assess hazards associated with active crustal faults newly discovered by the statewide lidar program. Particularly in central and eastern Oregon, the major earthquake hazards result from poorly known crustal faults. Lidar has greatly expanded the ability to find these faults; the state should systematically evaluate them using trenching, geophysical and field studies for their potential to generate damaging earthquakes. This action would help communities prepare and mitigate for newly defined hazard areas in central and eastern Oregon. Integration through Oregon Resilience Plan.	Assessing hazards associated with identified active crustal faults can help meet **Goal 4, 5, and 8** as it identifies where risk exists, which can show hazardous area where development can be minimized or eliminated, which can also minimize risk of injury/death and property damage. **Goal 10** can be advanced as this new mapping and information can be integrated/adopted into local and tribal government planning policies.	**DOGAMI**	CTP, NEHRP	2030
10	Provide technical assistance, funding, and alternative pathways and mechanisms to facilitate county, city, special district, and tribal adoption of new hazards mapping and other products and information into their planning policies.	Directing state resources, investments, and state staff efforts toward directly helping local and tribal governments integrate/adopt new hazard mapping and information into planning policies would advance **Goals 2 and 10,** and contribute to more resilient and informed communities.	**DLCD/** OEM	DLCD Technical Assistance Grants, DLCD Voluntary Periodic Review Grants, DLCD Coastal Grants, Oregon Metro, League of Oregon Cities	2030

2025 OREGON NHMP FIVE-YEAR MITIGATION ACTIONS					
Priority	**Mitigation Action**	**Contribution to Goal(s)**	**Lead/** Support **Agencies**	**Potential Funding**	**Target Date**
11	Create a clearinghouse for storing and sharing perishable data collected during natural hazard events according to the state's Perishable Data Plan(s). Emergency responders and community planners alike need access to the best and most current natural hazards data. This project would be a cooperative effort between authoritative data collection and analysis agencies — DLCD, DOGAMI, Oregon Department of Emergency Management (OEM), Oregon Department of Water Resources (OWRD), and federal partners (FEMA, US Army Corps of Engineers, National Weather Service, US Geological Survey) — and would include: • Establishing a single point of online access to reliable data, maps, and information about natural hazards (internal). • Developing, in conjunction with Oregon Department of Administrative Services-Geospatial Enterprise Office (DAS-GEO), a portal to distribute these data (external). • Developing a multi-agency State of Oregon flood hazard website. Integration may be through Risk Mapping, Analysis, and Planning (Risk MAP), Risk Plan, Framework Implementation Teams, OEM's Master Data Set, county city, special district, and Tribal NHMPs, Governor's interagency collaboration initiative, Goal 7 implementation, National Flood Insurance Program (NFIP), Oregon Department of Environmental Quality's (DEQ's) IRIS database, etc.	**Goal 1** is advanced by creating and establishing a clearinghouse to store and share perishable data that aligns with and supports the statewide mitigation program and strategy. Creating a clearinghouse to store and share perishable data would support **Goal 7** because storing and sharing perishable data, such as flooding, is important to understanding areas of flood risk and pose a risk for future potential repetitive and severe repetitive loss properties. A clearinghouse would support **Goal 15** by providing a site and resources for information-sharing and learning. **Goal 16** would also be advanced by enhancing collaboration and data sharing between government agencies and with the public.	**DOGAMI/** DLCD, OEM, OWRD, FEMA, USACE, NWS, USGS	HMGP, BRIC, USACE (Silver Jackets), NOAA-NWS, USGS	2030
12	Evaluate earthquake hazards in Bend region and in other major population centers statewide as resources allow. Systematically map and evaluate faults in the Bend-Sisters area for evidence of recent activity to assess the earthquake hazards for Central Oregon communities. Consider the intersecting hazards associated with both earthquakes and volcanic processes when carrying out these studies. Integration through Oregon Resilience Plan.	Evaluating and assessing earthquakes hazards in the identified areas can help meet **Goal 4, 5, and 8** as it identifies where risk exists, which can show hazardous area where development can be minimized or eliminated, which can also minimize risk of injury/death and property damage, as well as identify properties that need seismic upgrades. **Goal 10** can be advanced as this new mapping and information can be integrated/adopted into local and tribal government planning policies and support future land use planning.	**DOGAMI**	HMGP, BRIC, CTP, NEHRP, USGS, CVO	2030

2025 OREGON NHMP FIVE-YEAR MITIGATION ACTIONS					
Priority	**Mitigation Action**	**Contribution to Goal(s)**	**Lead/** Support **Agencies**	**Potential Funding**	**Target Date**
13	Aid and support community participation in the National Flood Insurance Program (NFIP) and encourage existing Community Rating System (CRS) communities to improve their programs, with emphasis on coastal cities and counties, during the life of each Oregon NHMP. See the CRS Information Center at: http://training.fema.gov/EMIWeb/CRS/ for more information. Each year, DLCD encourages qualified jurisdictions to participate in the CRS program or strengthen their CRS ratings. Integration through the Silver Jackets and Risk MAP programs.	This action supports **Goal 7**, by reducing repetitive and severe repetitive flood losses. It also advances **Goals 4 and 5** by preventing exposure to flood hazards through flood mitigation planning. This mitigation action supports mitigation **Goal 15** because of the CRS program's emphasis on taking action to reduce flood losses and on education and building partnerships to reduce flood losses.	**DLCD/** USACE (Silver Jackets), OEM	NFIP, Risk MAP, USACE	2030
14	Upgrade the Oregon Landslide Warning System consistent with next steps and recommendations in the 2021 Oregon Landslide Warning System report. Upgrades should include rainfall thresholds from local rain gauges and a permanent real-time website showing areas under a landslide warning, and providing guidance on what people can do to protect their lives and property from a landslide.	Upgrading the Oregon Landslide Warning System would advance **Goals 4 and 5** by improving advanced warning of landslides and making warnings more accessible so affected people are aware and can evacuate more quickly and protect their property from landslides. It would advance **Goal 15** because landslide warning information would be shared with the whole community using a real time landslide warning website with guidance for protecting lives and property from landslides.	**DOGAMI/** OEM, ODF, ODOT	HMGP, BRIC, CTP, USGS, ODOT, NHSA	2030
15	Collaborate on a landslide workshop to increase the State's understanding of climate change effects on landslide hazards in Oregon. Climate change may have multiple effects on landslides in Oregon, including rainfall events of increased intensity or duration, some of which will occur not long after wildfires. Understanding these factors better will increase understanding of changes to the landslide hazard and how to mitigate the hazard. Workshops are productive and efficient venues for exchanging information among professionals in the field.	Collaborating on a landslide and climate change workshop will advance **Goal 3** because it will provide information on how climate change affects landslides and align it with mitigating landslide hazard. It will advance **Goal 15** by engaging the community in understanding the effects of climate change on landslides using a workshop as a method of engagement. It will advance **Goal 16** by providing a space for communication and collaboration among agencies to mitigate and better understand landslide hazards.	**DOGAMI/** OCCRI, ODF, DLCD, OEM	Professional Associations	2030
16	Increase availability and distribution of air conditioning systems for the most vulnerable people in areas most at risk to extreme heat events. Continuing efforts to increase availability and distribution of air conditioning systems, particularly in manufactured homes in Cooling Zone 3 and in multifamily homes and apartments across the state, would help alleviate adverse impacts from extreme heat events. OHA has dedicated staff who plan to fund and install air conditioning units in communities most affected by extreme heat, such as manufactured homes and multifamily homes and apartments. Work continues to establish a consistent supply chain of air conditioning units.	Increasing availability and distribution of air conditioning systems will advance **Goal 2** by directing state mitigation resources, specifically OHA staff, funding, and installation resources, toward providing air conditioning units to populations that are most vulnerable to and affected by extreme heat. It will advance **Goal 4** by providing air conditioning units to manufactured homes, multifamily homes, and apartments to prevent heat related death and injury.	**OHA**	OHA, ODHS	2030

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Priority	**Mitigation Action**	**Contribution to Goal(s)**	**Lead/** Support **Agencies**	**Potential Funding**	**Target Date**
17	Add climate change modeling, prescribed fire, and Communities at Risk data into Oregon Wildfire Risk Explorer (OWRE). Integrate data and assessment information from OSU Extension projects. In 2019 ODF and Oregon State University (OSU) completed the Oregon Wildfire Risk Explore (OWRE) through federal grant funding to make the most up-to-date information on wildfire risk available to homeowners, communities, local managers, and planners. The OWRE shows current large fire perimeters and where historical ignitions have occurred. The Quantitative Wildfire Risk assessment developed by the US Forest Service provided the base data for the OWRE. Local governments have used the assessment in updating Community Wildfire Protection Plans (CWPPs), and it provides guidance and educational resources for the public. Since its roll-out, ODF has added a Wildland Urban Interface (WUI) layer to the OWRE and plans to add a new Communities at Risk layer. ODF and OSU will make other updates as data becomes available. Integration through Climate Change Adaptation Framework.	The addition of climate change modeling, prescribed fire, Communities at Risk, and OSU Extension project data into the OWRE supports mitigation **Goals 3, 4, 5, 6, and 9.** Increasingly robust and diverse data and related analysis can inform local CWPP updates and the identification of mitigation actions that reduce impacts from wildfire to people, property, historic and cultural resources, and the natural environment. Additionally, the integration of climate change modeling furthers the understanding of climate change and wildfire, helping to advance **Goal 3.**	**ODF/**OSU	USFS, BLM, FEMA, OSU, ODF	2030
18	Create new lidar-based Landslide Inventory and Susceptibility Maps, especially near population centers. DOGAMI has issued numerous publications and will continue to inventory population centers until all have inventoried. DOGAMI will create these maps in cooperation with local jurisdictions. Specific methods and priority locations are still to be determined. The Oregon Landslide Workgroup will determine the locations. These new maps will enable communities to introduce development restrictions or recommend mitigation strategies in areas highly susceptible to landslides. Once completed, DOGAMI will continue to inventory less populated areas to cover the entire state. Integration may be through Statewide Planning Goal 7.	Creating new lidar-based landslide inventory and susceptibility maps will advance **Goal 8** by providing a more updated understanding of where landslides are likely to occur near populated areas and provide an understanding of where continued development may be impracticable. It will advance **Goal 10** by creating more informative, reliable, and comprehensive landslide inventory and susceptibility mapping. It will advance **Goal 16** by fostering collaboration between DOGAMI and local jurisdictions as they work together to create landslide maps.	**DOGAMI**	CTP, HMGP, BRIC	2030
19	In coordination with the Emergency Coordination Center, review and maintain the state's established Perishable Data Plan(s). Perishable Data Plans establish protocols for the consistent collection and study of impacts on pre-event data collection instruments and post-event landscape impacts.	Reviewing and maintaining the state's perishable data plans will advance **Goal 7** because perishable data plans include flooding, and maintaining perishable flood data is important to understanding areas of flood risk and potential repetitive and severe repetitive loss properties. It will advance **Goal 16** by enhancing collaboration and data sharing between government agencies and with the public.	**OEM**	US ACOE (Silver Jackets), DOGAMI	2030

2025 OREGON NHMP FIVE-YEAR MITIGATION ACTIONS					
Priority	**Mitigation Action**	**Contribution to Goal(s)**	**Lead/** Support **Agencies**	**Potential Funding**	**Target Date**
20	Develop guidance for local cities and counties on how to use Statewide Planning Goal 7, Areas Subject to Natural Hazards, together with other pertinent Statewide Land Use Planning Goals to classify lands subject to natural hazards in the buildable lands inventory and adjust urban growth boundaries in a manner that minimizes or eliminates potential damage to life, property, and the environment while continuing to provide for efficient development patterns. This guidance will help cities and counties integrate local natural hazards mitigation plans with comprehensive plans and will enhance consistency in buildable lands inventories. Integration is through Statewide Planning Goals including Goal 7, Areas Subject to Natural Hazards discourages new development in areas subject to natural hazards. Goal 14, Urbanization, and other Statewide Land Use Planning Goals encourage development within urban growth boundaries.	Developing guidance for local entities on how to use Statewide Land Use Planning Goal 7 will contribute to **Goal 1** because it will help counties and cities across the state to understand Goal 7 better and it will be a step forward in a more comprehensive application of Goal 7 across the state. It will contribute to **Goal 8** by giving cities and counties tools to identify which portions of their jurisdictions are not fit for development or require further mitigation because of potential for harm to people and property.	**DLCD**	CTP, State Funding	2030
21	Conduct a pilot project on two coastal estuaries to develop a framework for modeling sea level rise and to assess the overall impact of sea level rise on the estuaries. Implement sea level rise modeling for the pilot study areas. Use study results to guide a future, more comprehensive and coast-wide assessment of sea level rise impacts. Once completed, use the results to minimize future damage or loss of property and the environment. In 2024, DLCD completed an updated version of the Sea Level Rise Guide for local governments based on this work. Integration through the Climate Change Adaptation Framework.	Conducting a pilot project to develop a framework for modeling sea level rise in estuaries will contribute to **Goal 1** by informing a potential future comprehensive and coast wide assessment that could inform a coastwide strategy. It will contribute to **Goal 10** by providing improved natural hazard information with the potential to be adopted statewide.	**DLCD/** DOGAMI	National Estuary Program Watersheds Grant	2030

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Priority	**Mitigation Action**	**Contribution to Goal(s)**	**Lead/** Support **Agencies**	**Potential Funding**	**Target Date**
22	Fund climate change adaptation and resilience-building activities. Local and Tribal governments are best positioned to develop and implement projects that promote climate change adaptation and build local resilience to climate change. The state can contribute to these efforts by establishing grant programs, and by facilitating local ability to learn about and apply for federal and philanthropic grants.	Adaptation- and resilience-building at the local level will work towards a comprehensive hazard mitigation program (**Goal 1**). Developing a fund for such activities will meet **Goal 2** when addressing vulnerable communities. **Goal 3** is in direct relationship with building a climate change adaptation funding program. Increasing funding availability for climate adaptation projects will have a direct effect on **Goal 11** through supporting grey and green infrastructure. Local economies can be diversified through climate change adaptation (**Goal 13)**. Accessing funds at the local and tribal level can motivate the whole community to build resilience (**Goal 15**). Addressing climate change adaptation at the local and tribal level with available funding will enhance general communication, collaboration, and coordination amongst all agencies and groups by working together in establishing, applying for, and implementing such funding programs (**Goal 16**).	**OEM/** DLCD	Oregon Legislation	2030
23	Provide technical assistance to the counties, cities, and Tribes with the greatest vulnerabilities identified by the risk assessment to undertake resilience activities for the hazards to which they are most vulnerable. Many of the most vulnerable jurisdictions require technical support to understand how to best improve their resilience. A priority region for mitigation against a Cascadia Subduction Zone event is the coast, and should include critical facilities, such as hospitals, healthcare facilities, vulnerable populations, and lifeline infrastructure, such as water and power.	Providing technical assistance to most vulnerable counties, cities, and tribes would advance **Goal 2** by directing state resources and state staff effort toward directly helping local and tribal governments mitigate for hazards that they are most vulnerable to. It would advance **Goal 16** by enhancing collaboration and coordination at all levels of government, especially through technical assistance relationships between state government and local, county, and tribal governments.	**DLCD**	FEMA BRIC Grants, FEMA HMGP, EPA Community Change Grants	2030
24	Install real-time capability on the remaining 7 state-operated stream gauges to make the state's stream gauge network 100% real-time in the year 2025. The availability of timely and accurate data from stream gauges is essential for flood forecasting, for prediction of imminent flood hazards, and for response to flood emergencies. Today, 248 gages provide real-time data; 7 remain to be updated. Other initiatives for integration include the Oregon Integrated Water Resource Strategy and Silver Jackets.	Updating the remaining stream gauges to real-time assessments can minimize loss of life and property damage **(Goals 4 & 5).** Depending on the streams' locations, **Goal 7** could be achieved to reduce repetitive and severe repetitive flood loss. Goal 11 will be met by increasing resilience of gray infrastructure.	**OWRD/** Silver Jackets. DLCD	USGS-GWSIP; BRIC; Clean Water State Revolving Fund (EPA); CDBG	2030

2025 OREGON NHMP FIVE-YEAR MITIGATION ACTIONS					
Priority	**Mitigation Action**	**Contribution to Goal(s)**	**Lead/** Support **Agencies**	**Potential Funding**	**Target Date**
25	Provide outreach to county, city, special district, and tribal governments so they can help residents understand hazards and how to better prepare for the hazard events to which they are most vulnerable. Most of these governments require educational and learning opportunities to understand how to best improve their resilience. Use engagement tools and best practices to equitably engage Oregonians about natural hazard risks. Through the Risk Assessment Upgrade project, DLCD developed a risk assessment tool in a geospatial environment that uses a multiple-criteria decision analysis technique called PROMETHEE. DLCD used the results of this study to identify most vulnerable areas throughout the state and develop dedicated outreach and technical assistance strategies.	Hazard outreach and education would advance **Goals 4**, **14**, and **15**. Communities that are informed of hazards risks are more resilient to hazard events, reducing risk of loss of life during a hazard event. Thus, community education advances **Goal 4**. Outreach and education also strengthen relationships, which advances **Goal 14**. Finally, identifying most vulnerable areas supports **Goal 15**, to motivate the whole community to build resilience and mitigate against the effects of natural hazards.	**DLCD/** OEM	BRIC	2030
26	Undertake inner bay total water level modeling to assess flooding impacts from sea level rise, tides, and storms. Modeling would incorporate inner bay and outer coast processes, similar to modeling performed in Grays Harbor, WA.	Inner bay total water level modeling would advance **Goal 10** by providing informative and up to date information on sea level rise, tides, and storms that can be used in local and tribal government planning policy.	**DOGAMI/** DLCD	NOAA	2030
27	Conduct research on the impact of climate change on flood conditions in Oregon. Flood risk is strongly associated with the dominant form of precipitation in a basin, with mixed rain-snow basins in Oregon already seeing increases in flood risk. Precipitation amount and intensity both impact the type of flooding. Generally, western Oregon basins are projected to experience increased precipitation, and therefore flood risk, in future decades. Increased access to information about the potential impacts of climate change on flood conditions in Oregon by federal and state agencies will help counties, cities, special districts, and Tribes identify mitigation actions that will reduce the potentially increased risk. DOGAMI's risk assessments have provided qualitative statements about the impacts of climate change on flood conditions but do not quantitatively assess these impacts. DOGAMI has incorporated the findings from the Oregon Climate Change Research Institute (OCCRI) on future climate conditions into its studies but will need additional resources to produce a detailed understanding of the impact of climate change on floods in Oregon. Integration through Oregon Climate Change Research Institute and Climate Change Adaptation Framework.	This action advances **Goal 10** because it facilitates refined mapping of one of Oregon's dominant hazards – flood. It also supports **Goal 16**, which seeks to increase communication, coordination, and collaboration between all levels of government.	**OCCRI/** DOGAMI, DLCD	State funds, NOAA, Risk MAP, other research grants	2030

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Priority	**Mitigation Action**	**Contribution to Goal(s)**	**Lead/** Support **Agencies**	**Potential Funding**	**Target Date**
28	Adopt implementing rules for Statewide Planning Goal 7 that require counties and cities to adopt new or updated hazard mapping. Such rules will help protect people and property from the impacts of natural hazards. They also will provide more certainty for developers, especially with respect to housing production and needed infrastructure development or redevelopment.	Adopting rules that require counties and cities to adopt new or updated hazard mapping for Statewide Planning Goal 7 would advance **Goals 4 and 5** by identifying locations of hazard risk to comprehensively protect from loss of life, injury, and property damage. It would advance **Goal 10** by leading to the adoption of informative, reliable, and up to date mapping that would directly apply to planning policy through Statewide Planning Goal 7.	**DLCD**	State funds	2030
29	Establish a climate adaptation and resilience workgroup within the Oregon Climate Action Commission. The 2025 Oregon Climate Action Commission's workplan recommends that a climate change adaptation and resilience work group be established to produce recommendations to improve resilience and to produce materials to help agencies consider how their programs and projects might contribute to or reduce carbon emissions or increase resilience to climate change. This recommendation came from the informal Climate Change Adaptation Framework Implementation Team, a group of 25 state agencies that developed the Climate Change Adaptation Framework (DLCD, 2021)	This mitigation action supports mitigation **Goals 1 and 3** by providing a comprehensive climate change strategy that aligns with natural hazards mitigation programs.	**OHA/** DLCD	OHA	2030
30	Mitigate risks at the Critical Energy Infrastructure (CEI) hub. Align with mitigation occurring under the Oregon Department of Environmental Quality's (DEQ's) Fuel Tank Seismic Stability Program.	Mitigating risks at the CEI Hub would advance **Goal 2** by aligning with and supporting mitigation work being done through DEQ's fuel tank seismic stability program. It would advance **Goals 4 and 5** because the CEI Hub poses a large amount of risk during an earthquake and mitigating seismic hazards will reduce risk to life and property. It advances **Goal 11** by improving the resilience of critical energy infrastructure and services.	**DEQ/** DOGAMI, OEM	DEQ	2030
31	Request the Oregon Legislature to fund the State Disaster Loan and Grant Account immediately following a presidentially declared disaster or other disaster. The State Disaster Loan and Grant Account can be used to fund local government and school district mitigation projects after a Presidentially declared disaster. The Oregon Legislature may authorize deposits to the account when requested. DLCD Technical Assistance Grants, US Department of Housing and Urban Development (HUD) Community Development Block Grant (CDBG), and FEMA's Safeguarding Tomorrow through Ongoing Risk Mitigation (STORM) Act may be initiatives for integration.	Requesting that the legislature fund the State Disaster Loan and Grant Account after a disaster will advance **Goal 2** by prioritizing state funding for disaster recovery and mitigation measures. It will advance **Goal 14** by ensuring that disaster recovery funding is available after a natural hazard event.	**OEM**	DLCD, HUD, CDBG, FEMA STORM Act	2030

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Priority	**Mitigation Action**	**Contribution to Goal(s)**	**Lead/** Support **Agencies**	**Potential Funding**	**Target Date**
32	Develop a proposal to the United States Geological Survey (USGS) to rectify mapping of faults along Oregon's borders with Nevada, Idaho, California and Washington. The USGS fault database includes numerous discontinuous faults, particularly in Eastern Oregon, so that the probabilistic national seismic hazard maps underestimate the hazard. DOGAMI is proposing to create an Oregon-specific Quaternary Faults Database (ORQ-Faults). Part of the ORQ-Faults development would include collaboration with Nevada, Idaho, California and Washington to ensure that faults align across state boundaries. Once that is done, the USGS will be able to use this information.	Working with the USGS to rectify mapping of faults along the Southern and Eastern borders of Oregon will advance **Goal 10** by improving seismic fault mapping and understanding of seismic hazards in these parts of the state which can be applied to mitigation planning policy. It will advance **Goal 16** by facilitating communication and coordination between the USGS and Oregon government agencies.	**DOGAMI**	USGS, NEHRP	2030
33	Add Snow Telemetry (SNOTEL) gauges in Zig Zag near Mt. Hood and in Douglas County. SNOTEL is an automated near real-time data collection network that provides mid- to high-elevation hydroclimatic data from mountainous regions of the western United States. A standard SNOTEL station provides snow water equivalent, snow depth, precipitation, and temperature data. The SNOTEL network is maintained by the United States Department of Agriculture (USDA) Natural Resources Conservation Service Snow Survey and Water Supply Forecasting Program. (NRCS SNOTEL and Snow Course Data | Drought.gov) This information provides data about precipitation and Oregon's water regime that is important for climate assessments, drought, and flood mitigation.	Adding SNOTEL gauges in Zig Zag and in Douglas County will advance **Goal 10** by providing additional data on snowfall and hydroclimatic data for areas where data is not currently being gathered.	**OWRD/** OCCRI, USACE (Silver Jackets)	USDA's NRCS Snow Survey and Water Supply Forecasting Program	2030
34	Complete a hazard mitigation policy legislative needs assessment in collaboration with IHMT agencies. The Oregon NHMP contains specific policy recommendations. In addition, the state of Oregon maintains policies related to natural hazards and the mitigation thereof. It is unclear at this time what legislative action would be needed to fully implement existing and proposed mitigation actions. The State IHMT recommends completing an assessment of the potential legislation needed to implement hazard mitigation policies. Integration may be through Statewide Planning Goal 7 and the National Flood Insurance Program (NFIP).	A hazard mitigation policy legislative needs assessment in collaboration with IHMT agencies will advance **Goal 1** by using a coordinated approach across state agencies to implement a comprehensive approach to legislative priorities for natural hazard mitigation. It will advance **Goal 2** by coordinating between state agencies to develop legislative priorities for how state mitigation resources and investments can best build resilience across the state.	**OEM/** State IHMT	State funds	2030

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Priority	**Mitigation Action**	**Contribution to Goal(s)**	**Lead/** Support **Agencies**	**Potential Funding**	**Target Date**
35	Develop an improved methodology for gathering data on drought and related impacts in the areas most vulnerable to drought as identified through the risk assessment. Include tests of the robustness of drought indicators across future climate scenarios and the frequency of re-evaluation. Although there are areas in Oregon that have suffered from drought, there has not been a coordinated effort to systematically characterize the impact of droughts on Oregonians and ecosystems. Communities are beginning to plan for worst case drought scenarios and need better information about the frequency, duration, and intensity of previous droughts to assess the appropriate response.	An established methodology for gathering data on drought impacts, duration, and frequency would help direct mitigation resources to those drought-affected areas **(Goal 2)** and further align natural hazard mitigation work with climate change adaptation **(Goal 3).** Water and green infrastructure are directly affected by drought impacts (**Goal 11**).	**DLCD/** OWRD, OWEB, OCCRI	NOAA-NIDIS; WaterSMART-DRP; Bureau of Reclamation; OWEB Drought Relief Grants	2030
36	Inventory and evaluate state owned buildings most important to state function (excluding schools, hospitals, and fire stations identified in DOGAMI's 2007 analysis.). Because the state does not have a policy standard for collecting this data, complete information with which to assess the potential for damage to state buildings and critical facilities is not available.	By inventorying and evaluating state owned buildings most important to state function, information necessary to identify appropriate mitigation actions to minimize property damage is provided, which supports **Goal 5. Goal 11** is also advanced by providing information needed to increase the resilience of critical/essential infrastructure and services that are state-owned and operated.	**DOGAMI**	CTP, Risk MAP, HMGP, State funds	2030
37	Conduct seismic mitigation of five coastal facilities that provide medical care and shelter. The coast will experience the strongest shaking and a tsunami from a Cascadia Subduction Zone event, resulting in injuries and displaced people. Residents and visitors will require medical attention. Tsunami refugees will require sheltering. Many of the hospitals on the coast are too small to have inpatient services and space for sheltering; they typically have a small emergency room or clinic and then transport patients to larger facilities. It is very difficult to financially to retrofit a hospital. The Business Oregon Seismic Rehabilitation Program awarded funds to Samaritan Pacific Communities Hospital in Newport in 2017 and Peace Harbor Medical Center in Florence in 2019. Hospitals may not apply due to need for a local match; the grant program requires a full seismic retrofit and it can be hard to segment off areas of buildings. Integration through Oregon Resilience Plan.	Conducting seismic mitigation of coastal facilities that provide medical care and shelter would advance **Goal 2,** as it would prioritize and direct mitigation resources and investments to enhance resilience of these essential coastal facilities. **Goal 5 and 11 a**re supported as these facilities would be more resilient and incur less damage in the event of a natural hazard event, and which would also contribute towards advancing **Goal 4,** as more people would be able to receive medical care and shelter in the event of a natural disaster.	**DOGAMI/** DLCD, OHA, ODHS, OEM	NTHMP, NEHRP, HMGP, BRIC, OHA, ODHS-OREM, Local funds, Private funds	2030

2025 OREGON NHMP FIVE-YEAR MITIGATION ACTIONS					
Priority	**Mitigation Action**	**Contribution to Goal(s)**	**Lead/** Support **Agencies**	**Potential Funding**	**Target Date**
38	For each hazard addressed in the Oregon NHMP, develop guidance that includes example comprehensive plan policy and code language to assist local and tribal governments in planning effectively for resilience to natural hazards. County, city, and Tribal governments often lack up-to-date policies and codes to ensure public safety and increase resilience to natural hazard events, as well as staff capacity and expertise to take on these issues. Such guidance is often requested but the state has not provided funding to support this type of technical assistance for county, city, and tribal governments.	Developing guidance for each addressed hazard advances **Goal 1** by supporting the development of a comprehensive statewide natural hazards mitigation guidance and strategy for each addressed hazard that affects Oregon. **Goal 2** is advanced as mitigation technical assistance resources are provided to assist and guide communities in building resilience to natural hazards and minimizing overall damage, which also helps meet **Goals 4, 5, 6, 7, and 11**. This information could be incorporated into and inform local and tribal planning policies, which advances **Goal 10**. These guides could also enhance communication, collaboration, and coordination across planning entities, which supports **Goal 16.**	**DLCD**	CTP, HMGP, BRIC, State funds	2030
39	Standardize data sources used by the risk assessment tool to create authoritative data layers maintained by the Oregon Geospatial Enterprise Office's Framework Implementation Team (FIT) program. Rather than data being privately held by state agencies, the FIT will make the data available to other state agencies, counties, cities, special districts, Tribes, and the public.	Coordinating and standardizing data to create authoritative data layers advances **Goals 10** and **16**. Fulfilling this goal would support adoption of authoritative hazards information into local planning policy documents, advancing **Goal 10**. Further, standardizing and maintaining data sources can support streamlined identification of vulnerable areas, thus advancing **Goal 16**.	**DLCD/** DAS-EIS	State funds	2030
40	Collaborate on a landslide workshop to increase the state's understanding of co-seismic landslides. Many co-seismic landslides will likely be triggered in the next major earthquake. However, the most likely locations and magnitude of risk are unclear. The co-seismic landslides will be a significant portion of the earthquake hazard and understanding them will help with disaster mitigation both in the absence of and after a disaster.	Collaborating to host a landslide workshop would support the enhancement of communication, coordination, and collaboration between agencies at all levels of government, which would advance **Goal 16**.	**DOGAMI/** DLCD	Professional Associations, NEHRP	2030
41	Re-evaluate extreme precipitation potential. Two studies to evaluate the magnitude of extreme precipitation events in Oregon are in progress and will be complete by the end of 2026. The state will use this information to evaluate extreme flooding in Oregon.	Re-evaluating extreme precipitation potential would contribute to reducing RL and SRL flood loss properties, **Goal 7**. It could also increase resiliency toward our stormwater facility infrastructure, aligning with **Goal 11**.	**OWRD/** OCCRI, OCS	FMA, BRIC	2030
42	Continue to analyze interdependencies between lifelines and energy: assess and plan for backup power needs for critical facilities, such as water/wastewater, fire stations, and hospitals). Provide support for energy resilience at certain facilities. See the Oregon Energy Security Plan for further background.	Interlinking lifelines with critical energy infrastructure directly relates to **Goal 1**. Addressing backup plans for water/wastewater connects to **Goal 11**. Focusing energy support on critical facilities should indicate moving away from development in areas that can't be properly mitigated from natural hazard damage (**Goal 8**)	**ODOE/** DEQ, DLCD, Business Oregon, ODOT	Water/Wastewater Financing Program; Capital Projects Fund (CPF); USDA Community Facilities Grant Program	2030

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Priority	**Mitigation Action**	**Contribution to Goal(s)**	**Lead/** Support **Agencies**	**Potential Funding**	**Target Date**
43	Track loss of life during and after natural hazard events.	Tracking loss of life during and after a natural hazard event is an integral part of minimizing loss of life and reducing injuries during future or subsequent hazards. This would support **Goal 4**.	**OHA/** OEM	OHA, OEM	2030
44	Establish formal and official authority for the State IHMT. Since its formation, the State IHMT has continued to play a major role in hazard mitigation activities, including the development of this hazard mitigation plan. The Oregon Department of Emergency Management (OEM) has recommended that the State IHMT be formally and officially established as an advisory body. Integration initiatives may be through the Governor's Office and the Oregon Seismic Safety Policy Advisory Council (OSSPAC).	Establishing the State IHMT as a formal and official authority will advance the implementation comprehensive, statewide NH mitigation program and strategy, which supports **Goal 1.** As an advisory body, it can help advance **Goal 16** by providing enhancing communication, collaboration, and coordination among agencies to mitigate natural hazards.	**OEM**	State funds	2030
45	Update the state's Peak Discharge Estimation Program. Peak discharge estimation tools can help determine the magnitude and frequency of floods. The state's program provides engineers and land managers with the information needed to make informed decisions about development in or near watercourses. The Peak Discharge Estimation Program is based on a modified version of the U.S. Geological Survey's Bulletin 17b (https://water.usgs.gov/osw/bulletin17b/dl_flow.pdf). The U.S. Geological Survey (USGS) has updated this bulletin to 17c (tm4b5.pdf - Guidelines for Determining Flood Flow Frequency—Bulletin 17C). The Oregon Water Resources Department (OWRD) needs to update its methodology to reflect the more recent guidelines. Initiatives for integration are through the Oregon Integrated Water Resources Strategy. Other actions involve education about flood frequency, especially in the aftermath of a flood.	With the prevalence of larger storm systems and precipitation events, **Goals 4, 5, & 7** would all be assisted through updating the state's Peak Discharge Estimation Program.	**OWRD/** Silver Jackets, DLCD	USGS-GWSIP; BRIC; Clean Water State Revolving Fund (EPA); CDBG; FMA	2030

2025 OREGON NHMP FIVE-YEAR MITIGATION ACTIONS					
Priority	**Mitigation Action**	**Contribution to Goal(s)**	**Lead/** Support **Agencies**	**Potential Funding**	**Target Date**
46	Fund the Oregon Climate Change Research Institute (OCCRI) and the Oregon Climate Service (OCS) to provide state agencies with the data and technical support necessary to increase resilience, promote adaptation to, and reduce risk from climate-related natural hazards. OCCRI and OCS are Oregon's premier agencies producing climate science. The work they do is important not only for managing the state's farms, forests, and fish and wildlife habitats, but also for understanding and mitigating climate-related natural hazards. Their work is foundational to providing for public health, safety, and welfare.	Increasing state and local resilience in climate adaptation by funding OCCRI and OCS directly relates to **Goal 3**. Mitigating climate-related effects on our natural environment through the work of these groups fulfills **Goal 9.**	**OEM/** OCCRI, OCS	State funds	2030
47	Evaluate sediment impacts to Oregon's water resources. Oregon has unique water resources, some of which are for drinking water. Landslides can have a great impact on this resource by delivering large amounts of sediment to surface waters. Evaluation of erosion potential by watershed will help water regulators and providers identify areas for mitigation. Initiatives for integration include the Oregon Department of Environmental Quality (DEQ) and the Oregon Department of Forestry (ODF).	Studying erosion potential near watersheds is foundational to understanding the variety of potential impacts on Oregon's water resources and supports mitigation **Goals 8** and **11**. Such studies will inform development patterns, thus fulfilling **Goal 8** by minimizing or eliminating development in hazardous areas. Additionally, evaluating sediment impacts to water resources, particularly potential landslide impacts on drinking water sources supports **Goal 11** by increasing the resilience of such critical facilities.	**DOGAMI/** DEQ, ODF, OWEB	OWEB	2030
48	Pursue Enhanced Plan status as a collaborative statewide strategy led by the State Interagency Hazard Mitigation Team (State IHMT) and others. Oregon lost enhanced plan status in September 2020 due in large measure to budget and capacity issues. Studies have definitively demonstrated that investing in mitigation generates a significant return on investment (ROI) and reduces the need for costly response and recovery activities. OEM and State IHMT agencies need non-federal financial support for additional staff to match federal mitigation dollars and to engage in non-federally supported yet necessary mitigation activities. These activities include but are not limited to implementation of related state programs; integration among related state programs; integration with county, city, special district and Tribal programs; and technical assistance, both financial and non-financial, for counties, cities, special districts, and tribes. Other initiatives may involve Business Oregon-IFA, NFIP, Climate Change Adaptation Framework, and DCBS-DFR.	Maintaining and enhancing the state's Natural Hazard Mitigation Plan supports the fulfillment of mitigation **Goal 1** by supporting the development of a comprehensive statewide natural hazards mitigation strategy.	**OEM/** DLCD	HMGP, BRIC, State funds	2030

2025 OREGON NHMP FIVE-YEAR MITIGATION ACTIONS					
Priority	**Mitigation Action**	**Contribution to Goal(s)**	**Lead/** Support **Agencies**	**Potential Funding**	**Target Date**
49	Use LIDAR to assess landslide hazards along rights of way. Such data will improve critical infrastructure resilience in the face of landslide events by providing useful information to planners, design professionals and decision makers prior to delivery system construction. Integration may be through Statewide Planning Goal 7.	Using the best available technology to assess landslide susceptibility along right of ways supports the fulfillment of mitigation **Goal 11** by supporting the resilience of critical infrastructure.	**DOGAMI/** ODOT	CTP, HMGP, BRIC, FHWA	2030
50	Strengthen fuel resilience including: 1) geographic diversification of fuel storage and strategic fuel storage facilities and 2) backup power at fuel stations. See the Oregon Energy Security Plan for further background.	Strengthening fuel resilience, such as diversifying fuel storage facilities and ensuring backup power, across the state will contribute towards meeting **Goal 5**, by minimizing potential property damage to the facilities themselves and surrounding properties. It also advances **Goal 11** by enhancing the resilience of these critical/essential infrastructure and services from natural hazards, which also helps ensure people have continued access during and after natural hazard events, which supports **Goal 14.**	**ODOE**	ODOE, US DOE, HMGP, BRIC	2030
51	Improve instrumentation and methods for identifying and projecting different aspects of drought and identifying the communities most vulnerable to drought and its impacts. The Oregon Climate Change Research Institute (OCCRI) assessed drought frequency, duration, intensity, etc., in Oregon as part of the seventh Oregon Climate Assessment. Impacts and vulnerability can be assessed to some extent if objective, quantitative metrics of impact and vulnerability are identified. The Risk Assessment Upgrade is evaluating vulnerability, but more could be done to improve the area covered by ground observations and to incorporate climate instability into drought projections. Other initiatives for integration include the Oregon Integrated Water Resources Strategy.	**Goal 2** is met by using the updated risk assessment to prioritize building resilience against drought in communities indicated to be most vulnerable. **Goal 3** is met by working to implement the Oregon Climate Assessment research into drought vulnerability. Using OCCRI's research directly informs **Goal 10** as it begins to hit the ground in policymaking and/or informing local government decision-making. **Goal 15** would be met through using best practices in OCCRI's evaluation.	**OWRD/** OWEB. OCCRI, DLCD	NOAA-NIDIS; WaterSMART-DRP; Bureau of Reclamation; OWEB Drought Relief Grants	2030
52	Install landslide mitigation measures along transportation corridors that impact five most vulnerable areas. ODOT will install landslide mitigation measures, such as rock bolts, rock nets, catchment basins, benched slopes, horizontal drains, and retaining walls along key corridors as time, funding, and resources allow to reduce the risk of landslide hazards and improve transportation reliability.	Installation of landslide mitigation measures supports mitigation **Goal 11** by enhancing the resilience of critical infrastructure such as roads and bridges. This action also supports mitigation **Goals 15** and **16** by supporting whole community resilience and enhancing collaboration to identify areas most vulnerable to natural hazards.	**ODOT**	ODOT, FHWA	2030

2025 OREGON NHMP FIVE-YEAR MITIGATION ACTIONS					
Priority	**Mitigation Action**	**Contribution to Goal(s)**	**Lead/** Support **Agencies**	**Potential Funding**	**Target Date**
53	Implement actions recommended in the Oregon Resilience Plan that OSSPAC identifies as highest priority and that the state can accomplish within the five-year life of this plan to prepare Oregon's residents to survive and recover from a Cascadia Subduction Zone earthquake and ensuing tsunami.	The Oregon Resilience Plan and its recommended actions are about building resilience and prioritizing mitigation resources and investments for the CSZ event and resulting tsunami, which contributes towards **Goal 2.** These recommended actions aim to minimize injury/death and property damage for the CSZ and tsunami event, which supports **Goals 4 and 5.** The Oregon Resilience Plan and recommended actions can also help to identify hazardous and high-risk areas where to eliminate or minimize development, which advances **Goal 8.** The Plan encourages strong community relationships to ensure that essential goods and services are resilient and remain accessible both during and after a CSZ and tsunami event, which supports **Goal 14. Goal 16** is advanced through the enhancement of communication, collaboration, and coordination between government and public entities to mitigate against CSZ and tsunami event.	**OEM/** OSSPAC	HMGP, BRIC, NEHRP	2030
54	Implement climate change adaptation policies and priorities as set forth in the Climate Change Adaptation Framework (DLCD, 2021). The Climate Change Adaptation Framework, developed in consultation with 25 state agencies, outlines strategic climate change adaptation actions. A Climate Change Adaptation Framework Implementation Team reviews progress toward implementing the strategies. Changes, if any, will be made to the Framework roughly every five years.	This mitigation action supports **Goals 1 and 3** by providing a comprehensive climate change strategy that aligns with natural hazards mitigation programs.	**DLCD**	HMGP, BRIC, NOAA, State funds	2030
55	Develop a plan to create a lifelines backbone for the 11 coastal communities with hospitals. Coastal hospitals will require fuel, electricity, and water to operate after a Cascadia Subduction Zone event. Currently, power and water infrastructure is extremely vulnerable. The coast urgently needs cost-effective methods to ensure reliable power and water. The Oregon Department of Geology and Mineral Industries developed the Coastal Hospital Resilience Project (DOGAMI, 2019) to improve disaster resilience to a Cascadia Subduction Zone earthquake. It includes guidance to be locally self-sufficient for three weeks; evaluates seismic vulnerabilities of hospitals and identifies alternate care sites; and develops a hospital resilience plan. Integration through Oregon Resilience Plan.	Developing a plan to create a lifelines backbone for coastal communities with hospitals would fold into the comprehensive strategy of **Goal 1**. **Goals 4 and 5** would be met by concentrating mitigation and CSZ adaptation around coastal hospitals. **Goals 14, 15, & 16** would be achieved as this action would require a large-scale and wide-ranging effort of multiple forms of governments, community groups, private institutions, and invested individuals on how to organize and sustain resilience of care in such a disaster scenario.	**ODOT/** ODOE, DEQ, DLCD, Business Oregon, OEM	Capital Projects Fund (CPF); USDA Community Facilities Grant Program; HSGP; HMA; BRIC	2030

2025 OREGON NHMP FIVE-YEAR MITIGATION ACTIONS					
Priority	**Mitigation Action**	**Contribution to Goal(s)**	**Lead/** Support **Agencies**	**Potential Funding**	**Target Date**
56	Provide ongoing funding for the expansion of the Oregon Resilience Hubs and Networks Initiative. Resilience Hubs provide shelter, technical support, supplies, and education for all four elements of the disaster cycle: preparation, mitigation, response and recovery. Their presence, access, and activities build community cohesion, establishing and advancing community resilience. Resilience Networks provide the active foundation of the resilience hubs. The Network groups collaborate to support the purposes and activities of a resilience hub.	Providing ongoing funding for the expansion of the Oregon Resilience Hubs and Networks Initiative advances **Goal 2** by directing mitigation resources and investments towards building resilience. This initiative also advances Goal 3 by aligning and coordinating natural hazards mitigation and climate adaptation efforts to enhance community resilience. **Goals 14, 15, and 16** are advanced by using collaboration, communication, and coordination across governments and communities to build resilience and enhance mitigation efforts through information, funding, and resource sharing, which will also contribute towards ensuring that goods and essential services can be accessed during and after natural hazard events.	**ODHS/** OHA, OEM, DLCD	OHA, ODHS, HMGP, BRIC	2030
57	Pursue funding for developing data to support assessments of probability, vulnerability, and risk for drought, windstorms, and winter storms. Drought, windstorms, and winter storms are significant hazards in Oregon. Projections of future drought and, depending on the definition or metric, winter storms are available. Projections of high winds are available but have considerable uncertainty. To better protect the public, Oregon must find funding to develop additional necessary data. Through the Risk Assessment Upgrade, the state continues to gather and use data to better assess these hazards. Other initiatives for integration include United States Department of Agriculture's Natural Resources Conservation Service.	Pursuing funding to develop data for drought, windstorm, and winter storm hazard risks throughout the state supports mitigation **Goals 1**, **3**, and **10**. Creating and implementing best available data concerning these hazards fulfills a statewide mitigation strategy outlined in **Goal 1**. This effort also supports **Goal 10** by creating and maintaining reliable, informative datasets that are available for integration into local planning policy. Finally, this effort supports **Goal 3** by enhancing both instruments and methods for assessing hazards influenced by climate change to holistically understand climate impacts on hazard predictions.	**DLCD/** OWRD, OCCRI, OEM	USDA's NRCS, HMGP, State funds	2030

2025 OREGON NHMP FIVE-YEAR MITIGATION ACTIONS					
Priority	**Mitigation Action**	**Contribution to Goal(s)**	**Lead/** Support **Agencies**	**Potential Funding**	**Target Date**
58	Install High Water Mark (HWM) signs after flood events and co-locate stage crest gauges on select HWM signs. HWM signs installed in high visibility areas increase the general public's awareness of flood risk and drive flood mitigation actions in communities. They spark conversations about past floods and are a good entry point for discussions promoting mitigation actions such as elevating buildings, purchasing flood insurance, and participating in FEMA's Community Rating System (CRS) program. Stage crest gauges co-located with select HWM signs will capture new high-water data when floods occur. Collection of HWM is essential to continued education around flood risk. Use the Silver Jackets perishable data plan as a framework for collecting data across state and federal agencies. Develop a framework to collect HWM data at a community level, which allows for collection of additional flood information. The Silver Jackets team will also provide a collaborative approach to providing flood outreach for flood education from this database of collected high water marks. This action will also require integration through the National Flood Insurance (NFIP) within DLCD's program.	High Water Mark (HMW) signs after flood events increase the public's general awareness of flood risk, thus reducing result of loss of life and property damage (**Goals 4 & 5**). Increasing HWM data and locations will reduce repetitive and severe repetitive flood losses (**Goal 7**). The indirect benefits from HWM signs can strengthen relationships and resilience amongst local governments and groups have access to goods and services by understanding previous impacts and extents, helping communities appropriately assess and prepare for future events (**Goal 14**).	**Silver Jackets/** DLCD; OWRD	USGS-GWSIP; BRIC; Clean Water State Revolving Fund (EPA); CDBG; FMA	2030
59	DFR will teach classes about wildfire insurance coverage between 2025 and 2030. Wildfires have displaced thousands of Oregonians over the last few years. Homeowner's and renter's insurance is a vital tool to financially withstand the impacts of wildfires. DFR hosts information about insuring against wildfire on its website and will continue to lead outreach classes to the public about the value of homeowner's and renter's insurance. DFR utilizes social media and publications.	Consumer education related to fire insurance is a key component of increasing resilience of the whole community, supporting mitigation **Goal 15.** Outreach in communities identified by the risk assessment to be the most vulnerable helps to ensure people have financial resources to withstand the impacts of wildfires.	**DCBS-DFR**	DFR	2030

2025 OREGON NHMP FIVE-YEAR MITIGATION ACTIONS					
Priority	**Mitigation Action**	**Contribution to Goal(s)**	**Lead/** Support **Agencies**	**Potential Funding**	**Target Date**
60	Implement improved tsunami way-finding signage solutions to assist with tsunami evacuation under all conditions (day or night). Hardened and improved evacuation routes may include the use of elevated safe areas (vertical evacuation structures) above the level of modeled inundation. After a Cascadia Subduction Zone earthquake, a tsunami could arrive within minutes. It is essential that residents and visitors be able to move to high ground quickly on foot. This requires clearly marked evacuation routes that pedestrians can navigate even in dark and stormy weather. Where high ground is available, the state should identify projects that will enable Oregon to establish new standards and guidelines for methods to harden and mark wayfinding of tsunami evacuation routes to natural high ground. Where natural high ground is unavailable within the expected evacuation time, evaluate the retrofitting existing facilities or constructing new vertical evacuation structures that rise above the level of tsunami inundation and can serve as safe refuges. DOGAMI has completed Beat the Wave tsunami evacuation analyses for every community on the Oregon Coast over the past 10 years. Improvements include hardening existing routes, developing new evacuation trails, retrofitting bridges, and constructing one or more vertical evacuation structures, where applicable. Integration through the Oregon Resilience Plan.	Tsunamis present unique hazard mitigation opportunities. Implementing improved way-finding signage supports mitigation **Goals 4**, **14**, and **15**. Effective signage is critical to reducing loss of life during a hazard event, thus fulfilling **Goal 4**. Improving wayfinding and encouraging Beat the Wave activities also supports mitigation **Goal 14** by strengthening local relationships among governments, community-based organizations, and businesses. Identifying projects that will enable Oregon to establish new standards and guidelines for methods to harden and mark wayfinding routes, as well as retrofitting existing facilities supports mitigation **Goal 15** by encouraging whole community resilience through information sharing.	**OEM/** DOGAMI, ODOT, DLCD	CTP, HMGP, BRIC, NEHRP, NTHMP	2030
61	Strengthen wildfire and winter storm resilience of electrical transmission and distribution systems focusing on small utilities and energy providers without internal or other resources to build resilience features into systems (before and after disasters). See the Oregon Energy Security Plan for further background.	Strengthening the electrical transmission and distribution systems of small utility and energy providers supports mitigation **Goals 2, 5,** and **11.** Small providers often serve rural areas of the state, which may overlap with communities that are most vulnerable and in need of prioritized resources and investments in support of **Goal 2.** More resilient electrical transmission and distribution systems are less likely to fail or cause damage to surrounding property due to power outage and wildfires, thus supporting **Goal 5. Goal 11** is supported through increased resilience of critical electrical infrastructure and the services it provides and supports.	**ODOE/** OPUC	USDA Rural Development Electric Program, US DOE, FEMA	2030

2025 OREGON NHMP FIVE-YEAR MITIGATION ACTIONS					
Priority	**Mitigation Action**	**Contribution to Goal(s)**	**Lead/** Support **Agencies**	**Potential Funding**	**Target Date**
62	Develop an improved methodology for gathering data on channel migration and related impacts in the communities most vulnerable to channel migration. The methodology would include collecting data during and after major storm events. Although areas in Oregon have been impacted by channel erosion and migration, there has not been a coordinated effort to systematically characterize how frequently, where, or how much this hazard has cost Oregonians. Individual communities respond to this hazard, but a statewide understanding is needed to plan for future channel migration and develop outreach materials and a coordinated response.	Coordinating an effort to systematically characterize temporal and geographic variability of channel migration supports mitigation **Goals 7** and **16**. Mapping channel migration areas supports mitigation **Goal 7** to reduce flood losses. Coordinating such efforts supports **Goal 16**, enhances communication, collaboration, and coordination at all levels of government.	**DOGAMI/** USACE (Silver Jackets)	CTP, USGS, USACE (Silver Jackets)	2030
63	Identify metrics for measuring community resilience.	This mitigation action supports mitigation **Goal 15**, motivating whole community resilience through engagement, listening, learning, information sharing, and funding opportunities. Identifying metrics to measure community resilience requires engaging communities across each of **Goal 15**'s activities.	**DLCD/** OHA	OHA, NOAA, CTP	2030
64	Request and compile seismic and flood information for personnel-occupied buildings from other agencies. Determine flood and earthquake damage and losses expected to occur to the state-owned building inventory and provide advice on higher education buildings. Produce information to enable development of statewide priorities and strategies to guide mitigation of earthquake risk, to protect lives during an earthquake, and to preserve ongoing operations after an earthquake. Use accepted methods to determine building type, construction, and occupancy to estimate damage and losses due to various earthquake scenarios and probabilities relating to building codes. Other initiatives include Oregon Resilience Plan and NFIP.	Producing and compiling flood and earthquake information will help guide related statewide priorities and strategies, which advances **Goal 1.** Information will support efforts to protect lives and structures, which support **Goals 4 and 5. Goal 7** is supported as compiled flood information will help identify and reduce flood losses across the state. Determining hazard risk to state-owned buildings and identifying potential mitigation actions will help advance **Goal 11.**	**DOGAMI/** DAS	State funds	2030
65	Develop a statewide strategy to encourage the purchase of flood insurance. The state regularly recommends flood Insurance as a mitigation strategy as part of public outreach during flood studies and individual NFIP community outreach. It's known that well-insured communities recover faster. A strategy will help the state direct information to underinsured areas thereby reducing vulnerability, facilitating recovery, and increasing access to "increased cost of compliance" funding. Private flood insurance in Oregon (and nationwide) is growing and is estimated at approximately 20% of the market share currently in Oregon. Integration is through the NFIP and CRS.	This strategy would implement **Goal 1** as part of a comprehensive, statewide natural hazards mitigation program and strategy.	**DLCD/** USACE (Silver Jackets)	NFIP, USACE	2030

2025 OREGON NHMP FIVE-YEAR MITIGATION ACTIONS					
Priority	**Mitigation Action**	**Contribution to Goal(s)**	**Lead/** Support **Agencies**	**Potential Funding**	**Target Date**
66	Update hazard probabilities in NHMP for all hazards. The Risk Assessment Upgrade for the 2025 NHMP included updating hazard probabilities. Continue to incorporate the best scientific methods available to develop hazard probabilities in the 2030 NHMP.	Updating hazard probabilities within the risk assessment for use in the state NHMP will support mitigation **Goal 1**, **2**, and **4**. Evaluating and updating probabilities will advance **Goal 1** by supporting the implementation of a comprehensive mitigation strategy. Completing this update will support **Goal 2** by more accurately identifying vulnerable populations and communities and clarifying where state resources should be shared to reduce these vulnerabilities to natural hazards. Finally, updating hazard probabilities supports **Goal 4** by reducing loss of life during a hazard event.	**DLCD/** IHMT Agencies	HMGP, BRIC, State funds	2030
67	Establish an online platform and procedure for collecting and sharing mitigation actions from state, local, and tribal NHMPs. Currently there is no easy way for governments to research and share mitigation actions. Having an online "mitigation action tracker" would facilitate communication, cooperation, collaboration among state, local, and tribal governments, enhancing mitigation planning statewide. Initiatives for integration include local governments' and tribes' natural hazards mitigation programs, and FEMA Region 10's Mitigation Division	Establishing an online platform and procedure to collect and share mitigation actions from NHMPs across the state will enhance mitigation planning and strategies across the state, which supports **Goal 1.** The online platform will also facilitate and encourage communication, collaboration, and coordination among all levels of governments and tribal nations, and encourage, which advances **Goal 16.**	**OEM**	CTP, State funds	2030
68	Provide funding and technical assistance to local governments to use the new guidance on classifying lands subject to natural hazards in their buildable lands inventories and adjusting urban growth boundaries. Local Gov'ts need funding and technical assistance to be able to use the new guidance on how to classify lands subject to natural hazards and adjust urban growth boundaries to protect life, property, and the environment from natural hazards while providing for efficient development patterns within urban growth boundaries. Comprehensive Plan amendments are likely to result. This funding and technical assistance will promote integration through the Statewide Planning Goals and local natural hazards mitigation plans with comprehensive plans.	**Goal 2** is advanced as funding and technical assistance will be directed towards local governments for mitigation and resilience building efforts. Using new guidance to classify lands subject to natural hazards and adjusting UGBs will help protect life, property, and the environment, which supports **Goals 4, 5, and 9.** Applying the guidance will help local governments to provide more efficient and safe development patterns in and around lands subject to natural hazards, which advances **Goal 8.** Additionally, by providing funding and technical assistance to local governments to use and apply new guidance will promote the integration of Statewide Planning Goals and mitigation planning into local comprehensive planning, which advances **Goal 10**.	**DLCD**	DLCD Technical Assistance Grants, DLCD Voluntary Periodic Review Grants, Other State funds	2030

2025 OREGON NHMP FIVE-YEAR MITIGATION ACTIONS					
Priority	**Mitigation Action**	**Contribution to Goal(s)**	**Lead/** Support **Agencies**	**Potential Funding**	**Target Date**
69	Establish an online repository and procedure for storing finalized, FEMA-approved local and tribal NHMPs as well as the Oregon NHMP. Currently there is no single repository for local and tribal NHMPs and very few can be found online in their final format. Assisting local governments and tribes with finalizing their NHMPs after FEMA's final approval (inserting FEMA's final approval letter and effective dates) and uploading them to a single, online repository in a timely manner will provide opportunities for collaboration and improving state and local coordination in mitigation planning. The Climate Change Adaptation Framework and Oregon Explorer are other integration initiatives.	Establishing an online repository and procedure to store NHMPs from across the state will enhance mitigation planning and strategies across the state, which supports **Goal 1,** as well as provide support to local and tribal governments in this process, which supports **Goal 2.** The repository will also provide opportunities to collaborate and coordinate with state, local, and tribal entities in mitigation planning, which advances **Goal 16.**	**OEM**	CTP, HMGP, BRIC, State funds	2030
70	Establish the Oregon NHMP as a living document. Establish a platform for housing the Oregon NHMP and a procedure for continually updating and enhancing it. Other initiatives for integration could include the Climate Change Adaptation Framework.	Continued maintenance of the Oregon NHMP advances mitigation **Goal 1** and **16** by supporting a comprehensive statewide mitigation strategy through ongoing maintenance and updates to the NHMP, thus advancing **Goal 1**. This action also supports the collaboration of state and local agencies by creating and maintaining a venue to evaluate risks and identify most vulnerable populations and communities, thus supporting **Goal 16**.	**OEM/** DLCD	State funds	2030
71	Improve state agency procedures for tracking data on state-owned/leased buildings and critical or essential facilities. Create a policy standard for facilities data collection required from state agencies on an annual basis. Continue to pursue this through the Risk Assessment Upgrade. Develop a facilities data framework standard that best enables hazard mitigation analysis; incorporate data into DAS-CFO DataMart and make available to partner agencies at will. Integration through the Oregon Resilience Plan.	Improving state agency procedures for tracking data on state-owned/leased and critical or essential buildings or facilities advances **Goal 5** by maintaining a more updated and comprehensive inventory of buildings owned and leased by the state and critical and essential buildings and facilities so buildings within hazard zones can be identified and damage can be minimized. It advances **Goal 6** by allowing for the identification of any state-owned or -leased historic and cultural resources and minimize their damage from hazards. It advances **Goal 10** by allowing for the adoption of updated building and facilities data for the best understanding of what assets are exposed to hazards. It advances **Goal 11** by developing a better dataset that includes critical and essential infrastructure that can lead to increased resilience. It advances **Goal 16** through collaboration and communication between state agencies to develop improved procedures and to collect data.	**DOGAMI/** DAS	State funds	2030

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Priority	**Mitigation Action**	**Contribution to Goal(s)**	**Lead/** Support **Agencies**	**Potential Funding**	**Target Date**
72	Develop a database of non-state-owned critical/essential facilities and their property values. FEMA requires the state's plan to: (a) identify critical facilities located in the identified hazard areas, and (b) estimate the potential dollar losses to those structures. Data for non-state-owned critical facilities are incomplete and lack standardization, therefore creating a wide margin of error. Identifying local non-state-owned critical facilities and gathering descriptive data for these structures will help increase the quality of the data, resulting in a more precise understanding of state and regional vulnerabilities and mitigation priorities. These data were developed for previous versions of the Oregon NHMP and have been updated not as a database, but as a data layer to be used in the tool developed through the Risk Assessment Upgrade project. Integration may be through The Oregon Resilience Plan.	Developing a database of non-state-owned critical/essential facilities and their property values advances **Goal 5** by improving knowledge of locations of critical facilities in identified hazard areas so property damage can be minimized. It advances **Goal 10** by facilitating a more comprehensive database of critical and essential facilities that are not owned by the state. It advances **Goal 11** by improving knowledge of locations and values of non-state owned critical and essential facilities so their resilience can be increased.	**DOGAMI/** DAS	State funds	2030
73	Conduct critical infrastructure vulnerability analysis in "most vulnerable jurisdictions" for the hazards to which they are most vulnerable. Most vulnerable jurisdictions require analyses and technical support to improve their resilience.	Conducting critical infrastructure vulnerability analysis in the most vulnerable jurisdictions advances **Goal 2** by directing vulnerability analysis toward the communities that are indicated to be the most vulnerable and in need of technical support. It advances **Goal 11** by focusing analysis and technical support toward critical and essential facilities.	**DOGAMI**	CTP, HMGP, BRIC, NEHRP, NTHMP	2030
74	Identify metrics for tracking whether infrastructure is being built or upgraded to withstand hazard events.	Identifying metrics for tracking whether infrastructure is being built or upgraded to withstand hazard events advances **Goal 11** by enhancing the ability to understand if resilience of critical and essential infrastructure is being increased.	**DLCD/** DCBS-BCD, OEM	State funds	2030
75	Institutionalize interagency bodies that work to advance natural hazards mitigation and climate change adaptation and mitigation.	Institutionalizing mitigation and climate adaptation work will advance mitigation **Goal 3** and **16.** Institutionalizing this work will advance **Goal 3** by supporting further collaboration and alignment of hazards mitigation and climate adaptation policy work occurring across agencies. Additionally, this action will support **Goal 16** by designating a central venue to support interagency coordination to more efficiently address issues and policy concerns.	**DLCD/** OEM	State funds	2030
76	Fill risk assessment data gaps. Some indicators that would have been informative for the risk assessment upgrade could not be used because the data were unavailable or required expensive subscriptions. Ongoing funding would be needed to access the most up-to-date data necessary for local, tribal, and state risk assessment updates into the future.	Risk assessment is the foundation of natural hazard mitigation planning. Thus, eliminating data gaps within the statewide risk assessment fulfills mitigation **Goal 2** by producing accurate results identifying communities most vulnerable to natural hazards impacts.	**DLCD/** DOGAMI, OCCRI	State funds	2030

2025 OREGON NHMP FIVE-YEAR MITIGATION ACTIONS					
Priority	**Mitigation Action**	**Contribution to Goal(s)**	**Lead/** Support **Agencies**	**Potential Funding**	**Target Date**
77	Create a plan to ensure communication continues during public safety power shutoffs and other power loss events. Currently there is no plan for continuing communications requiring power during natural hazard events.	Creating a plan to ensure communication is not disrupted due to hazard-related power loss events would help contribute to communication infrastructure protection and resilience, which supports **Goals 5 and 11.**	**ODOE/** OPUC	State funds	2030
78	Request seismic and flood information from landlords of state-leased spaces as part of analyzing potential new leases and potential renewals. Determine flood and earthquake damage and losses expected to occur to the state-owned/leased building inventory including higher education buildings. Produce information to enable development of statewide priorities and strategies to guide mitigation of earthquake risk, to protect lives during an earthquake, and to preserve ongoing operations after an earthquake. Use accepted methods to determine building type, construction and occupancy, to estimate damage and losses due to various earthquake scenarios and probabilities relating to building codes. Other Initiatives for integration include Oregon Resilience Plan and NFIP.	Compiling flood and seismic risk information will support efforts to protect lives and structures, which support **Goals 4 and 5. Goal 7** is supported as compiled flood information will help identify and reduce flood losses across the state for state-leased spaces. Determining hazard risk to state-owned buildings and identifying potential mitigation and resilience building actions and strategies will help advance **Goal 11**.	**DAS/** DOGAMI	State funds	2030
79	Use DAS-CFO data and investigation of seismic and flood risk to DAS-owned and -leased buildings in an effective, routine decision-making process for building occupancy, maintenance, use and potential mitigation treatments. This information over time can provide for strategic and responsible voluntary flood and seismic upgrades in areas of greatest need for reasonable cost as a part of broader facilities management. Other Initiatives for integration include Oregon Resilience Plan and NFIP	Using DAS-CFO data and investigation of seismic and flood risk in relation to building occupancy, maintenance and use to identify potential mitigation treatments can help reduce loss of life and structures, which supports **Goals 4 and 5.** This could also identify where flood risk is and where to mitigate flood risk, which advances **Goal 7.** This could help identify how and where to increase the resilience of essential structures owned and leased by DAS, which supports **Goal 11.**	**DAS/** OEM, DOGAMI, DLCD	State funds	2030
80	Collaborate and workshop with other professionals to increase understanding of co-seismic landslides that can cause tsunamis. Some of these can occur underwater. New high resolution bathymetry data would increase understanding of what happened in past earthquakes and thus better understand possible future events. Initiatives for integration include Oregon Resilience Plan.	This mitigation action would further mitigation **Goal 11** by increasing agency understanding of co-seismic landslide susceptibility and potential impacts on surrounding communities and infrastructure.	**DOGAMI**	Professional Associations, NTHMP, NEHRP	2030

2025 OREGON NHMP FIVE-YEAR MITIGATION ACTIONS					
Priority	**Mitigation Action**	**Contribution to Goal(s)**	**Lead/** Support **Agencies**	**Potential Funding**	**Target Date**
81	Document the economic, social, cultural, and environmental impacts of drought, especially in the most vulnerable jurisdictions. Documenting past drought conditions and effects, especially impacts on people and the environment, is one component of understanding and preparing for future droughts. Oregon does not have the resources to conduct a thorough analysis of drought's impact to various sectors. Today, most impact-related data are anecdotes. Include in the drought assessments summaries of past drought frequency, distribution, intensity, and duration and projections of future drought conditions. Doing so is critical, especially as climate projections indicate that the Pacific Northwest will more regularly experience warmer temperatures and population projections suggest that human needs for water will increase. Part of this project has been completed through the Risk Assessment Upgrade and the other completed through the 2025 Oregon NHMP Update. Other initiatives for integration include USDA Natural Resources Conservation Service.	Documenting the impacts of drought will advance **Goal 2** by promoting better understanding of drought hazard and what communities are most vulnerable. It will advance **Goal 10** by improving drought data and providing more information on drought that can contribute to local and tribal planning policy.	**OWRD/** OHA	NOAA-NIDIS; WaterSMART-DRP; Bureau of Reclamation; OWEB Drought Relief Grants	2030
82	Support Risk MAP flood hazard map update initiatives throughout the state. FEMA produces new flood hazard maps through the Risk MAP program with support from DOGAMI, USGS, and USACE. The Risk MAP program operates out of OEM. The Risk MAP program prioritizes areas of Oregon for study that have older data, updated LiDAR data, and an interest in new hazard information, resilience and mitigation conversations. DLCD will support the Risk MAP process by helping communities update local floodplain ordinances, and the Risk MAP program will remain responsive to natural hazard mapping and mitigation needs through integration with Silver Jackets and partner outreach.	The Risk MAP program and the multiple agencies supporting and directing local efforts to update flood hazard maps and local floodplain ordinances to build community resilience against flooding advances **Goal 2.** By updating flood hazard maps, new flood hazard information and concerns may arise, which can help in identifying at-risk areas that may require mitigation efforts, which supports **Goal 7.** This updated flood hazard data and information can be used to inform and update local floodplain ordinances, which supports **Goal 10.**	**OEM**	Risk MAP	2030

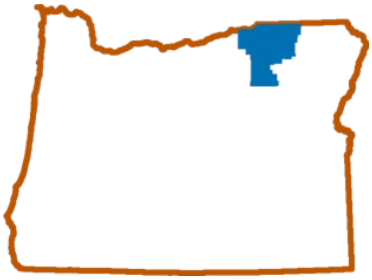
2025 OREGON NHMP FIVE-YEAR MITIGATION ACTIONS					
Priority	**Mitigation Action**	**Contribution to Goal(s)**	**Lead/** Support **Agencies**	**Potential Funding**	**Target Date**
83	Provide education on use of state-of-the-art atmospheric river classification and science in flood resilience. Recent years have seen an increase in understanding of and the science around atmospheric rivers. The Center for Western Weather and Weather Extremes (CWWWE) developed an extensive library of outreach material around these impactful climatic phenomena. The intent of CWWWE's work is to provide practitioners with the necessary tools to be aware of and prepared for flooding. This work by the CWWWE is meant to supplement the National Weather Service's forecasts in a way that provides a longer window of potentially impactful weather patterns. Since atmospheric rivers are a major component of Oregon's flood risk, it is important to educate communities on available information that can supplement existing monitoring activities. Because much of this science is new, the state needs to educate practitioners on these new tools which are meant to build resilience throughout the State.	Clarifying the appropriate use of atmospheric river science and corresponding data in risk assessments and in community outreach supports the advancement of mitigation **Goals 3, 7**, **10**, and **16**. Providing education on atmospheric rivers data collection instruments and the appropriate use of this new science can clarify the link between natural hazards and climate change risks and adaptation, thus furthering mitigation **Goal 3**. Use of this data in mitigation planning advances mitigation **Goal 7** by reducing development within areas at risk of repetitive and severe repetitive flood losses. Use of these data in planning purposes can further mitigation **Goal 10**. Finally, outreach amongst local jurisdictions supports mitigation **Goal 16** by enhancing the coordination and collaboration amongst jurisdictions to mitigate risks of natural hazards.	**USACE (Silver Jackets)/** DLCD, OCCRI	NFIP, USACE, NOAA-NWS	2030
84	Establish a program for studying winter storms and their impacts statewide. As a part of that program, develop a system for gathering snowfall data statewide. Where feasible, expand the network of snow observation stations at strategic locations throughout the state to provide data on snow water content, snow depth, and snowmelt throughout winter and spring across major environmental gradients. Integration through Climate Change Adaptation Framework and the Oregon Climate Change Research Institute.	Tracking weather patterns, including snowfall, supports mitigation **Goals 3** and **7** by systematically gathering weather pattern data and expanding monitoring stations which can support the alignment of hazards risks and projected climate change risks. Additionally, this mitigation action supports mitigation **Goal 7** by clarifying potential flood risks resulting from snow melt.	**ODOT/** OWRD, ACOE (Silver Jackets) OPUC, ODOE, OCCRI	FHWA, State funds	2030
85	Through the Risk Assessment Upgrade, DLCD developed a risk assessment tool in a geospatial environment that uses a multiple-criteria decision analysis technique called PROMETHEE. DLCD used the results of this study to prioritize communities and develop dedicated outreach strategies. To better protect the public, Oregon must find funding to develop additional necessary data. Other initiatives for integration include USDA Natural Resources Conservation Service.	**Goal 2** would be met through strengthening the risk assessment tool. Continual upgrades to the risk assessment tool could strengthen relationships among governments by sharing and disseminating increased risk assessment data (**Goal 14**). **Goals 15 & 16** would be met by using the upgraded risk assessment model in more planning-based scenarios.	**DLCD/** State IHMT Agencies, DAS-GEO	USDA-NRCS, DAS-GEO, Other State funds	2030
86	Undertake needed updates to coastal erosion hazard zones developed for the Oregon Coast. DOGAMI developed existing erosion hazard maps between 2001 and 2007 and in many places on the coast, are now being exceeded by contemporary coastal processes. In some cases, no mapping has been produced.	**Goal 3** would be met through increased coastal erosion updates. **Goal 8** would likely be addressed as developable areas decrease from coastal erosion.	**DOGAMI**	CTP, HMGP, NOAA, NTHMP, NEHRP	2030

2025 OREGON NHMP FIVE-YEAR MITIGATION ACTIONS					
Priority	**Mitigation Action**	**Contribution to Goal(s)**	**Lead/ Support Agencies**	**Potential Funding**	**Target Date**
87	Implement probabilistic tsunami hazard analyses (PTHA) inundation modeling on the Oregon Coast to enable the development of the next generation of tsunami products for coastal communities. Previous DOGAMI tsunami modeling relied on deterministic (scenario-based) Cascadia earthquake rupture processes, and further did not consider friction in the modeling. PTHA allows for consideration of potentially many thousands of scenarios, which helps to better constrain uncertainty levels (e.g., understanding of the rupture process, and short paleoseismic history). Furthermore, PTHA enables the production of inundation products that are risk-based that reflect a range of commonly used average return periods (ARPs), such as the 100, 475, 975, 2,475-year, and either the 4,975-year or potentially an even lower probability event. Such data are critically important in the design of vertical evacuation structures, highway bridges on the coast, and evacuation zones.	**Goals 4 and 5** would be addressed through implementing stronger tsunami hazard analysis modeling. **Goal 8** would likely be strengthened through greater tsunami hazard and inundation awareness, as the modeling could generate stronger development mapping and structural reinforcement. Reinforcement design would be more tailored and effectuated through stronger scenario-based data informing where to design, increasing the resilience of grey and green infrastructure (**Goal 11**). The resilience of such structures would assist those most vulnerable to tsunami inundation scenarios, accomplishing **Goal 14**.	**DOGAMI**	CTP, HMGP, NOAA, NTHMP, NEHRP	2030
88	Fund coastal change monitoring. DOGAMI initiated a coastal monitoring program in 2004 and currently re-surveys core sentinel sites on a seasonal basis. The data generated from this effort have been used in coastal flood risk modeling, in the development of coastal erosion hazard zones and site-specific geotechnical applications. Furthermore, state agencies use the data produced to support decision making (e.g., OPRD). These data are essential for understanding existing and future coastal hazards, and are thus essential for increasing community resilience, promoting adaptation to, and reducing risk from coastal-related hazards (erosion and flooding).	Continual funding of the coastal change monitoring program would add a strong coastal element towards **Goal 1**, the development of a statewide hazard mitigation program. RL and SRL flood losses would be directly mitigated through the implementation of data gathered from this program (**Goal 7**). Unique coastal environments (dunes, eelgrass, scrub shrub, swamp forests) could have mitigation actions established based on the data acquired from this program (**Goal 9**). Most mitigation actions attributed from this program would utilize natural features and systems, meeting **Goal 12**. In the event of catastrophic coastal events, the coastal monitoring program could produce greater coordination outcomes by identifying critical resources and routes (**Goal 14**).	**DOGAMI**	CTP, NOAA	2030
HHPD-1	Continue assessing risk for state-regulated high hazard potential dams (HHPDs).	This mitigation action supports mitigation **Goals 4** and **5** by providing the basis for action to study and evaluate risks resulting from high hazard potential dams. Continued monitoring and assessment of state-regulated high hazard potential dams (HHPDs) is essential to supporting **Goal 4**, and reducing loss of life from natural hazards and high hazard potential dams. Additionally, continued monitoring and assessment supports **Goal 5**, minimizing property damage from natural hazards and high hazard potential dams.	**OWRD**	FEMA's HHPD Program, State funds	2030

2025 OREGON NHMP FIVE-YEAR MITIGATION ACTIONS					
Priority	**Mitigation Action**	**Contribution to Goal(s)**	**Lead/** Support **Agencies**	**Potential Funding**	**Target Date**
HHPD-2	Support an initiative to develop funding for rehabilitation efforts for high hazard potential dams (HHPDs).	Rehabilitating high hazard potential dams supports mitigation **Goals 4** and **5** by reducing risks to people and property. Rehabilitation of known high hazard dams is critical to achieving **Goal 4**, protecting people, and **Goal 5**, protecting property.	**OWRD**	State funds	2030
HHPD-3	Complete floodplain management plans for inundation areas below priority high hazard potential dams (HHPDs).	Completing floodplain management plans supports mitigation **Goals 4**, **5**, and **7**. Completing floodplain management plans supports **Goal 4**, protect people, and **Goal 5**, protect property, as robust management supports holistic hazard mitigation. Additionally, completing floodplain management plans reduces flood losses as defined by the NFIP, supporting mitigation **Goal 7**.	OWRD	FEMA's HHPD Program, State funds, Local funds, Private funds	2030
HHPD-4	Re-evaluate extreme precipitation potential for high hazard potential dams (HHPDs).	Updated evaluation of extreme precipitation potential supports mitigation **Goals 4 and 5** by contributing an up-to-date and robust knowledge of the risks presented by high hazard potential dams.	**OWRD/** OCCRI, OCS	NOAA, State funds	2030

5.4 Mitigation Success Stories

5.4.1 Umatilla Flood Mapping Upgrades



Hazard: Flood

Location: Pendleton, Oregon – Umatilla River

Quick Facts

Goals:
4 – Protect Life
5 – Protect Property
8 – Eliminate development in hazardous areas

Mitigation Actions:
39, 62, 85

Lead Agency:
OWRD

Project Type:
Elevation, Mapping, HWM

Project Start:
02/05/2020

Project End:
12/31/2024

Project Cost:
$200,000

Funded By:
FEMA
US Army Corps of Engineers

Context – Beginning on Wednesday, February 5, 2020, several strong weather systems passed through northeastern Oregon resulting in heavy rain combined with snowmelt. This caused historic flooding along the Umatilla River through the City of Pendleton. This flood, coupled with flooding along tributaries to the Umatilla River in previous years, elevated flood concerns in Umatilla County.

Problem – Migration of the Umatilla River resulted in flooding adjacent property and invalidating effective flood maps. The impacted area consisted of a large watershed and the City of Pendleton and County had no significant expertise or funding to accomplish a remapping of the watershed.

Solution/Benefits – After the flood, the Oregon Silver Jackets team (a subcommittee of the Interagency Hazard Mitigation Team (IHMT)) leveraged programs of federal/state partners to assist the local communities. The USGS, OWRD, and the Corps performed site visits after flooding to collect high water marks. The high-water marks were used by OWRD to assess the frequency of floods and fill in missing information from the gaged data. The Corps levee safety program inspected levees and provided technical support to the communities. FEMA and the Corps partnered to scope out a flood study that collected survey data and models that will be used for a remapping study through FEMA's risk map program. DOGAMI will be receiving funding to assess channel migration zones. The Corps floodplain management program was leveraged to model McKay Creek from McKay Reservoir to the Umatilla River.

Figure 1: Umatilla River flood of 2020.

Figure 2: Collection of HWM by OWRD staff.

Figure 3: USGS Surveying HWM data in a flooded development adjacent to the Umatilla River.

Figure 4: Collection of HWM along a riprap bank protection along the Umatilla River.

5.4.2 Willamette River Flood Mapping

Hazard: Flood

Location: City of Portland, Oregon

Context – The Oregon Silver Jackets group, a flood sub-committee to the State's Interagency Hazard Mitigation Team (IHMT), takes advantage of available federal programs to meet state and local objectives. The Corps of Engineers Floodplain Management Program was leveraged to help the City of Portland develop a model that can be used to manage floodplain along the Lower Willamette River.

Problem – The current effective model for the Lower Willamette River from Willamette Falls to the Columbia River Confluences is based on an outdated model developed in 1980. The City of Portland requires a "no-rise" analysis be performed for any activity within the channel. Superfund sites located along the Willamette River as subject to these No-Rise analysis; however, the current effective model is not suitable for these analyses.

Solution/Benefits – The Corps of Engineers in partnership with the Oregon Silver Jackets Team received funding to develop a flood model for the Lower Willamette River from Willamette Falls to the Columbia River confluence. This model is based on the best available LiDAR data and a bathymetric dataset developed by the City of Portland. This bathymetry is based on a compilation of the best available data and current survey of bridges along the Willamette. The resulting model was accepted by the City of Portland and FEMA to facilitate no-rise analyses by the superfund projects.

Quick Facts

Goals:

8 – Eliminate development in hazardous areas

9 – Minimize mitigation project impacts to the environment

12 – Integrate natural features and processes into risk reduction actions to protect people, property, and the environment from natural hazards.

Mitigation Actions:

39, 62, 85

Lead Agency:

DLCD

US Army Corps of Engineers

Project Type:

Elevation, Mapping

Project Start:

05/02/2020

Project End:

01/01/2025

Project Cost:

$100,000

Funded By:

US Army Corps of Engineers

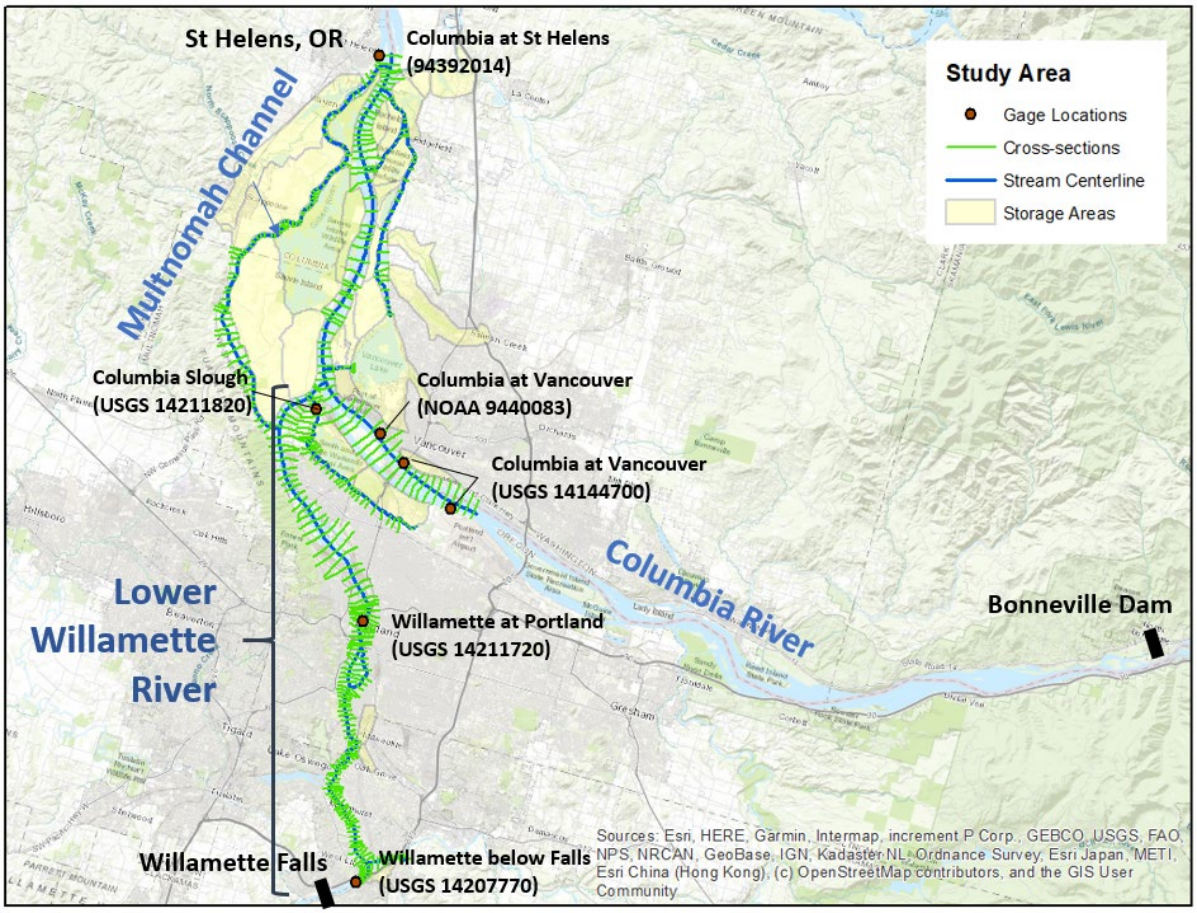


Figure 1. Study area and hydraulic model extents.

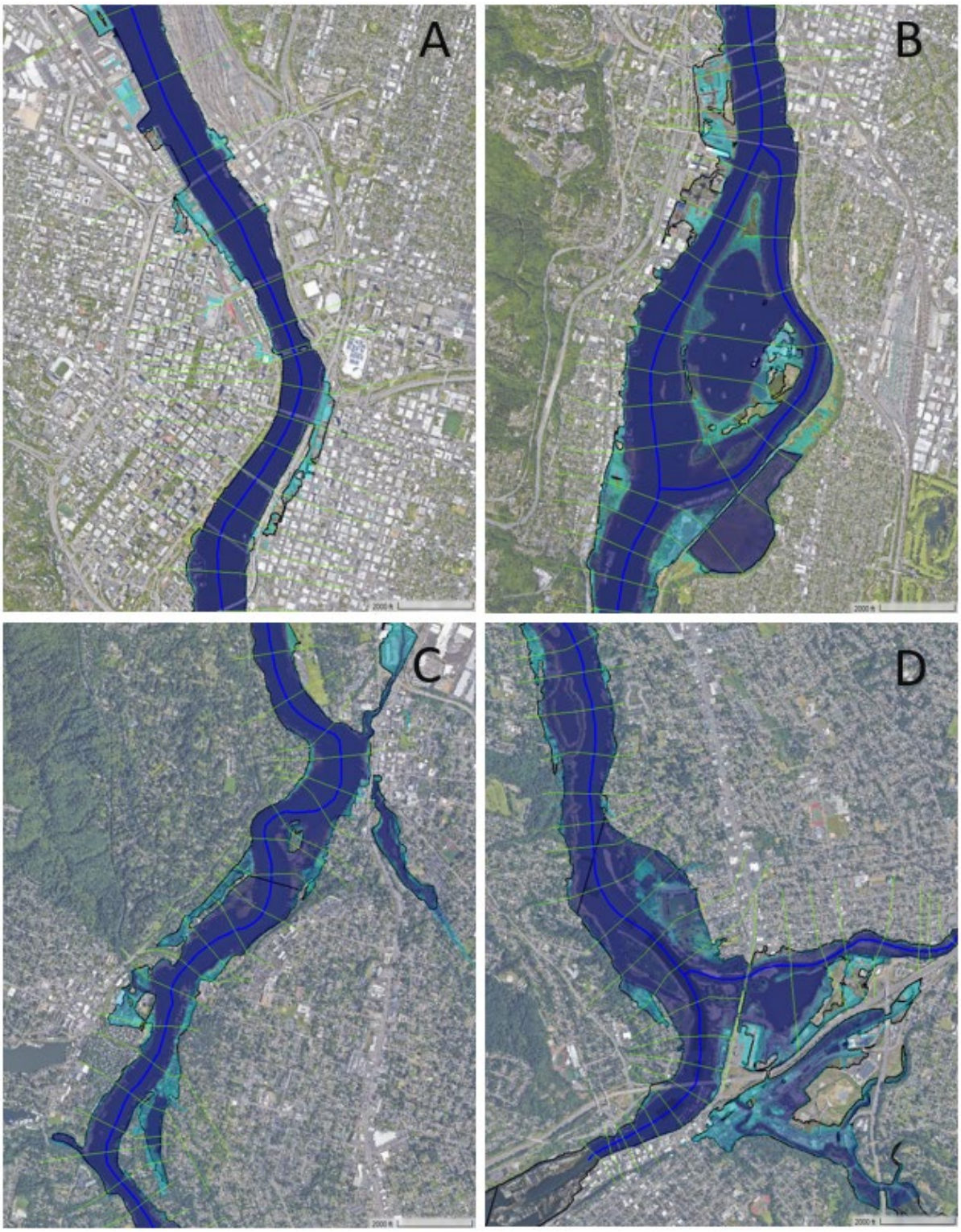
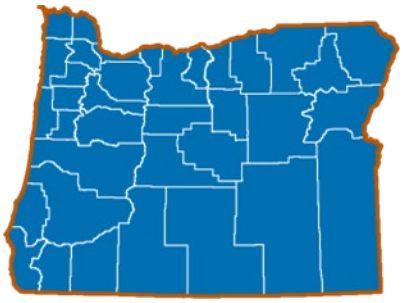


Figure 2: Comparison of modeled and observed inundation extents along the Willamette River for the February 1996 event

5.4.3 Oregon Energy Security Plan



Hazard: Winter and Windstorms

Location: Statewide

Context – The Oregon Department of Energy published the Oregon Energy Security Plan in September 2024 following direction from the federal government and SB 1567. The plan finds risks to electricity, liquid fuel, and natural gas/propane systems, and proposes ways to mitigate those risks.

Problem – The state found a need to comprehensively evaluate risks to energy systems across the state and bring together existing relevant threat information for electricity, liquid fuels, and natural gas systems and collected new data to fill data gaps.

Quick Facts

Goals:
11 - Increase the resilience of critical or essential infrastructure

Mitigation Actions:
42, 64, 75, 88

Lead Agency:
ODOE

Project Type:
Energy security planning

Project Start:
2023

Project End:
2024

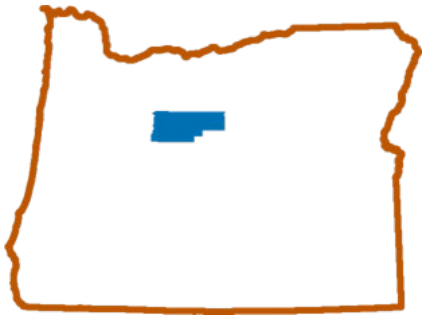
Funded By:
Infrastructure Investment and Jobs Act (IIJA)

Solution – Using funding from the federal government's Infrastructure Investment and Jobs Act (IIJA), the Oregon Department of Energy led a coordinated effort with other state agencies, the U.S. DOE, county and local governments, tribal governments, citizen groups, utilities, nonprofit organizations, businesses and industry leaders, and the public to develop and implement Oregon's Energy Security Plan.

Benefits – The Oregon Department of Energy included an energy risk assessment and mitigation measures in the plan. improve Oregon's energy security. State, local governments, and Tribes — in collaboration with energy providers, nonprofit organizations, and all Oregonians — can use the information in the plan to better prepare for supply disruptions and make more informed decisions related to energy systems and infrastructure investments, resilience and hardening strategies, and asset management.

ODOE also developed, with support from partners and project contractors, a geospatial screening tool to assess the viability of existing fuel storage sites as potential candidates for fuel diversification and increased storage.

5.4.4 Flood Mapping Updates



Hazard: Flood

Location: City of Madras, Oregon

Context – Property owners and residents have stated that the current effective Flood Insurance Rate Maps (FIRM) for the City of Madras is not accurate. Often, they report that specific properties are not inundated with floodwaters during flood events. In response to this concern the City of Madras obtained a grant from the Army Corps of Engineers to re-map the floodplain. The city derived the original 1989 Flood Insurance Study from surveys, topographic maps, and other available tools at the time. The re-mapped floodplain was prepared primarily with Light Detection and Ranging (LiDAR) and was supplemented with surveys. LIDAR is accurate to +/- .10 inches, which is much more accurate than the tools used in the 1989 study.

Quick Facts

Goals:
4 – Protect life
5 – Protect property
8 - Eliminate development in hazardous areas

Mitigation Actions:
39, 62, 85

Lead Agency:
US Army Corps of Engineers

Project Type:
Mapping study

Project Start:
10/01/2017

Project End:
12/31/2024

Project Cost:
$70,000 ($4.5 million Bridge Replacement)

Funded By:
US Army Corps of Engineers – Floodplain Management
Madras/County (Bridge Repair)

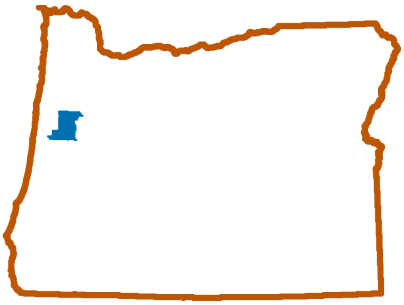
Problem – This study revealed several new findings. Most importantly, that the bridge over Willow Creek on J Street was not constructed to allow flood water to pass the bridge and would cause other areas of the city, such as The Pines subdivision, to be inundated with floodwater during a 100-year flood event.

Solution/Benefits – As a result of the flood study, the City and Jefferson County funded the expansion of the J Street bridge so that no additional properties would be included in the Special Flood Hazard Area because of the J Street bridge being undersized.

The bridge expansion was completed in 2023, and no additional properties will be included in the Special Flood Hazard Area because the J Street bridge being undersized.

Figure 1: Old J Street Bridge.

5.4.5 Oregon Silver Jackets Flood Risk Assessment



Hazard: Flood

Location: Benton County, Oregon

Quick Facts

Goals:

4 – Protect life

5 – Protect property

8 - Eliminate development in hazardous areas

9 – Minimize mitigation project impacts to the environment

12 – Integrate natural features and processes into risk reduction actions to protect people, property, and the environment

Mitigation Actions:

17, 39, 85

Lead Agency:

Oregon Silver Jackets

Benton County, Oregon

DLCD

Project Type:

Training, Collaboration Initiative

Project Start:

05/15/2023

Project End:

09/30/2023

Project Cost:

$40,000

Funded By:

Oregon Silver Jackets

Benton County Planning

Context/Background – There is a plethora of flood map products available for planners to use in their planning activities. Have you ever wondered what flood map product to use during a flood event or how to bring staff together to discuss all the tools and maps available for a day? The Oregon Silver Jackets team, the flood hazard sub-committee to the Interagency Hazard Mitigation Team (IHMT), helped clarify this in the summer of 2023. The Silver Jackets focused on the Willamette River through Benton County and worked with several partners from the Federal Emergency Management Agency (FEMA), Department of Land Conservation & Development (DLCD), USGS, Oregon Department of Emergency Management (OEM), the Weather Service, U.S. Army Corps of Engineers (USACE). The event was hosted by a local planner and floodplain staff from the community in Benton County, Oregon.

Problem – The County was reviewing its hazard mitigation plan. This meeting attempted to bridge the gap between emergency management and floodplain management departments found in many Oregon counties and cities. A goal of the flood risk assessment meeting was to help community staff understand the myriad of flood risk mapping products available and help the county integrate the products or lessons learned into their hazard mitigation plan and local floodplain management ordinance.

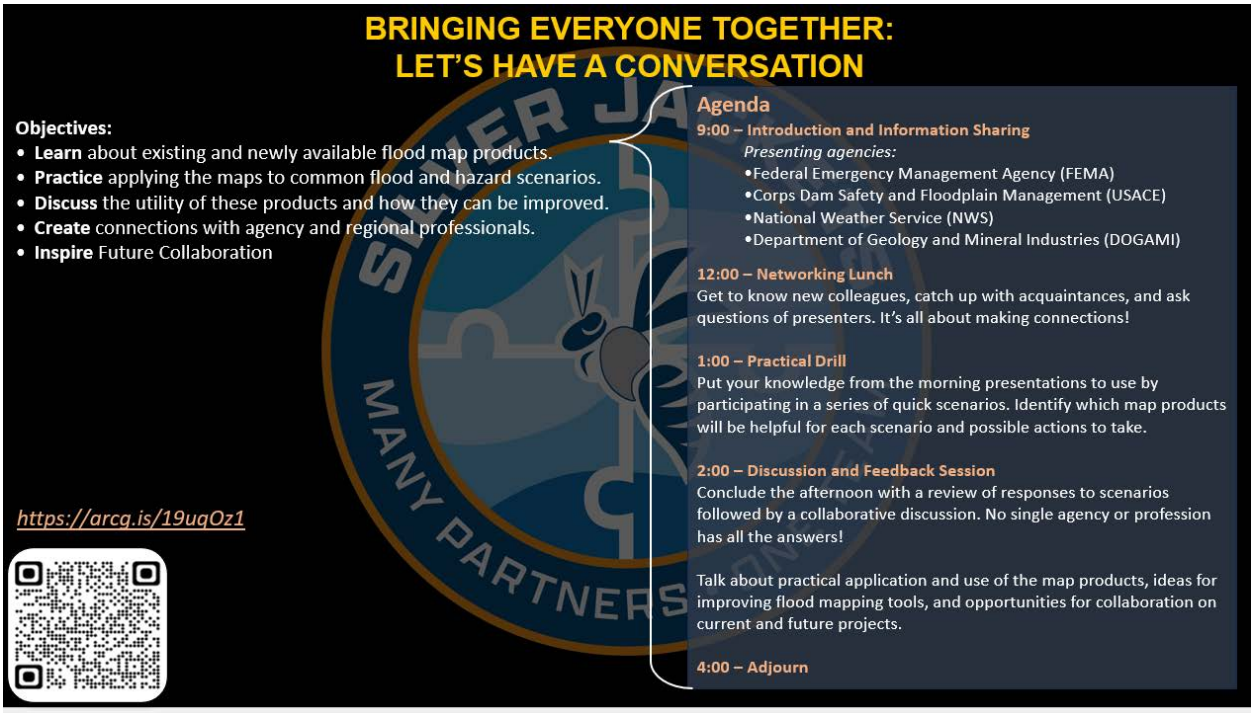
Solution – Floodplain Management is a team effort. This one-day training event brought together many staff to make connections, have conversations, and to receive instruction on the many products available to respond to and recover from a widespread flood event.

Benefits – Silver Jackets played an active role in helping staff understand the available maps and tools used to evaluate flood mapping and risk assessments for improved flood recovery and response actions overall.

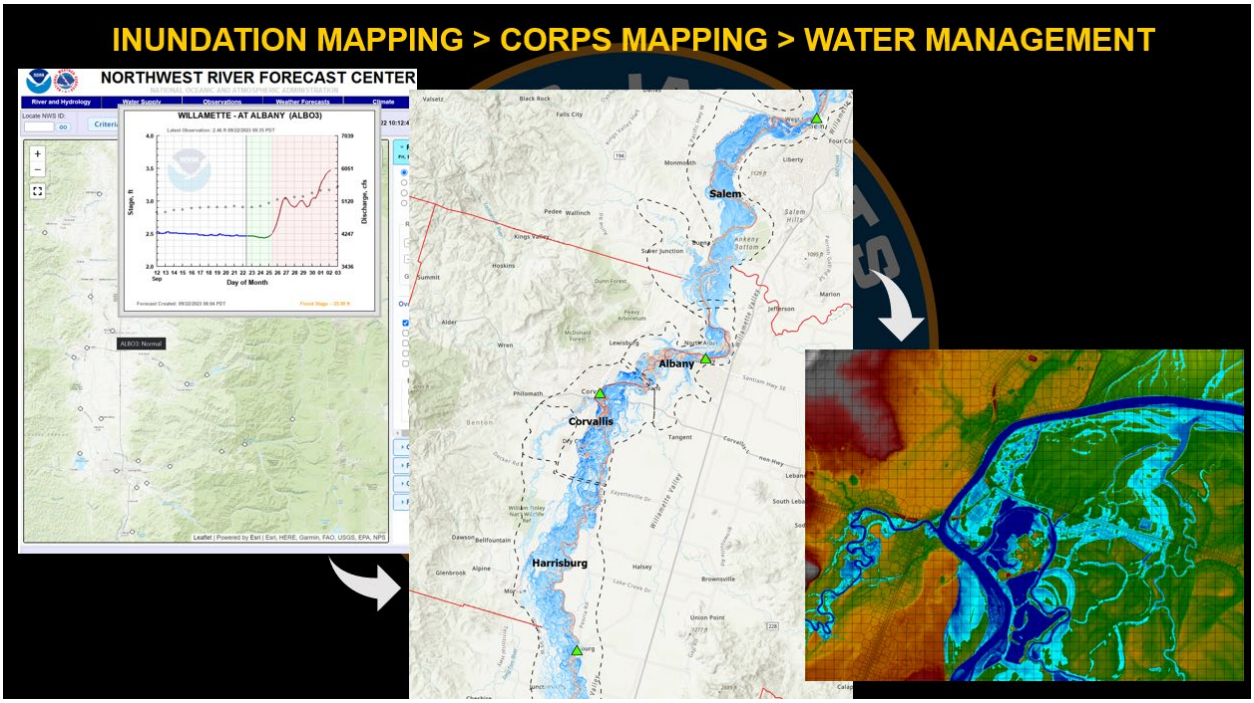
Lessons Learned – There are many flood map products that have a unique purpose. Staff expressed that there needs to be more training around flooding and how to access the myriad of map products.

Figure 1: Corps of Engineers discussing flood maps.

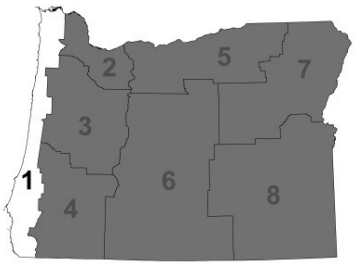
Figure 2: The Corps Dam Safety discussing the National Inventory of Dams.



Inundation Mapping Slide:



5.4.6 King Tide Signage



Hazard: Flood

Location: Oregon Coast

King Tide Signage

Context/Background – The king tides are the highest tides of the year. While "king tides" is not a scientific term, it describes a high tide event when the sun, moon, and earth are aligned causing higher than typical gravitational pull on the tides. When high tides occur coupled with other rain events, such as atmospheric rivers, the water level rise can cause flooding, erosion, and inundation to low lying coastal areas and may impact structures and property and cause risks for people in coastal areas.

Quick Facts

Goals:

4 – Protect life

9 – Minimize mitigation project impacts to the environment

12 – Integrate natural features and processes into risk reduction actions to protect people, property, and the environment from natural hazards

Mitigation Actions:

29

Lead Agency:

DLCD

Oregon Silver Jackets

Project Type:

Outreach, Signage

Project Start:

10/01/2022

Project End:

09/30/2024

Project Cost:

$25,000

Funded By:

Oregon Silver Jackets

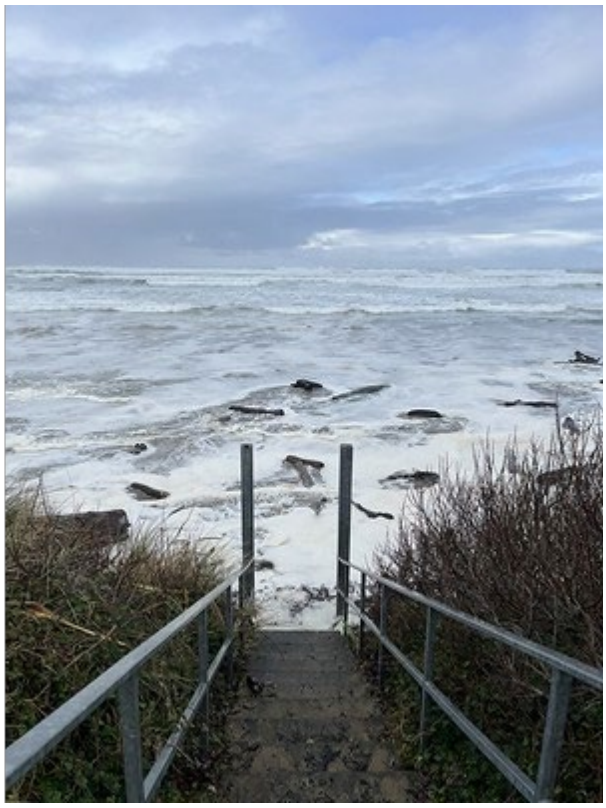
Observing king tides can provide us insight into what future sea level rise may look like in our coastal communities. Each year we see on average three (3) king tide events that can cause temporary narrowing of the shoreline along the Oregon coast.

Problem – Oregon is facing the effects of changing climate and ocean conditions. Sea levels are expected to continue to rise, causing more erosion and flooding in coastal areas. This is especially true during king tide events coupled with winter storms in Oregon. The Oregon Coastal Management Program (OCMP) have published a set of tools to plan for these changes. OCMP's focus is to educate coastal communities on how to use these tools to build coastal resilience. Signage and video production helped OCMP achieve some of these goals.

Solution/Benefit – Installing interpretative King Tide Signage is one way for outreach and educating the public about king tides. Accessible signage was created with partnerships between DLCD Coastal group and Oregon Silver Jackets to produce signage that coastal planning staff could install within their community around the topic of king tides. The signage includes a modern QR code and illustrations to educate the public about the king tides. Additionally, the signage is intended as a flood risk reduction outreach as the king tides attract many residents and visitors to the coast every year to view this phenomenon. DLCD shared the signs with those coastal communities interested in installing signage in their communities. A supporting video was produced to provide additional training information for coastal communities.

King Tides Signage in Taft, Lincoln City (Rhiannon Bezore, 2024)

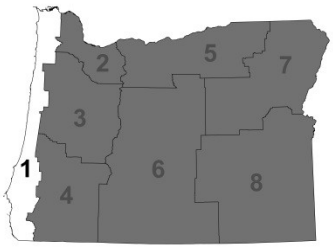
King Tides Signage in Warrenton (Warrenton staff, 2021)



Reduced beach access at Tolavana Park, Cannon Beach (Kerry Burg, 2024)

Reduced beach access at Tillicum Beach State Park, Yachats (S. Thompson, 2024)

5.4.7 CTUI Reservation Property Acquisition and Demolition Project



Hazard: Flood

Location: The Confederated Tribes of the Umatilla Indian Reservation

Context/Background – The Umatilla Indian Reservation (UIR) is approximately 172,000 acres (273 square miles) in northeast Oregon established by an 1855 treaty with the Walla Walla, Cayuse and Umatilla Tribes, who make up the Confederated Tribes of the Umatilla Indian Reservation (CTUIR). This treaty ceded approximately 6.4-million acres to the U.S. government in return for a promised 520,000 acres, though a subsequent government survey halved this reservation to 265,000 acres. Oregon's Slater Act of 1885 and the U.S. General Allotment Act of 1887 reduced the reservation again to 172,000 acres and split the land into individual allotments. Under the allotment system, the U.S. government gave CTUIR men 160 acres, women 80 acres, and children 40 acres. The rest was considered "excess" and sold to non-Native American immigrants coming West, creating a checkerboard of Indian and non-Indian ownership across the UIR: CTUIR-owned trust, allotted trust, CTUIR-owned fee, and non-Indian-owned fee.

Quick Facts

Goals:

4 – Protect Life

8 – Eliminate development in hazardous areas.

9 – Minimize mitigation project impacts to the environment

12 – Integrate natural features and processes into risk reduction actions to protect people, property, and the environment from natural hazards

Mitigation Actions:

17

Lead Agency:

OEM

CTUIR

Project Type:

Property buyout and restoration

Project Start:

March 2022

Project End:

December 2024

Project Cost:

$3,285,000

Funded By:

FEMA HMGP

The CTUIR is governed by an elected non-member Board of Trustees under a 1949 Constitution and Bylaws. The CTUIR has land use jurisdiction on all lands within the UIR external boundaries regardless of ownership under a 1990 Memorandum of Agreement with Umatilla County. In the mid-1990s, CTUIR developed a land-acquisition program with a goal of ensuring over 50% of the land on the reservation is Indian-owned. The UIR land currently is 52% trust acres and in Individual Indian/Tribal ownership, including trust and fee, while 48% of the land is owned by non-Indians.

The UIR currently has a total population of 3,069; approximately 1,500 are enrolled CTUIR Tribal Members, 300 are enrolled with other federally recognized Tribes, and the remaining population is non-Indian. CTUIR has over 3,100 enrolled Tribal Members, with about half living on or near the UIR.

A significant portion of the Umatilla River watershed is located on the UIR. Topographical features of the UIR include lower elevation (1,200') agricultural/grazing lands and higher elevation forested lands of the Blue Mountains (4,500'). Higher elevation land receives significant annual snowfall, which drains into the Umatilla River. The UIR has experienced a significant increase of flood events due to rapid weather changes, high temperature and rain, which cause quick melt of the snowpack.

In early February 2020, Eastern Oregon experienced an unusually wet Spring when an atmospheric river transported moisture from the Pacific Ocean. This resulted in moderate to heavy snow that transitioned to rain in Umatilla County's Blue Mountains. The heavy rain combined with snowmelt runoff resulted in one of the worst flood events in the region. The peak flow on the Umatilla River at Pendleton on February 6 was estimated to be around 19,000 cubic feet per second (cfs), eclipsing the previous high flows of 13,300 cfs in February 1996 and 15,500 cfs in January 1965. This flood also permanently altered the Umatilla River's course. The 2020 Umatilla River Flood damaged or destroyed a number of homes on the UIR, as well as downriver in the cities of Pendleton, Echo, and other areas within the watershed. The Oregon Governor and U.S. President made disaster declarations for the area.

Problem – Over 15 tax lots on the UIR were directly impacted by the 202 Umatilla River Flood. All structures were within the National Flood Insurance Program (NFIP) Special Flood Hazard Area (SFHA). Residential structures were substantially damaged; they either sustained major damage or were destroyed.

Solution – Through FEMA's Hazard Mitigation Grant Program (HMGP), local communities and Tribes may purchase flood-prone properties, remove the buildings, and maintain the land as open space. Acquisition is voluntary and can help mitigate flood risk after a Presidential Disaster Declaration. The UIR applied for a received three HMPG grants to acquire and remove structures, septic tanks and drain fields, utilities, wells, and all unnatural debris from over 15 properties in the SFHA.

The CTUIR proposed to phase this project, to allow adequate time to address environmental and historic preservation (EHP) requirements (at least 25 structures needed historic built environment evaluations), which must be completed prior to demolition; and to prevent further delay of the property acquisitions. Phase 1 included pre-award costs, acquisition, EHP review, and property boundary surveys. Phase 2 included demolition, decommissioning, and closeout.

Benefits – CTUIR purchased the properties at pre-flood fair market value with the applicable deed restriction for the properties to remain in open space without future development except as prescribed under HMGP provisions. Following acquisition and environmental clearance, the CTUIR requested FEMA approval to submit fee-to-trust conversion applications to the US Department of Interior for these properties to be held in trust for the CTUIR.

The CTUIR Cultural Resources Protection Program within the Department of Natural Resources employs archaeologists and the Tribal Historic Preservation Officer (THPO). This program conducted an archaeological pedestrian survey of all properties which revealed the requirement for additional EHP reviews. Many of these properties were original Indian allotments that had been sold into non-Indian ownership and removed from trust status to fee. In addition to mitigating future flood damages, this project also contributed to the CTUIR mission to reacquire land on the UIR that is owned by non-Indians.

Below are some before and after photos of one property.

Figure 1: Caldwell Property pre-demolition

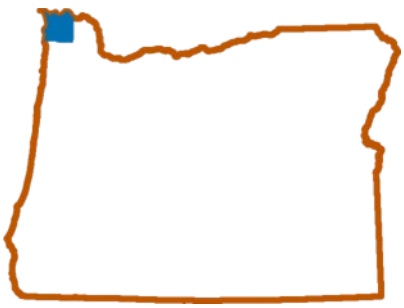
Figure 2: ADU on Caldwell property, pre-demolition.

Figure 3: Shop/bar pre-demolition

Figure 4: Cleared property

Figure 5: Cleared property and hydroseed

5.4.8 Sea Level Rise Vulnerability Toolkit



Hazard: Coastal Hazards

Location: Clatsop County

Context – The Oregon Coastal Management Program (OCMP) has created several tools to help communities plan for a changing coastline.

Problem – Climate change is causing global sea levels to rise. Oregon's coastlines and coastal communities are vulnerable to the impacts of sea level rise. The Oregon Coastal Management Program (OCMP) has developed tools to assist local communities in planning for the impacts of sea level rise.

Solution – The OCMP in partnership with a NOAA Coastal Management Fellow created several tools to address these vulnerabilities.

Quick Facts

Goals:
5 – Protect property
8 – Eliminate development in hazardous areas.
15 - Motivate whole community resilience

Mitigation Actions:
29

Lead Agency:
DLCD

Project Type:
Sea level rise mapping

Project Start:
2022

Project End:
2024

Funded By:
NOAA Coastal Management Program

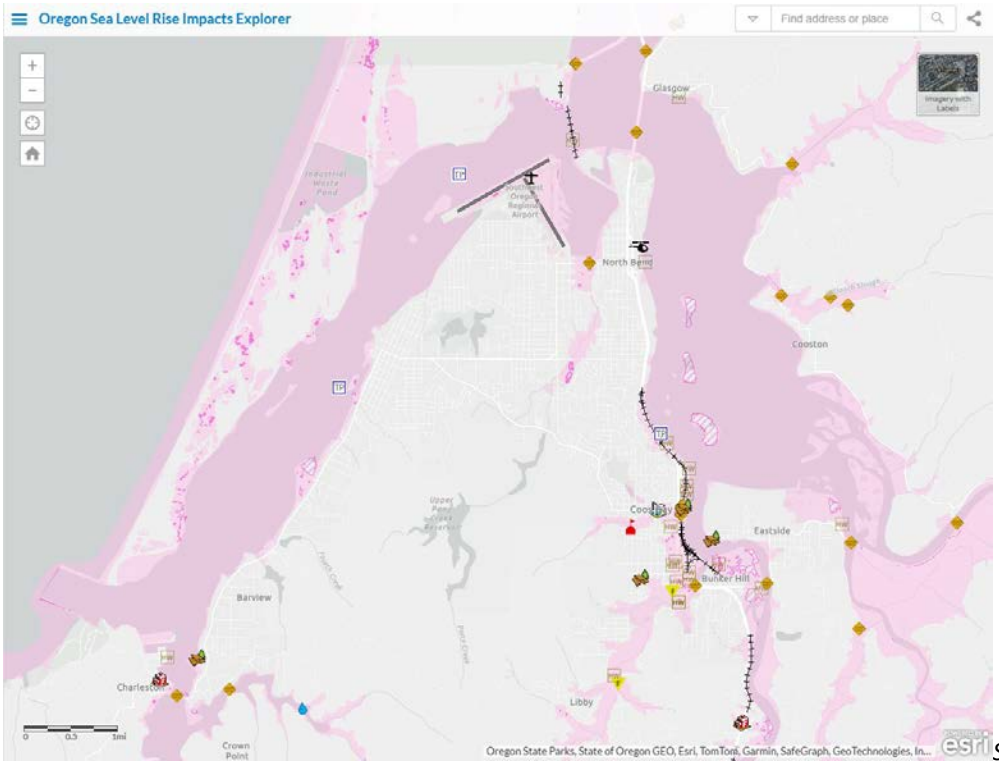
OCMP staff developed a toolkit for local governments and communities to assess and address the impacts of sea level rise, which consists of three parts:

1. Sea Level Rise Impact Explorer is a combination of multiple data sources and is meant to serve as a planning tool. The dataset is not regulatory unless a jurisdiction adopts it. 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 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 or organization's vulnerability assessment. Instructions for the Impact Assessment worksheets.
3. Sea Level Rise Planning Guide for Coastal Oregon is a toolkit 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. This document is intended to guide local planning and development decisions on the Oregon Coast to support community resilience and ensure effective coastal management actions.

A 2022-2024 NOAA Coastal Management Fellow joined the Oregon Coastal Management Program team to focus on sea level rise adaptation planning and help implement the tools described above.

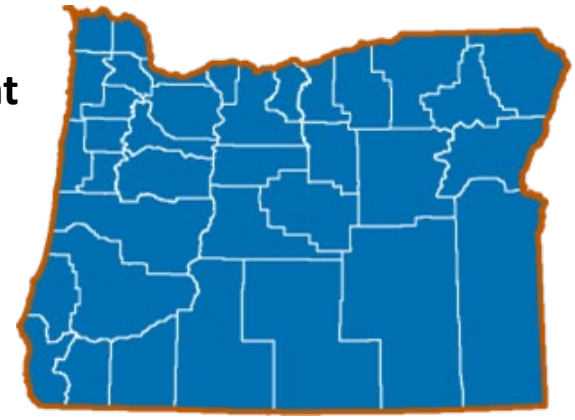
Benefits

The fellowship project provided direct capacity to advance sea level rise adaptation planning at the local level in Clatsop County. This will involve hosting community outreach and open house events to identify community assets at risk from sea level rise and working with communities to prioritize and develop sea level rise adaptation measures.



Snapshot of the Oregon Sea Level Rise Impacts Explorer tool. Community assets are mapped within potential sea level rise areas, illustrating areas for future mitigation investment.

5.4.9 Statewide Climate Change Social Vulnerability Assessment



Hazard: Climate Change

Location: State of Oregon

Context/Background – Climate change is disrupting our natural and built environments, our health, livelihoods, and sense of place. The Department of Land Conservation and Development (DLCD) conducted a survey and in-person workshops in the fall of 2022 and spring of 2023 to learn more about how the effects of climate change impact Oregonians. DLCD learned that people across the state value access to the outdoors, community gatherings, clean air and water, high-quality food, and local decision-making power. Many Oregonians are concerned about how climate change might impact their wellbeing, livelihoods, and sense of place. Workshop and survey participants want their state government and local governments to support and facilitate locally relevant climate change adaptation actions intended to strengthen the built and social environment.

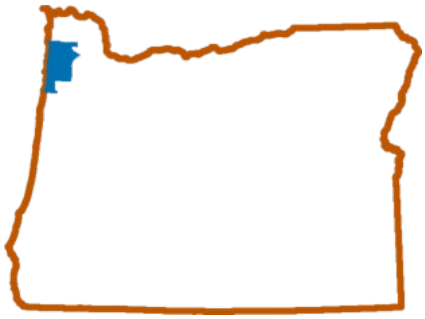
Problem – Effective climate change adaptation actions are as varied and complex as the communities in which they are deployed. This project found that Oregonians are ready to begin climate change adaptation, and they want adaptation actions to be in sync with local values.

Solution – One of the predominant themes is the request for true partnership — that state technical and financial support is welcome if local voices are included in project design, implementation, and management. Furthermore, Oregonians want state agencies to integrate what they are already doing into a comprehensive climate change adaptation program.

Benefits – The multi-agency Climate Change Adaptation Framework Team offered key recommendations that are intended to be updated and adjusted with each 5-year update.

The Climate Change Adaptation Framework has been appended to Oregon's Natural Hazard Mitigation Plan, to support efficient and timely update cycles and synchronicity between these two plans.

5.4.10 Southern Flow Corridor tidal wetland habitat restoration



Hazard: Coastal flooding

Location: Tillamook, Oregon

Context/Background – The Southern Flow Corridor (SFC) was designed to create salmon habitat and decrease flooding. This project, completed in 2017, now has a new report detailing the economic and social benefits and successes of the project.

Problem – In Tillamook, Oregon, construction of dikes and channels has led to significant local declines in wetlands (Brophy 2019). Loss of wetland habitat has led to negative long-term effects on both developed areas nearby such as nuisance flooding, and overall ecosystem function of estuaries such as dwindling vital habitats for native fish and wildlife. In 2006 a storm event caused flooding, erosion, and landslides around the town of Tillamook resulting in millions of dollars in damages.

Solution – To respond to the 2006 storm event and mitigate future coastal hazards, a formal Declaration of Collaboration was signed by 24 local, state, and federal agencies, public organizations, members of legislative and executive government, and local farmer associations to address this flood risk. The SFC restoration effort was the result of this collaboration. Restoration areas included tidal wetlands, which protect against storms and flooding, supporting fish and wildlife populations, providing scenic views, cleaning water, and providing a buffer against sea level rise (Barbier et al. 2011).

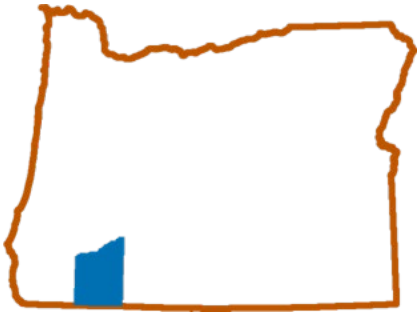
Benefits –

- **Water Quality**: The SFC restoration site is likely trapping sediment flowing into it from the Wilson and Trask Rivers, decreasing the amount of sediment settling in Tillamook Bay. This may decrease the frequency and/or amount of dredging needed to maintain shipping lanes, saving approximately $1,500 to $8,000 per year. Continued monitoring is recommended to quantify and value potential additional ecosystem service benefits associated with improvements in water temperature and dissolved oxygen levels. New research on abated nutrient loads is suggested as restored wetlands hold large potential to reduce agricultural runoff.
- **Flood Mitigation**: Under a set of assumptions, it is estimated that reductions in flooding on Highway 101 may produce benefits associated with avoided travel costs of approximately $7,200 per flood event. No conclusion could be drawn from a comparison of flood insurance claims comparing moderate flood events before and after site restoration. Post-project modeling exercises suggest the restoration may reduce flooding significantly in the adjacent communities. There were large annual benefits from restoration found in the housing market analysis (see below) that likely can be attributed to reducing flood risk. Future studies are recommended to (i) quantify the flood reduction benefits as more events occur post-restoration and (ii) to investigate the potential benefits of the SFC site in mitigating the impacts of local sea level rise.
- **Salmon Habitat**: Restoration of tidal wetland habitat led to an observed increase in the number of sub-yearling Chinook salmon and staghorn sculpin using the SFC site. Millions of dollars in economic benefits through use (recreational fishing) and non-use (existence value) values may

be possible if the site contributes to increasing the abundance of returning adult salmon populations in Tillamook Bay. Further monitoring and research are needed to evaluate potential changes in both sub-yearling and returning adult populations of Chinook, coho and other species as the SFC site matures to realize and estimate these benefits of habitat restoration.

- **Carbon Storage**: Estimates suggest the SFC site may store up to 27,000 tons of carbon through organic material accretion and burial. Using simplifying assumptions and current social cost of carbon estimates, the net present value of carbon storage is estimated to range from $530,000 to $736,000. The site has potential to emit greenhouse gases as the wetlands mature, so continued monitoring efforts are needed to track the net carbon fluxes at the restoration site in the future.
- **Benefits to the Community**: Although no primary data were collected on recreation or other social and cultural benefits provided by the SFC restoration, this report provides examples of economic values for benefit flows that recreational fishing, hiking, or kayaking at the site may generate. Surveys soliciting information about site usage will be necessary to quantify the economic benefits of the site to the local community, indigenous peoples, and the state of Oregon.
- **Housing Market Analysis**: A difference-in-differences hedonic pricing model suggests that housing prices in residential areas near the SFC restoration increased by 10 percent after completion of the project relative to homes further from the project. This represents an average benefit of $19,000 per home within ¾ of a mile of the site. Aggregated by the number of residential homes near the site, the total range of benefits resulting from the SFC restoration estimated from the econometric model is between $5.2 to $32.9 million, suggesting the housing market benefits alone may be greater than project costs ($11.2 million).
- **Economic Impact Analysis**: During the four years of the SFC restoration (2013-16), an IMPLAN analysis conducted by NOAA estimates that the project supported 108 jobs and $14.6 million in total economic output in the state of Oregon.

5.4.11 Wildfire Defensible Space



Hazard: Wildfire

Location: Ashland, Oregon

Wildfire Defensible Space

Context/Background – Defensible space is the buffer you create between a building on your property and the grass, trees, shrubs, or any wildland area that surrounds it.

Managing the vegetation around your home plays an important role in reducing the risk of losing your home to wildfire by allowing firefighters to safely defend it in the event of a fire. By managing the vegetation around your property, you can significantly reduce the risk of losing your home.

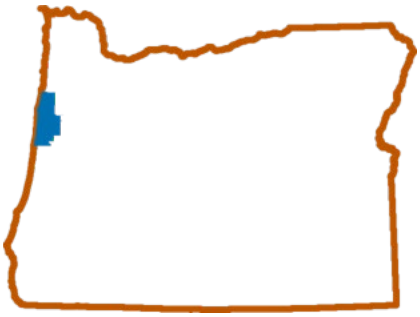
During large wildfire events, with the likelihood of only a limited number of resources being available for home protection in many neighborhoods, defensible space can increase an individual home's chances of surviving without firefighter intervention.

Problem – Ashland's setting, history of wildfires, and increasingly long, hot, and dry summers put us at high fire risk each year. In 2018, the entire City of Ashland was designated as a Wildfire Hazard Zone.

Solution – Ashland Fire and Rescue and the City of Ashland were awarded a $3 million Federal Emergency Management Agency (FEMA) grant as a part of its Pre-Disaster Mitigation Grant Program.

Benefits – This grant aims to create wildfire-defensible space around 1,100 homes throughout the city. The objective of the Pre-Disaster Mitigation (PDM) program is to reduce overall risk to the population and structures from future hazard events as well as reduce reliance on federal funding from future disasters. Specifically, the purpose of this proposed PDM project is to slow the spread of wildfire within the City of Ashland and reduce the likelihood of wildfire impacts on people and property.

5.4.12 Coastal Resilience Conservation Project



Hazard: Coastal Hazards

Location: Confederated Tribes of the Siletz Indians (CTSI) in Lincoln County

The Oregon Department of Land Conservation and Development's (DLCD) Coastal Management Program and the Confederated Tribes of Siletz Indians (CTSI) announce $4.85 million in Bipartisan Infrastructure Law funding for the conservation of an iconic property along Oregon's coastal shoreline. This project aims to protect a 42-acre property on the central coast of Oregon, safeguarding its unique ecological and cultural significance.

Quick Facts

Lead Agency:
DLCD Coastal Management Program
Confederated Tribes of Siletz Indians (CTSI)
Lincoln County

Project Type:
Land preservation for cultural stewardship

Project Start:
May 2024

Project End:
Ongoing

Project Cost:
$4.85 million

Funded By:
Bipartisan Infrastructure Law funding

The National Oceanic and Atmospheric Administration (NOAA) recently announced 22 award recommendations nationwide, totaling $59.8 million in funding for coastal management programs. This funding is intended to increase resilience through landscape-scale habitat restoration and conservation projects. The $4.85 million awarded to Oregon will provide funding necessary for CTSI to acquire the property which supports some of the rarest and most ecologically-significant habitats on the Oregon coast, rich marine and terrestrial species diversity, and unique habitat corridors — from the ocean to upland rainforest —critical for species migration and connectivity. These unique habitat qualities are of equal cultural importance to CTSI, bolstering the resilience of the Tribe and coastal community.

With its nearshore and marine protected habitats, freshwater streams, diverse shoreline shrub and forest habitat, and unique Sitka spruce wetlands, this property will be the centerpiece of a regional tribal effort focused on invigorating cultural traditions. The property is located within a region that was historically (pre-contact) heavily settled by the Alsea band of CTSI. The Alsea people were seal and sea lion hunters who fished the nearshore habitats.

While the Siletz people have been stewarding Oregon's central coast since time immemorial, CTSI experienced a loss of over 100 miles of coastal shoreline ownership nested within 1.1 million acres of original reservation land. With this funding, CTSI will regain ownership of this 42-acre property and conserve the land as an anchor for cultural resilience and regional collaboration in nearshore, forest, and wetland conservation and education. The Siletz people will provide opportunities for education and outreach about the richness of the Oregon coast, the central role of the tribes in its stewardship, and the value of conserving lands and waters.

Oregon's central coast region, known for its pristine landscapes and vital ecosystems, faces increasing threats from development and climate change. Partners invested in this work are building on the conservation of this land towards a central coast conservation and education program that strengthens community resilience. Lincoln County, the Lincoln County Board of Commissioners, and the Lincoln County Department of Planning and Development have been strong supporters of this project and CTSI. With established relationships and shared goals, the County and CTSI leveraged their initial investments to move this project forward.

Photo Credit: Lincoln County.

Chapter 6 Local Capabilities and Planning Coordination

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6.1 Overview

A capability assessment identifies the resources available to carry out mitigation actions. The policies and programs used to mitigate hazards build on a community's existing capabilities. It is the state's responsibility to coordinate state and local mitigation activities. State support makes communities aware of data, resources, and state priorities for mitigation that could be included in local plans.

Oregon has a robust array of agencies and legislation directed towards hazard mitigation and disaster preparedness and response. The state works diligently to provide multiple resources to each county, municipality, and tribe. However, given the vast range of risks and needs in communities along with the overall sheer size of the state, delivering these services and resources equitably can be challenging.

There is no one consistent way to categorize and assess a local jurisdiction's ability to implement mitigation actions. Cities, counties, and tribes all possess distinct assets and limitations in operations, and it is important for the State of Oregon to approach each jurisdiction's abilities uniquely. As a Home Rule state, jurisdictions are empowered to enact their own laws and codes and make policy choices except where pre-empted by state or federal law.

Members of the Interagency Hazard Mitigation Team (IHMT), a group of 23 agencies that meet quarterly to understand losses arising from natural hazards and coordinate recommended strategies to mitigate loss of life, property, and natural resources represent many of the state's resources for hazard mitigation.

State agencies not only can provide technical assistance and coordination capacity but can also assist counties, cities, special districts, and Tribes in assessing their hazard mitigation capabilities. Coordinating with the appropriate state agencies will help increase the mitigation capacities of local and tribal governments.

6.2 Local and Tribal Capability Assessment

6.2.1 Local Capabilities

Table 6.2.1-1 displays the different capabilities local and tribal jurisdictions have and leverage in pursuing successful mitigation actions. The table is by no means exhaustive but rather is meant for local jurisdictions to locate where their strengths and opportunities are in guiding and developing capacity. Capabilities can be evaluated through an examination of broad categories, including existing authorities, policies, programs, funding, and resources. Those in **bold** under "Mechanisms" have been proven to be most effective capabilities.

Table 6.2.1-1: Local and Tribal Mitigation Capabilities

Capabilities	Description	Mechanisms
Plans & Policies	Plans and policies provide communities with clear priorities and directions. They contain jurisdiction goals and influence decisions mitigation decisions. Plans are developed and adopted through public processes, so the public's feedback has already been thoroughly assessed prior to plan adoption. Integrating hazard planning into local planning documents is the best way to achieve mitigation goals. Further, Local governments can use their broad regulatory authority to advance hazard mitigation actions.	• **Local Comprehensive Plans** • **Capital Improvement Programs** • **Emergency Operations Plan** • Climate Change Adaptation Plans • Streambank Buffer Protection Plan • Park and Recreation Master Plans • Transportation Plans • Water and Sewer Master Plans • Natural Hazards Mitigation Plans • Burn Permits
Codes & Ordinances	Codes and ordinances can direct development in the appropriate locations away from high-hazard areas and ensure the built environment is resilient to impacts from natural hazards.	• **Building Codes** • Zoning Codes • **Subdivision Regulations** • Statewide Planning Goal 7 Regulations • **National Flood Insurance Program** • **Community Rating System** • Stormwater Management Regulations • Erosion Control Regulations

Capabilities	Description	Mechanisms
Administration	Staffing in smaller jurisdictions can often be a challenging limitation, as can the volume of work in more populated jurisdictions. This is especially true if it involves enforcement of codes and ordinances. A robust administrative capacity can provide better planning, funding, and resource allocation. These resources can be leveraged for mitigation implementation.	• **Code Enforcement** • Engineering • **Emergency Management with a full-time Emergency Manager** • Planning Commission • Staffing
Technical	Less resourced local and tribal governments often lack capacity to seek and manage outside funding sources, coordinate with multiple state agencies, and assess the feasibility of mitigation actions.	• **Chief Building Officer** • Building Code Enforcement • Zoning Code Enforcement • Construction Project Management • **Grant Administrator** • **Grant Writer**
Financial	Financial capabilities include local, tribal, and other funding sources that do not need to be repaid and can be used to implement mitigation planning.	• **Capital Improvement Programs** • Taxes • Non-FEMA funding programs • Utility Fees • Impact Fees • **Zoning and Land Use Fees**
Educational	Local educational and outreach campaigns can close the gap in community awareness of hazards and mitigation planning and projects, increasing local capabilities through grassroots efforts.	• StormReady Certification • **Emergency Management and Mitigation Outreach** • Firewise Communities • Community Emergency Response Team (CERT) • Local Emergency Planning Committee (LEPC) • Be 2 Weeks Ready Program • Great ShakeOut
Groups & Associations	Local groups and associations can help spread the word about natural hazards, mitigation plans and projects, as well as identify community champions to drive mitigation actions to completion.	• Neighborhood Associations • Conservation Groups • Chamber of Commerce • Business Associations • Watershed Councils
Social Organizations	Community- or affinity-based social structures that allow people cross-cultural interaction, and public places where people can gather and socialize can be some of the most resilient infrastructure in hazard situations, especially in rural and tribal communities where social capital is paramount.	• Non-Profits • Faith-Based Groups • Community Centers • Assisted Living • Public Plazas • **Resilience Hubs**

6.2.2 Effectiveness

Mitigation actions should be structured around risks facing a jurisdiction and the capabilities and capacity of the jurisdiction to implement them.

6.2.2.1 Plans and Policies

Natural hazard mitigation planning is required by Goal 7: local governments must adopt comprehensive plans to reduce risk to people and property from natural hazards. However, Goal 7 lacks regulatory authority to compel mitigation action implementation. Some jurisdictions will integrate NHMPs, Community Wildfire Protections Plans, Climate Adaption Plans, and Capital Improvement Plans into their Comprehensive Plans. DLCD, OEM, and ODF encourage communities to coordinate these plans for stronger natural hazard mitigation implementation.

The Oregon Department of Emergency Management (OEM) measures the percentage of Oregon's population covered by FEMA-approved local government NHMPs at the end of the state fiscal year. Coverage dropped slightly from a high of 88 percent in 2020 to 86 percent in 2021, then precipitously to 62 percent in 2022 and bottomed out at 61 percent in 2023, an overall loss of 27 percent. Coverage rebounded by 15 percent in 2024, more than half of that lost over the previous three years. In June 2024, 76 percent of Oregon's population was covered by current, FEMA-approved plans.

Factors contributing to the losses include: (a) an increasing number of NHMPs need to be updated as Oregon has encouraged (per FEMA instruction in or about 2018) special districts to develop NHMPs, and many have; (b) the slow pace with which FEMA has approved HMGP and BRIC subgrants, key funding sources for local NHMP updates, over the last five or more years caused NHMPs to expire while awaiting grant approval or during the update process; previously this was not a problem; and (c) the more complex planning standards required by the updated Local Mitigation Planning Policy Guide effective April 19, 2023 require additional data gathering and analysis that slow the planning process. The rebound in 2024 can be explained by six multi-jurisdictional and one stand-alone city plan being re-approved by FEMA during that year.

The comprehensive plan is designed to guide the future actions of a community and provide guidance to implement measures such as land use plans and development regulations. It presents a vision for the future, with long-range goals and objectives for all activities that affect the local government. Oregon's 19 Statewide Planning Goals are achieved through local comprehensive planning. Implementing measures can then be used to guide development to less hazardous areas. Additionally, opportunities for redevelopment projects can be identified to improve hazard mitigation by adjusting current land uses and requiring current building codes and standards for rehabilitation of or other changes to existing structures.

Many communities are directly or indirectly addressing hazard mitigation through their capital improvement plans. Such plans are generally maintained on a five to six-year basis. Capital Improvement Plans distribute the expense of major capital construction projects over time. Long-range infrastructure improvement projects are implemented annually through a jurisdiction's standard budget process. In many cases, bonds are used to finance projects. In recent years, state and federal grants have been used to offset the costs of local infrastructure improvements.

The purpose of an Emergency Operations Plan (EOP) is to specifically protect people, property, and the environment during an emergency. It defines roles and responsibilities of how agencies should operate and communicate, operationalizing emergency responses and resources.

6.2.2.2 National Flood Insurance Program (NFIP) & the Community Rating System (CRS)

Participating communities must adopt the National Flood Insurance Program's (NFIP's) minimum floodplain management standards through local regulations. They must also adopt the latest effective Flood Insurance Rate Map (FIRM). These are important planning and regulatory capabilities because they support risk-aware development decisions in and around the floodplain.

Local floodplain programs are also built upon statewide requirements for land use planning and implementation of building codes. Local governments implement flood damage prevention ordinances through floodplain development permits, and the state building codes via local building permits. Many local governments in Oregon adopt higher regulatory standards into their flood damage prevention ordinances.

The NFIP's Community Rating System (CRS) allows communities to adopt floodplain management standards that exceed the NFIP's minimum requirements. The CRS rewards participating communities by discounting flood insurance premium rates. CRS participating communities (a) reduce flood damage to insurable property, (b) strengthen and support the insurance aspects of the NFIP, and (c) encourage a comprehensive approach to floodplain management. CRS classifications are based on points a community can achieve in 19 separate activities, providing discounts of flood insurance premium rates in increments of 5 percent. A Class 1 community receives the greatest discount, reaching 45 percent and a Class 10 community receives no discount.

In Oregon, 260 cities, counties, and tribes participate in the NFIP, including eight of the nine federally recognized tribes. Of those, 23 jurisdictions exceed the minimum NFIP standards through the CRS.

Table 6.2.2-1: Jurisdictions Participation in NFIP and CRS [October 2024]

County Name	Community Name	Plan Title	NFIP	CRS Level
Benton	Adair Village	Benton County Multi-Jurisdictional NHMP		
Malheur	Adrian		X	
Benton	Albany	Albany NHMP	X	5
Linn	Albany	Albany NHMP	X	5
Yamhill	Amity	Yamhill County Multi-Jurisdictional NHMP	X	
Clatsop	Arch Cape Sanitary District	Clatsop County Multi-Jurisdictional NHMP		
Gilliam	Arlington	Gilliam County Multi-Jurisdictional Natural Hazards Mitigation Plan	X	
Jackson	Ashland	Jackson County Multi-jurisdictional NHMP	X	9
Clatsop	Astoria	Clatsop County Multi-Jurisdictional NHMP	X	
Umatilla	Athena		X	
Marion	Aumsville	Marion County Multi-Jurisdictional All-Hazards Mitigation Plan	X	
Marion	Aurora	Marion County Multi-Jurisdictional All-Hazards Mitigation Plan	X	
Baker	Baker City	Baker County Multi-Jurisdictional NHMP	X	

County Name	Community Name	Plan Title	NFIP	CRS Level
Baker	Baker County	Baker County Multi-Jurisdictional NHMP	X	
Coos	Bandon	Coos County Multi-Jurisdictional NHMP	X	10
Washington	Banks		X	
Clackamas	Barlow		X	
Coos	Bay Area Hospital	Coos County Multi-Jurisdictional NHMP		
Tillamook	Bay City	Tillamook County Multi-Jurisdictional NHMP2023 Update	X	
Washington	Beaverton	Beaverton NHMP	X	10
Washington	Beaverton	Washington County NHMP		
Deschutes	Bend	Deschutes County Multi-Jurisdictional NHMP	X	
Benton	Benton County	Benton County Multi-Jurisdictional NHMP	X	7
Morrow	Boardman	Morrow County Multi-Jurisdictional NHMP	X	
Klamath	Bonanza		X	
Curry	Brookings	Curry County Multi-Jurisdictional NHMP	X	
Harney	Burns	Harney County Multi-Jurisdictional NHMP	X	
Linn	Brownsville		X	
Jackson	Butte Falls	Jackson County Multi-Jurisdictional NHMP	X	
Clackamas	Canby	Clackamas County Multi-Jurisdictional NHMP	X	
Clatsop	Cannon Beach	Clatsop County Multi-Jurisdictional NHMP	X	10
Grant	Canyon		X	
Douglas	Canyonville	Douglas County Multi-Jurisdictional NHMP	X	
Yamhill	Carlton	Yamhill County Multi-Jurisdictional NHMP	X	
Hood River	Cascade Locks	Hood River County Multi-Jurisdictional NHMP	X	
Josephine	Cave Junction	Josephine County Multi-Jurisdictional NHMP	X	
Jackson	Central Point	Jackson County Multi-Jurisdictional NHMP	X	6
Klamath	Chiloquin		X	
Clackamas	Clackamas County	Clackamas County Multi-Jurisdictional NHMP	X	10
Columbia	Clatskanie	Columbia County Multi-Jurisdictional NHMP	X	
Clatsop	Clatsop County	Clatsop County Multi-Jurisdictional NHMP	X	
Washington	Clean Water Services	Washington County NHMP		
Lane	Coburg	Lane County Multi-Jurisdictional NHMP	X	
Columbia	Columbia City	Columbia County Multi-Jurisdictional NHMP	X	
Columbia	Columbia County	Columbia County Multi-Jurisdictional NHMP	X	
Gilliam	Condon	Gilliam County Multi-Jurisdictional NHMP	X	
Coos	Coos Bay	Coos County Multi-Jurisdictional NHMP	X	
Coos	Coos County	Coos County Multi-Jurisdictional NHMP	X	
Coos	Coquille	Coos County Multi-Jurisdictional NHMP	X	
Washington	Cornelius	Washington County NHMP	X	
Benton	Corvallis	Benton County Multi-Jurisdictional NHMP	X	5
Lane	Cottage Grove	City of Cottage Grove NHMP	X	6
Lane	Creswell	Lane County Multi-Jurisdictional NHMP	X	

County Name	Community Name	Plan Title	NFIP	CRS Level
Crook	Crook County	Crook County Multi-Jurisdictional NHMP	X	
Jefferson	Culver	Jefferson County Multi-Jurisdictional NHMP	X	
Curry	Curry County	Curry County Multi-Jurisdictional NHMP	X	
Polk	Dallas	Polk County Multi-Jurisdictional NHMP	X	
Clackamas	Damascus		X	
Yamhill	Dayton	Yamhill County Multi-Jurisdictional NHMP	X	
Grant	Dayville		X	
Lincoln	Depoe Bay	Lincoln County Multi-Jurisdictional NHMP	X	
Deschutes	Deschutes County	Deschutes County Multi-Jurisdictional NHMP	X	
Marion	Detroit	Marion County Multi-Jurisdictional All-Hazards Mitigation Plan	X	
Douglas	Douglas County	Douglas County Multi-Jurisdictional NHMP	X	10
Douglas	Drain	Douglas County Multi-Jurisdictional NHMP	X	
Wasco	Dufur		X	
Yamhill	Dundee		X	
Lane	Dunes City	Lane County Multi-Jurisdictional NHMP	X	
Washington	Durham		X	
Jackson	Eagle Point	Jackson County Multi-Jurisdictional NHMP	X	
Umatilla	Echo	Umatilla County Multi-Jurisdictional NHMP	X	
Union	Elgin		X	
Douglas	Elkton	Douglas County Multi-Jurisdictional NHMP	X	
Wallowa	Enterprise	Wallowa County Multi-Jurisdictional NHMP	X	
Clackamas	Estacada	Clackamas County Multi-Jurisdictional NHMP	X	
Lane	Eugene	Lane County Multi-Jurisdictional NHMP	X	7
Lane	Eugene Water & Electric Board	Eugene-Springfield City		
Multnomah	Fairview	Multnomah County Multi-Jurisdictional NHMP	X	
Polk	Falls City	Polk County Multi-Jurisdictional NHMP	X	
Lane	Florence	Lane County Multi-Jurisdictional NHMP	X	
Washington	Forest Grove	Washington County NHMP	X	
Wheeler	Fossil	Wheeler County Multi-Jurisdictional NHMP	X	
Tillamook	Garibaldi	Tillamook County Multi-Jurisdictional NHMP2023 Update	X	
Washington	Gaston		X	
Marion	Gates		X	
Clatsop	Gearhart	Clatsop County Multi-Jurisdictional NHMP	X	
Marion	Gervais	Marion County Multi-Jurisdictional All-Hazards Mitigation Plan	X	
Gilliam	Gilliam County	Gilliam County Multi-Jurisdictional NHMP	X	
Clackamas	Gladstone	Clackamas County Multi-Jurisdictional NHMP	X	
Douglas	Glendale	Douglas County Multi-Jurisdictional NHMP	X	
Curry	Gold Beach	Curry County Multi-Jurisdictional NHMP	X	

County Name	Community Name	Plan Title	NFIP	CRS Level
Jackson	Gold Hill	Jackson County Multi-Jurisdictional NHMP	X	
Grant	Grant County	Grant County Multi-Jurisdictional NHMP	X	
Josephine	Grants Pass	Josephine County Multi-Jurisdictional NHMP	X	8
Sherman	Grass Valley	Sherman County Multi-Jurisdictional NHMP	X	
Multnomah	Gresham	Multnomah County Multi-Jurisdictional NHMP	X	
Baker	Haines		X	
Baker	Halfway	Baker County Multi-Jurisdictional NHMP	X	
Linn	Halsey	Linn County Multi-Jurisdictional NHMP	X	
Clackamas	Happy Valley	Clackamas County Multi-Jurisdictional NHMP	X	
Harney	Harney County	Harney County Multi-Jurisdictional NHMP	X	
Linn	Harrisburg	Linn County Multi-Jurisdictional NHMP	X	
Umatilla	Helix	Umatilla County Multi-Jurisdictional NHMP	X	
Morrow	Heppner	Morrow County Multi-Jurisdictional NHMP	X	9
Umatilla	Hermiston	Umatilla County Multi-Jurisdictional NHMP	X	
Washington	Hillsboro	Washington County NHMP	X	
Harney	Hines	Harney County Multi-Jurisdictional NHMP	X	
Hood River	Hood River	Hood River County Multi-Jurisdictional NHMP	X	
Hood River	Hood River County	Hood River County Multi-Jurisdictional NHMP	X	
Marion	Hubbard	Marion County Multi-Jurisdictional All-Hazards Mitigation Plan	X	
Baker	Huntington		X	
Linn	Idanha	Marion County Multi-Jurisdictional All-Hazards Mitigation Plan	X	
Polk	Independence	Polk County Multi-Jurisdictional NHMP	X	
Morrow	Ione	Morrow County Multi-Jurisdictional NHMP	X	
Morrow	Irrigon	Morrow County Multi-Jurisdictional NHMP	X	
Union	Island City			
Jackson	Jackson County	Jackson County Multi-Jurisdictional NHMP	X	7
Jackson	Jacksonville	Jackson County Multi-Jurisdictional NHMP	X	
Marion	Jefferson	Marion County Multi-Jurisdictional All-Hazards Mitigation Plan	X	
Jefferson	Jefferson County	Jefferson County Multi-Jurisdictional NHMP	X	
Grant	John Day	Grant County Multi-Jurisdictional NHMP	X	
Malheur	Jordan Valley		X	
Wallowa	Joseph	Wallowa County Multi-Jurisdictional NHMP	X	
Josephine	Josephine County	Josephine County Multi-Jurisdictional NHMP	X	
Lane	Junction City		X	
Marion	Keizer	Marion County Multi-Jurisdictional All-Hazards Mitigation Plan	X	
Washington	King City		X	
Klamath	Klamath County	Klamath County	X	
Klamath	Klamath Falls	Klamath County	X	

County Name	Community Name	Plan Title	NFIP	CRS Level
Union	La Grande	City of La Grande NHMP	X	
Yamhill	Lafayette		X	
Lake	Lake County	Lake County Multi-Jurisdictional NHMP	X	
Clackamas	Lake Oswego	Clackamas County Multi-Jurisdictional NHMP	X	
Multnomah	Lake Oswego	Clackamas County Multi-Jurisdictional NHMP	X	
Washington	Lake Oswego	Clackamas County Multi-Jurisdictional NHMP	X	
Coos	Lakeside	Coos County Multi-Jurisdictional NHMP	X	
Lake	Lakeview	Lake County Multi-Jurisdictional NHMP	X	
Lane	Lane County	Lane County Multi-Jurisdictional NHMP	X	6
Deschutes	La Pine	Deschutes County Multi-Jurisdictional NHMP	X	
Linn	Lebanon	Linn County Multi-Jurisdictional NHMP	X	
Morrow	Lexington	Morrow County Multi-Jurisdictional NHMP	X	
Lincoln	Lincoln City	Lincoln County Multi-Jurisdictional NHMP	X	
Lincoln	Lincoln County	Lincoln County Multi-Jurisdictional NHMP	X	
Linn	Linn County	Linn County Multi-Jurisdictional NHMP	X	
Grant	Long Creek		X	
Wallowa	Lostine	Wallowa County Multi-Jurisdictional NHMP	X	
Lane	Lowell	Lane County Multi-Jurisdictional NHMP	X	
Linn	Lyons	Linn County Multi-Jurisdictional NHMP	X	
Jefferson	Madras	Jefferson County Multi-Jurisdictional NHMP	X	
Malheur	Malheur County	Malheur County MJ NHMP	X	
Tillamook	Manzanita	Tillamook County Multi-Jurisdictional NHMP2023 Update	X	
Marion	Marion County	Marion County Multi-Jurisdictional All-Hazards Mitigation Plan	X	10
Wasco	Maupin		X	
Yamhill	McMinnville	Yamhill County Multi-Jurisdictional NHMP	X	
Jackson	Medford	Medford City NHMP	X	5
Klamath	Merrill			
Jefferson	Metolius	Jefferson County Multi-Jurisdictional NHMP		
Linn	Mill City	Marion County Multi-Jurisdictional All-Hazards Mitigation Plan	X	
Linn	Millersburg		X	
Umatilla	Milton-Freewater	Umatilla County Multi-Jurisdictional NHMP	X	
Clackamas	Milwaukie	Clackamas County Multi-Jurisdictional NHMP	X	
Multnomah	Milwaukie	Clackamas County Multi-Jurisdictional NHMP	X	
Wheeler	Mitchell	Wheeler County Multi-Jurisdictional NHMP	X	
Clackamas	Molalla	Clackamas County Multi-Jurisdictional NHMP	X	
Polk	Monmouth	Polk County Multi-Jurisdictional NHMP	X	
Benton	Monroe	Benton County Multi-Jurisdictional NHMP	X	
Grant	Monument		X	
Sherman	Moro city	Sherman County Multi-Jurisdictional NHMP		

County Name	Community Name	Plan Title	NFIP	CRS Level
Morrow	Morrow County	Morrow County Multi-Jurisdictional NHMP	X	
Wasco	Mosier		X	
Marion	Mount Angel city	Marion County Multi-Jurisdictional All-Hazards Mitigation Plan	X	
Grant	Mount Vernon		X	
Multnomah	Multnomah County	Multnomah County Multi-Jurisdictional NHMP	X	
Douglas	Myrtle Creek	Douglas County Multi-Jurisdictional NHMP	X	10
Coos	Myrtle Point	Coos County Multi-Jurisdictional NHMP	X	
Tillamook	Nehalem	Tillamook County Multi-Jurisdictional NHMP	X	7
Yamhill	Newberg	Yamhill County Multi-Jurisdictional NHMP	X	
Lincoln	Newport	Lincoln County Multi-Jurisdictional NHMP	X	
Coos	North Bend	Coos County Multi-Jurisdictional NHMP	X	
Washington	North Plains	Washington County NHMP	X	
Union	North Powder		X	
Malheur	Nyssa	Malheur County MJ NHMP	X	
Douglas	Oakland	Douglas County Multi-Jurisdictional NHMP	X	
Lane	Oakridge	Lane County Multi-Jurisdictional NHMP	X	
Malheur	Ontario	Malheur County MJ NHMP	X	
Clackamas	Oregon City	Clackamas County Multi-Jurisdictional NHMP	X	6
Lake	Paisley	Lake County Multi-Jurisdictional NHMP	X	
Umatilla	Pendleton	Umatilla County Multi-Jurisdictional NHMP	X	
Benton	Philomath	Benton County Multi-Jurisdictional NHMP	X	
Jackson	Phoenix	Jackson County Multi-Jurisdictional NHMP	X	
Umatilla	Pilot Rock		X	
Polk	Polk County	Polk County Multi-Jurisdictional NHMP	X	9
Clackamas	Portland	City of Portland 2021 NHMP	X	5
Multnomah	Portland	City of Portland 2021 NHMP	X	5
Washington	Portland	City of Portland 2021 NHMP	X	5
Curry	Port Orford	Curry County Multi-jurisdictional NHMP	X	
Coos	Powers	Coos County Multi-Jurisdictional NHMP	X	
Grant	Prairie City		X	
Columbia	Prescott	Columbia County Multi-Jurisdictional NHMP	X	
Crook	Prineville	Crook County Multi-Jurisdictional NHMP	X	
Columbia	Rainier	Columbia County Multi-Jurisdictional NHMP	X	
Deschutes	Redmond	Deschutes County Multi-Jurisdictional NHMP		
Douglas	Reedsport	Douglas County Multi-Jurisdictional NHMP	X	
Douglas	Riddle	Douglas County Multi-Jurisdictional NHMP	X	
Tillamook	Rockaway Beach	Tillamook County Multi-Jurisdictional NHMP2023 Update	X	10
Jackson	Rogue River	Jackson County Multi-jurisdictional NHMP	X	10
Douglas	Roseburg	Douglas County Multi-Jurisdictional NHMP	X	7
Sherman	Rufus	Sherman County Multi-Jurisdictional NHMP	X	

County Name	Community Name	Plan Title	NFIP	CRS Level
Marion	Salem	City of Salem NHMP	X	3
Polk	Salem	City of Salem NHMP	X	3
Clackamas	Sandy	Clackamas County Multi-Jurisdictional NHMP	X	
Columbia	Scappoose	Columbia County Multi-Jurisdictional NHMP	X	9
Linn	Scio	Linn County Multi-Jurisdictional NHMP	X	10
Marion	Scotts Mills	Marion County Multi-Jurisdictional All-Hazards Mitigation Plan	X	
Clatsop	Seaside	Clatsop County Multi-Jurisdictional NHMP	X	
Jackson	Shady Cove		X	
Jackson	Shady Cove	Jackson County Multi-jurisdictional NHMP	X	
Yamhill	Sheridan	Yamhill County Multi-Jurisdictional NHMP	X	8
Sherman	Sherman County	Sherman County Multi-jurisdictional NHMP	X	
Washington	Sherwood	Washington County NHMP	X	
Lincoln	Siletz	Lincoln County Multi-Jurisdictional NHMP	X	
Marion	Silverton		X	
Deschutes	Sisters	Deschutes County Multi-Jurisdictional NHMP	X	
Linn	Sodaville	Linn County Multi-Jurisdictional NHMP		
Wheeler	Spray	Wheeler County Multi-Jurisdictional NHMP	X	
Lane	Springfield	Eugene-Springfield City	X	
Marion	St. Paul		X	
Umatilla	Stanfield	Umatilla County Multi-Jurisdictional NHMP	X	10
Marion	Stayton	Marion County Multi-Jurisdictional All-Hazards Mitigation Plan	X	
Columbia	St. Helens	Columbia County Multi-Jurisdictional NHMP	X	
Marion	Sublimity	Marion County Multi-Jurisdictional All-Hazards Mitigation Plan		
Union	Summerville		X	
Baker	Sumpter		X	
Douglas	Sutherlin	Douglas County Multi-Jurisdictional NHMP	X	
Linn	Sweet Home	City of Sweet Home NHMP	X	
Jackson	Talent	Jackson County Multi-Jurisdictional NHMP	X	8
Linn	Tangent	Linn County Multi-Jurisdictional NHMP	X	
Wasco	The Dalles	Wasco County Multi-Jurisdictional NHMP	X	
Washington	Tigard	Washington County NHMP	X	
Tillamook	Tillamook	Tillamook County Multi-Jurisdictional NHMP2023 Update	X	9
Tillamook	Tillamook County	Tillamook County Multi-Jurisdictional NHMP2023 Update	X	10
Lincoln	Toledo	Lincoln County Multi-Jurisdictional NHMP	X	
Multnomah	Troutdale	Multnomah County Multi-Jurisdictional NHMP	X	9
Washington	Tualatin	Washington County NHMP	X	
Washington	Tualatin Valley Water District	Washington County NHMP		

County Name	Community Name	Plan Title	NFIP	CRS Level
Marion	Turner	Marion County Multi-Jurisdictional All-Hazards Mitigation Plan	X	
Umatilla	Ukiah	Umatilla County Multi-Jurisdictional NHMP	X	
Umatilla	Umatilla County	Umatilla County Multi-Jurisdictional NHMP	X	
Union	Union County	Union County NHMP	X	
Malheur	Vale	Malheur County MJ NHMP	X	
Lane	Veneta	Lane County Multi-Jurisdictional NHMP	X	
Columbia	Vernonia	Columbia County Multi-Jurisdictional NHMP	X	
Lincoln	Waldport	Lincoln County Multi-Jurisdictional NHMP	X	
Wallowa	Wallowa	Wallowa County Multi-Jurisdictional NHMP	X	
Wallowa	Wallowa County	Wallowa County Multi-Jurisdictional NHMP	X	
Clatsop	Warrenton city	Clatsop County Multi-Jurisdictional NHMP	X	
Sherman	Wasco	Sherman County Multi-jurisdictional NHMP	X	
Wasco	Wasco County	Wasco County Multi-Jurisdictional NHMP	X	
Washington	Washington County	Washington County NHMP	X	
Linn	Waterloo	Linn County Multi-Jurisdictional NHMP	X	
Lane	Westfir	Lane County Multi-Jurisdictional NHMP	X	
Clackamas	West Linn	Clackamas County Multi-Jurisdictional NHMP	X	
Umatilla	Weston	Umatilla County Multi-Jurisdictional NHMP	X	
Tillamook	Wheeler	Tillamook County Multi-Jurisdictional NHMP2023 Update	X	
Wheeler	Wheeler County	Wheeler County Multi-Jurisdictional NHMP	X	
Yamhill	Willamina	Yamhill County Multi-Jurisdictional NHMP	X	
Clackamas	Wilsonville	Clackamas County Multi-Jurisdictional NHMP	X	
Washington	Wilsonville	Clackamas County Multi-Jurisdictional NHMP	X	
Douglas	Winston	Douglas County Multi-Jurisdictional NHMP	X	
Marion	Woodburn	Marion County Multi-Jurisdictional All-Hazards Mitigation Plan	X	
Multnomah	Wood Village	Multnomah County Multi-Jurisdictional NHMP	X	
Lincoln	Yachats	Lincoln County Multi-Jurisdictional NHMP	X	
Yamhill	Yamhill	Yamhill County Multi-Jurisdictional NHMP	X	
Yamhill	Yamhill County	Yamhill County Multi-Jurisdictional NHMP	X	
Douglas	Yoncalla	Douglas County Multi-Jurisdictional NHMP	X	

Source: Community status book report for state OR

Table 6.2.2-2: Tribes Participation in NFIP and CRS [October 2024]

Tribe	Plan Title	NFIP	CRS Level
Burns Paiute Tribe	Burns Paiute Tribal Mitigation Plan		
Confederated Tribes of Siletz Indians	Confederated Tribes of the Siletz Indians Multi-NHMP	X	
Confederated Tribes of the Coos, Lower Umpqua, and Siuslaw Indians	Confederated Tribes of Coos, Lower Umpqua and Siuslaw Indians Tribal Mitigation Plan	X	

Tribe	Plan Title	NFIP	CRS Level
Confederated Tribes of the Grand Ronde	Confederated Tribes of Grand Ronde Tribal Mitigation Plan	X	
Confederated Tribes of the Umatilla Indian Reservation	Confederated Tribes of the Umatilla Indian Reservation Tribal Mitigation Plan	X	
Confederated Tribes of the Warm Springs Reservation	Warm Springs Tribal Mitigation Plan	X	
Coquille Indian Tribe	Coquille Indian Tribe NHMP	X	
Cow Creek Band of Umpqua Tribe of Indians	Cow Creek Band of Umpqua Tribe of Indians All-Hazards Mitigation Plan	X	
Klamath Tribes		X	

6.2.2.3 Building Codes & Code Enforcement

The mission of the Building Codes Division is to work with Oregonians to ensure safe building construction while promoting a positive business climate (Building Codes Division : About us : State of Oregon). This mission is accomplished through: (a) adopting and administering uniform statewide building codes; (b) providing code and rule interpretation; (c) assisting local government building departments and facilitating dispute resolution; (d) enforcing license, code, and permit requirements; (e) certifying inspectors and licensing trade professionals; (f) facilitating economic development efforts around the state; and (g) conducting inspections where local entities do not.

Building codes have proven to be effective in hazard mitigation, establishing uniform standards for all residential and commercial buildings in Oregon. At the local level, all jurisdictions have building codes that they adopt and enforce. This allows cities and counties in Oregon to ensure that new construction is built to minimum standards. Certain provisions of the building code apply to the design and construction of buildings located in areas prone to natural hazards. For example, the city of Ashland adopted and administers the 2023 Oregon Residential Specialty Code and the 2022 Oregon Fire Code. However, Oregon's minimum and maximum requirements do not allow local jurisdictions to exceed maximum requirements in most cases. Refer to the state capability assessment for Oregon State building codes related to hazard resilience.

6.2.2.4 Administrative & Technical

Local governments with the capability to seek funding and enforce codes have clear advantages in pursuing mitigation actions. Some jurisdictions lack a full-time emergency manager and staff, a clear deficiency for seeking and managing grants and ensuring code compliance. All 36 Oregon counties have Emergency Managers, whether full- or part-time, and cities over 85,000 can access the Emergency Management Performance Grant (EMPG) to help pay for Emergency Managers. Twenty-seven cities have full- or part-time Emergency Management positions, as do METRO, the Port of Portland, and the Regional Disaster Preparedness Organization (RDPO).

Emergency Managers consider resources such as staffing, access to technical experts, and funding to implement mitigation actions; whether the local government has the capacity not only to take, but also to maintain, a mitigation project; whether the local government has the capacity to accomplish a mitigation

project in a timely manner; whether the mitigation project is a short- or long-term fix; and the potential impacts to infrastructure or systems not directly related to the mitigation action.

Oregon's cities employ one of four forms of government that vary by administrative roles: (a) council/manager or administrator; (b) commission; (c) mayor/council; and (d) strong mayor. Most Oregon cities with populations over 2,500 use the council/manager or council/administrator form.

Twenty-eight counties are governed by a board of commissioners comprised of three to five elected members. The other eight are governed by a county court consisting of a county judge and two commissioners.

6.2.2.5 Financial

Many cities implement Capital Improvement Plans (CIPs) with great success in providing services to their communities within their budget. CIPs are effective at addressing mitigation actions through specific budgeting, especially when integrated into other plans and polices. For example, the City of Salem provides a comprehensive mapping of projects by category that allows citizens to see where infrastructure projects are occurring.

The property tax system in Oregon is heavily influenced by Measures 5 and 50, both of which limit the amount of tax that can be levied. These fixed tax rates, set at the 1997 level, limit potential growth in revenue for local governments and fail to reflect changes in community dynamics (https://www.oregon.gov/DOR/programs/gov-research/Documents/303-405-1.pdf). Property tax systems based on a fixed assessed value as opposed to market values severely limit a local government's ability to improve their financial situation(FAQ on Measures 5 and 50). Financial capabilities are tied to administration insofar as setting up fees, grant writing and administration, and other sources that could support CIPs. Having the appropriate staff to seek and manage funding is an essential capability for local governments.

6.2.2.6 Educational Outreach, Groups, and Organizations

Considered people-powered capabilities, grassroots movements involve people at their core directly serving locals, people with acute needs, and disadvantaged communities that cross jurisdictional boundaries. These capabilities are the most direct, on-the-ground resources for smaller communities, especially impacting underserved communities. They have the power to cross cultural or political barriers to serve, inform, and educate a broader range of people about disaster resilience and mitigation. Social cohesion, in the form of resilience hubs (such as community centers, general stores, town halls etc.), gives people not only a place to gather, shelter, and share information but also provides the foundation for a community response system during hazard events.

Part of education and outreach involves a local government's ability to work with and empower local organizations, groups, and institutions to work with residents to be prepared for natural hazard events. Strengthening neighborly relationships, knowing who and where your emergency operation contacts are, and providing community courses and training are all examples of increasing local capabilities in the event major social infrastructure is impeded. Local governments can help with spotlighting these resources as well as identifying appropriate resilience hub locations. Neighborhood associations, for example, have the potential for door-to-door outreach for community education pre-disaster and localized operations in post-

hazard scenarios. Another example is the Nehalem Bay Emergency Volunteer Corps (NBEVC), a non-profit that hosts a wealth of online knowledge about preparation, events, training, and other resources for the numerous natural hazard events that could affect the local area. The state has a responsibility to aid local governments' ability in outreach to these entities.

It's important that community members view their city's, county's, special district's, and Tribe's Natural Hazards Mitigation Plan capability section to see how they assess their abilities to coordinate local programs on a scale that meets community members' needs.

Numerous county plans in Eastern Oregon do an excellent job of listing the wealth of social connectivity entities in their areas, making their NHMP an active resource for the community.

6.2.3 Tribal Capability

The tribal capability assessment provides a general description of tribal mitigation capabilities in Oregon, including examples of successful policies and programs, followed by an analysis of the effectiveness of these capabilities. The assessment concludes with a discussion of opportunities and obstacles to implementing and strengthening tribal capabilities.

Table 6.2.3-1 lists the nine federally recognized Tribes in Oregon and their NHMP status. Tribes may work directly with FEMA or access assistance through the state. Those in bold have accessed state assistance to some degree.

Table 6.2.3-1: Federally Recognized Tribes' NHMP Status as of February 2025

Tribal Nation	Expiration Date	Status
Burns Paiute Tribe	7/20/2026	Approved
Confederated Tribes of Coos, Lower Umpqua, and Siuslaw	8/13/2029	Approved
Confederated Tribes of the Grand Ronde Community of Oregon	4/19/2020	Expired. Update in process.
Confederated Tribes of Siletz Indians of Oregon	1/27/2025	Expired. Update in process.
Confederated Tribes of the Umatilla Indian Reservation	1/31/2027	Approved
Confederated Tribes of Warm Springs Reservation of Oregon	9/19/2021	Expired. Update in process.
Coquille Indian Tribe	6/11/2023	Approved pending adoption
Cow Creek Band of the Umpqua Tribe	8/1/2029	Approved
Klamath Tribes	9/6/2022	Expired

Source: FEMA

Similar to local rural governments' capabilities, much of tribal capacity rests in a tribal government's ability to operationalize their governance and administration through staffing. The ability to apply and process grants, securing staff through competitive pay, and the development of master plans and regulatory documents provide similar effectiveness and limitations as local jurisdictions. For example, the Confederated Tribes of Coos, Lower Umpqua, & Siuslaw Indians (CTCLUSI) provides a comprehensive assessment of their planning, administrative, financial, and education capabilities and how they relate to hazard planning. Similarly, the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) provides a complete governmental organization structure within their NHMP.

Currently, four of the nine federally recognized tribes have current, FEMA-approved NHMPs. One will be approved once the Tribal government adopts it. Three plans are in the process of being updated. DLCD began assisting with tribal mitigation planning in 2020. Some tribes seem better equipped than others to plan, implement mitigation actions, pursue and manage grants, and more.

Many state agencies have government-to-government relations policies in place with the intent of recognizing tribal autonomy and bolstering communication. DLCD and OEM could initiate more outreach to coordinate with the Tribes and assist with mitigation-related needs or activities to the extent they desire. This could include assistance with data-gathering, mapping, setting up regular coordination meetings, and other initiatives that would potentially increase capacity.

6.2.4 Challenges and Obstacles

Low-capacity jurisdictions already struggling with overburdened staff and tight budgets are often unable to use or are unaware of mitigation capabilities. In plan development, some jurisdictions assess capabilities in an explicit section, others in the community profile. Conducting a thorough examination of available resources and capabilities and writing clearly about them in the plan will help development of mitigation strategies.

One such significant obstacle for low-capacity jurisdictions is the cost-share required for FEMA grants. For already financially constrained jurisdictions, a grant's cost share requirement is a deterrent, preventing them from applying. This is often seen with federal Hazard Mitigation Assistance (HMA) grants, including the Hazard Mitigation Grant Program (HMGP), Building Resilient Infrastructure and Communities (BRIC) and Flood Mitigation Assistance (FMA) programs, where the required non-federal cost share is 25%. Though the state legislature provided funding through House Bill 5006 (2021) to cover the cost share requirement for one FEMA grant in full, many low-capacity jurisdictions are still applying much less often than higher-capacity jurisdictions.

Other obstacles involve staffing, managing grant funding, and adhering to the administrative requirements of a grant. Many jurisdictions are without grant writers or administrators, and some maintain part-time Emergency Managers. Even if successful at applying for and receiving a grant, low-capacity jurisdictions often cannot see large projects through. Larger communities are generally able to obtain grants to implement mitigation actions but managing them can still be an obstacle. However, since the 2021 legislative session, OEM has more than doubled the number of its full-time staff positions, potentially lending more resources for local governments across the state. The OEM Mitigation and Recovery Regional Coordinators provide the local governments in their regions with technical assistance and coordination in pursuing mitigation grant opportunities. They may also assist the local governments in effectively leveraging state and federal dollars to maximize risk reduction and better position their communities to recover from disasters.

For a local Emergency Manager, finding the appropriate resources and agency to support efforts may also present a challenge. Each agency within the State IHMT offers support in a different facet of hazard mitigation, and jurisdictions can sometimes find the information they're looking for elusive. Agency regions and coordinating offices are very inconsistent across sectors. Difficulty in accessing reliable data to inform decision-making and prioritize mitigation efforts for these communities drain administrative capacity, unnecessarily extend timelines, and may potentially be a deterrent when making implementation choices.

Most importantly, building trust between community members and local authorities and encouraging active participation from underserved communities will build resilience and support mitigation efforts.

6.2.4.1 Underrepresented Communities

Underrepresented communities – those with lower incomes, longer travel times to services, limited safe routes, limited essential services and lifelines, often located in rural areas – generally have fewer resources available to them. This makes community organizing, "word of mouth" communications, integrating social systems, and social capital even more important.

Inversely, communicating with underrepresented communities in urban areas where messages are generally more accessible can also be an issue. The City of Salem approaches this issue by engaging faith communities, social service agencies, nonprofits, and neighborhood associations in building community resilience (Salem's Action Item #12).

Communities should prioritize meeting the needs of vulnerable populations – people who are elderly, children, disabled, homeless, have limited English proficiency, or are living in poverty, among other factors – through mitigation actions. Locating service centers, schools, hospitals, and more near these populations will reduce their vulnerability.

Social organizations that represent people of color, people with mental or physical disabilities, veterans, and other vulnerable populations should be included in mitigation planning processes to ensure their issues are addressed.

Economic constraints in rural areas may limit the ability to implement costly climate adaptation measures. Dependence on agriculture or other climate-sensitive industries may exacerbate the economic impacts of climate-related natural hazard events.

6.2.4.2 Climate Change

As climate change continues to shape the frequency, intensity, and location of natural hazard events, local governments will have to be more proactive in anticipating such impacts and designing mitigation actions that account for these changes. The increased frequency and intensity of natural hazard events could exacerbate impacts on already constrained budgets and finite resources.

A lack of awareness and understanding of the local impacts of climate change may result in a lack of urgency or prioritization in adaptation efforts, as well as insufficient knowledge about the specific vulnerabilities of the community to climate change. Aging or inadequate infrastructure may be more vulnerable to climate-related events, increasing the community's overall susceptibility.

Lastly, resistance or lack of buy-in from community members or local authorities may impede the adoption of climate-resilient practices and policies. Balancing short-term priorities with long-term climate mitigation and adaptation goals can be challenging.

6.2.4.3 Private Dams

In general, tribes and local governments' ability to reduce risk from potential dam failures is fairly low, unless the local government owns the dam. A notable exception is dams that are eligible for funding from FEMA's High Hazard Potential Dam program. Also, some local governments have participated in exercises to test their emergency action plans. Few local governments have used inundation maps to develop evacuation maps.

Inundation maps are only required for dams rated high hazard. Inundation maps for state regulated dams in Oregon are public information; however, there is no mechanism to get this information to people at risk from high hazard potential dams in unsatisfactory or poor condition. Residents below dams are usually unaware of the risk. The issue is mostly due to past developments below dams. Oregon land use regulations are fairly effective at limiting new development in areas below dams.

6.2.5 Potential Solutions

The State of Oregon has many resources and the capacity to hone those resources to better meet the multitude of needs across counties, cities, special districts and tribes. In general, assessing local capabilities could be bolstered by using FEMA's recommended capability assessment worksheet.

Already a direct liaison with a wealth of understanding, the Regional Coordinators at OEM can provide more direct technical assistance in plan monitoring and maintenance throughout the development of NHMPs to ensure that local capabilities support potential mitigation actions.

The Governor's Regional Solutions Team works to provide collaborative governance and facilitation and could assist in linking adjacent counties and cities' capacity to increase resilience. The Regional Solutions Team could take a more proactive approach in emphasizing hazard mitigation actions with local Emergency Managers. A multi-agency collaboration to identify funds to help cover the 25% non-federal cost share required by FEMA grants would lessen the financial burden on subapplicants.

One way to potentially address the non-federal cost share and reliance on FEMA's onerous grant review and approval timelines is to develop a state-driven funding and plan maintenance coverage program for which local jurisdictions and tribes can compete. This potential funding program would not only directly meet the state's mitigation actions #14 & #31 but would also call for stronger action concerning Goal 7. Aligning local NHMPs with local communities' housing production strategies is a DLCD priority for protecting our built environment. The Governor's Regional Solutions Teams and OEM's Regional Coordinators Program could play a part in coordinating a more robust technical assistance and outreach program to synchronize multi-jurisdictional mitigation strategies, potentially increasing resilience while reducing the cost-share burden on each jurisdiction.

With a robust building code inventory at the state level and a proven track record at improving disaster resilience, ensuring each county's Building Official has the appropriate support for implementation and enforcement would provide a strong measure of effectiveness and coordination.

The Emergency Management Performance Grant (EMPG) makes grants to states to assist jurisdictions in preparing for hazards. One of the objectives of the funds is to build continuity capabilities to ensure resilience of essential government functions and services. OEM applies for this grant on behalf of jurisdictions and Tribes as the eligible entity. Increasing awareness that OEM can provide technical support may help to increase the quantity of grant applications.

The biggest opportunity to reduce risks from high hazard potential dams would be to create a process to share information with residents and property owners at risk. This information is sometimes contained in floodplain management plans within NHMPs. The Oregon Dam Safety Program has drafted sample sections to add this information to NHMPs.

6.3 State and Local Planning Coordination

The State of Oregon has a strong history of working with local governments to reduce their risk from natural hazards. Maintaining this relationship is a top priority.

Considering the breadth of agencies and departments associated with hazard mitigation planning at the state level, it's imperative that their resources are available at the several scales needed to support all of Oregon's counties, cities, special districts, and tribes in natural hazards mitigation. This requires clear coordination and communication among state agencies and a willingness to collaborate and build local capacity.

Success of local mitigation efforts is one measure of the state's achievement of its mitigation goals. Likewise, local governments should take into account the resources the state can provide when determining its mitigation goals and actions. The better informed of and aligned with each others' mitigation priorities, the more easily both levels of government can collaborate in advancing resilience.

Local NHMPs provide the clearest insight into the success of mitigation efforts, allocation of resources, and overall community buy-in. This section describes the state's policies and processes for assisting local governments with hazard mitigation planning and projects, including funding opportunities, technical assistance, and training.

6.3.1 Technical Assistance

DLCD, DOGAMI, the Oregon Partnership for Disaster Resilience (OPDR), and the Oregon Climate Change Research Institute (OCCRI) provide direct state technical planning assistance for developing and updating local and tribal NHMPs. Funded through FEMA grants with a non-federal cost share of 25%, DLCD's staff and OPDR's staff and students support local government leaders throughout the mitigation planning process, ensuring a robust public process; that NHMPs are based on the best information available; and that they are approvable by FEMA. DLCD and OPDR assist local governments in the same way with developing or updating Community Wildfire Protection Plans that local governments can then integrate with their NHMPs.

DOGAMI provides county-level risk assessments and OCCRI provides county-level future projection reports that directly inform the natural hazards mitigation planning process. Staff also provide technical assistance indirectly, in the form of education and access to products and information on state and federal websites. Councils of Government and private sector consultants provide similar technical assistance.

At OEM, the State Hazard Mitigation Officer (SHMO) and two Deputy SHMOs lead teams which assist with mitigation project development, execution, and grant compliance. The Special Projects Coordinator leads mitigation plans; public information and outreach, particularly for earthquake and tsunami hazards; and tsunami evacuation planning.

Since 2021, OEM has added 15 new staff members to assist in HMA grant assistance, RiskMAP coordination, administration, and general technical assistance. Though this increase in capacity has resulted in new support for local governments it has also increased administrative and reporting responsibilities.

DLCD's Ocean and Coastal Management Program (OCMP) staff provide local governments on the Oregon Coast assistance in complying with Statewide Planning Goal 7 which requires planning for natural hazards. Also frequently working cooperatively with DOGAMI, OCMP staff assist with planning for a Cascadia Subduction Zone earthquake and tsunami, sea level rise, coastal erosion, and other hazards unique to the coast. Goal 7 encourages implementing the National Flood Insurance Program (NFIP) minimum and higher standards. In 2015, DLCD staff began assisting local jurisdictions with updating and developing new NHMPs. DOGAMI continues to develop local risk assessments that underpin local NHMPs through FEMA's Cooperating Technical Partners (CTP) program and partnering with the Risk MAP (Mapping, Assessment and Planning) Program.

Together, OEM and DLCD provide technical assistance to property owners, local governments, and tribes for mitigating repetitive loss (RL) and severe repetitive loss (SRL) properties. DLCD and OEM provide notification and information about mitigation grants to state agencies, tribes, counties, cities, and special districts. OEM provides assistance, to the degree possible, to communities to help them prepare grant subapplications. The state and local governments must have an information sharing agreement with FEMA to obtain RL and SRL data. Since the state does not have such an agreement and is therefore unable to share RL and SRL data with local governments, DLCD advises them to request the data from FEMA and execute the data sharing agreement. Once the local governments have obtained the data, DLCD will work with them to identify mitigation options and prioritize mitigation projects for RL and SRL properties.

DOGAMI

In addition to the RiskMAP Program's natural hazard data products, specific hazard information, risk, and vulnerability assessment products are provided by DOGAMI on a funding-contingent basis. When State funding is involved, it may come through DOGAMI itself or from other State agencies. One example is DOGAMI's initial study of statewide channel migration zone susceptibility which was fully supported with State funds. This is an important step forward in understanding the state's flood risk and is expected to pave the way for further state and federal funding to support detailed channel migration zone delineations. Ultimately, these non-regulatory, informational products can help save lives and reduce property damage from flooding. Another example is DOGAMI's recently launched flood hazard webpage, http://www.oregongeology.org/flood/default.htm.

Numerous other agencies — federal (e.g., FEMA, USGS, USACE), state (e.g., ODF, ODOT, OHA) and local (counties, cities, councils of governments, and special districts) also contribute valuable technical information and support to local mitigation planning efforts. The Oregon Department of Forestry, as an example, provides assistance protecting against insect and disease infestation. The Oregon Health Authority manages Oregon's Health Security, Preparedness, and Response (HSPR) Program in collaboration with OEM to provide resources in the event of health emergencies and natural hazard events.

In addition to contributions by state, federal, and local agencies, other entities contribute critical technical assistance to the hazard mitigation planning and include the Oregon Partnership for Disaster Resilience (OPDR) and Oregon Climate Change Research Institute (OCCRI).

OPDR

A critical source of technical hazard mitigation planning assistance in Oregon, the Oregon Partnership for Disaster Resilience (OPDR), part of the Institute for Policy Research and Engagement at the University of Oregon, assists local jurisdictions with grant writing, local NHMP development or updates, process facilitation, stakeholder engagement, public outreach, and hazard research services and serves as a liaison between tribes and local governments and state, federal and NGO partners during the mitigation planning process. OPDR strives to ensure that tribes and local communities:

- Receive the tools and resources to successfully facilitate and document plan development or plan update processes;
- Establish regional partnerships to discuss collaborative projects and implementation strategies; and
- Engage with a variety of state and local agencies and organizations that can assist with local risk reduction strategies.

OCCRI

Oregon Climate Change Research Institute (OCCRI), created under HB 3543 (2007), also plays a critical role, providing technical assistance to local jurisdictions and the state by analyzing the influence of climate change on natural hazards. OCCRI is a network of dozens of researchers and professionals at Oregon State University, Portland State University, University of Oregon, and other universities, agencies, and organizations. Among OCCRI's charges from the Legislature is assessment of "the state of climate change science, including biological, physical and social science, as it relates to Oregon and the likely effects of climate change on the state." According to OCCRI, to meet its charges from the Legislature, the institute serves roles that include the following:

- Facilitate research on climate change and its effects on natural and human systems in Oregon.
- Serve as a clearinghouse for climate change information.
- Provide climate change information to the public in integrated and accessible formats.
- Provide technical assistance to local governments in developing climate change policies, practices, and programs.
- Produce a biennial assessment on the state of the science of climate change as it applies to Oregon and the likely effects of climate change on the state.

Resource Assistance for Rural Environments (RARE) is an AmeriCorps program also housed at the University of Oregon's Institute for Policy Research and Engagement. Its mission is "to increase the capacity of rural communities to improve their economic, social, and environmental conditions, through the assistance of trained graduate-level members who live and work in communities for 11 months." The RARE program has successfully provided natural hazards mitigation planning assistance to rural communities and the state could potentially create a relationship with the program to provide ongoing mitigation planning assistance in rural communities.

Technical assistance provided by DLCD's Oregon Coastal Management Program (OCMP) during the life of the 2020 Oregon NHMP resulted in these accomplishments:

- The Oregon Coastal Management Program created a collection of tools to assist communities in planning for sea level rise impacts specific to the Oregon coast both within estuaries and along the outer coast. The three resources in this kit support data acquisition, vulnerability assessment, and adaptation planning.
- The Sea Level Rise Impact Explorer assists communities and planners in accessing and exploring community data sets with respect to sea level rise impacts so they can understand the risks and plan accordingly.
- The Sea Level Rise Impact Assessment Tool is a digital workbook designed to help users inventory what activities take place within areas affected by sea level rise, assess vulnerability to harm, and prioritize further investigation into remedial and adaptive actions.
- The Sea Level Rise Planning Guide for Coastal Oregon is a document that provides a suggested approach to evaluating the assets and populations at risk from the impacts of sea level rise.
- DLCD worked with a NOAA Coastal Management Fellow to complete a sea level rise vulnerability assessment for Clatsop County. The Fellow led community workshops in which community assets at risk from sea level rise were identified; completed a Sea Level Rise Impact Assessment; developed Inundation Mitigation and Adaptation Action Plans for project implementation; and created a Sea Level Rise Community Engagement Guide for other communities to carry out similar work.
- DLCD has contracted DOGAMI to update the previously used 1975 Beach and Dune Inventory maps for the whole coast, starting with a pilot project in Tillamook County. DLCD has worked with Tillamook County, Coos County, and the City of Bandon to adopt these new inventory maps into their comprehensive plans and to update their Beaches and Dunes sections of their comprehensive plans, policies, and codes. DLCD is also working with Clatsop County to do the same as they update their comprehensive plan for Goals 16, 17, and 18. Adopting these maps and updating accompanying Goal 18 policies can limit hazards to people and property along the ocean shore and minimize impact to the natural beach and dune environments.
- The OCMP also assists with addressing hazards to promote community resilience through the ongoing King Tides Project. This project is co-coordinated with Coast Watch, a nonprofit group housed within Oregon Shores. The project asks community volunteers to take and submit photographs of king tide impacts such as storm surge, coastal flooding, and erosion. Photos taken during king tides can show the impact of higher sea levels and storms on those sites. This information can help raise awareness of possible impacts from sea level rise and inform planning for coastal inundation. Staff for the King Tides Project created a new website and are improving the image by tagging and sharing efforts, conducting outreach events, and spreading awareness through press interviews and social media.

6.3.2 Funding Assistance

Funding for the State's Hazard Mitigation Planning Program comes primarily from FEMA's non-disaster grant program, Building Resilient Infrastructure and Communities (BRIC), and from the post-disaster Hazard Mitigation Grant Program (HMGP). These grants are supplemented by state and local general funds, University of Oregon in-kind cost share, and other in-kind cost share sources (e.g., local stakeholder cost share).

6.3.2.1 Land Use Planning Grants

The Land Conservation and Development Commission oversees a grant program through which each biennium local government is awarded general funds for purposes that support the statewide land use planning program. One of the grants in the program is the Technical Assistance (TA) Grant. It is a competitive grant that has the following five priorities, in order:

1. Promote economic development.
2. Plan for resilience to natural hazards and climate change
3. Plan for resolution of a local planning issue, challenges in integrating conflicting statewide planning goals, or problem of statewide concern that can provide a framework, solutions, or guidance for similar programs to be implemented by other local governments around the state.
4. Provide infrastructure financing plans for urbanizing areas.
5. Update comprehensive plans and implementing codes to respond to changes in state law, regulatory streamlining, or significantly changed local conditions since the last plan update.

In the 2023-25 biennium, the descriptive language for Priority #2 acknowledges the need to plan for resilience to natural hazards and climate change and provides assistance with (a) creating or updating local natural hazards mitigation, climate adaptation, pre-disaster recovery, and planning to reduce climate pollution; (b) other studies and activities supporting local resilience to natural hazards, climate adaptation, pre-disaster recovery, and climate mitigation; (c) incorporating new natural hazards, climate adaptation, climate pollution reduction, and pre-disaster recovery data and policies, and related state goals, policies, and regulations, into comprehensive plans, land use and zoning regulations.

The legislature reduced the amount of funding allocated to this program in response to the 2009 great recession and has not restored previous levels of funding since then, despite DLCD's requests to do so. One bright spot since then – the legislature has increased technical assistance funding since 2018 for local government work on housing issues, thus allowing use of the technical assistance funding for other types of projects, which may include projects addressing natural hazards.

DLCD and OEM have continued to request new funding to support hazard mitigation-related staff positions in their respective agencies. New positions would increase the state's capacity to develop data useful for local hazard mitigation planning; provide access for local jurisdictions and tribes to that data; provide technical assistance to local jurisdictions for mitigation planning, projects, and integrating local NHMPs with comprehensive plans, implementing programs and regulations.

6.3.2.2 Mitigation Program Regional Representatives

The Regional Coordinators Program at OEM employs specialized field staff members to support local and Tribal emergency management partners through all areas of emergencies and disasters. Regional Coordinators provide service to all 36 counties in Oregon. The OEM Tribal Liaison, who helps coordinate emergency management initiatives for the nine federally recognized Tribes of Oregon, provides additional support to the Regional Coordinators Program. The Regional Coordinators Program is structured into two teams: Preparedness and Response Coordination Team and Mitigation and Recovery Coordination Team.

6.3.3 Training

Oregon delivers a robust calendar of training classes and events each year that support mitigation planning, project development and implementation, and risk reduction. Oregon also delivers the *Oregon Prepared* Conference in the spring of each year which brings together emergency managers and others for a few days of training and networking.

OEM Mitigation Planning staff will provide periodic training, in partnership with FEMA, on how to develop and implement natural hazard mitigation plans. OEM will use:

- The FEMA "318" series of classes (G-318, etc.)
- Webinars
- Individual technical assistance

Table 6.3.3-1: State NFIP Trainings by DLCD Staff

Training	2024	2023	2022	2021	2020
Oregon Private Land Surveyors of Oregon Conference Salem, Or.					
Elevation Certificates		x	x		x
Floodplain Management for Surveyors		x			
L0273: Managing Floodplain Development Through the NFIP June 5-8, 2023 Eugene, Or.		x			
L0273: Managing Floodplain Development Through the NFIP May 6-9, 2024 Newport, Or.	x				
Northwest Regional Floodplain Management Association Conference					
Silver Jackets Update		x		x	
Oregon Biological Opinion Update	x	x			
Oregon State Breakout Discussion	x	x		x	
Federal Flood Risk Management Standard Webinar Dec. 2024	x				
Oregon Dept. of Insurance Commission Floodplain Training	x				
DLCD trainings					
Hazard Happenings - Post Disaster Floodplain Management				x	
Buildable Lands Inventory TAC	x				
Hazards Work Group BiOp Update	x				
Oregon Coastal Planners Network	x				
All-Staff Meeting March 2024	x				
The Seminar Group - Basic Floodplain Management	x				
Oregon Floodplain Manager Group Quarterly Meetings					
NOAA-NMFS Biological Opinion (BiOp) Update Oct. 2024	x				
Oregon Silver Jackets Update March 2024	x				
Oregon Silver Jackets					
Inundation Mapping National Presentation	x				
Substantial Damage Training			x		x
Oregon Realtor Association Conference Presentation				x	

Training	2024	2023	2022	2021	2020
Flood Preparedness Webinar			x		
Insurance Workshops DLCD & FEMA					x
ASFPM Presentation - Post Wildfire Floodplain Management				x	
Fish Enhancement Policy Rescission Presentation				x	
NFIP and Floodplain Management in Oregon				x	

Table 6.3.3-2: Geological Hazard Trainings by OEM - 2020-2024

Year	Training Number	Description
2024	FEMA P-2055, ATC-20	In this training, participants learn how to evaluate the safety of buildings following earthquakes. Trainees learn how to perform seismic inspections and safety evaluations of buildings, and to post appropriate safety-status placards. These evaluations and placards can be used in planning and executing evacuation, re-entry, and rebuilding strategies. Under NETAP, ATC-20 training can only be obtained if conducted in conjunction with FEMA P-154 or FEMA P-2055.
2023	FEMA P-1100	Wood light-frame residential buildings represent the most common type of dwelling in the United States. Although this type of construction in one- and two-family configurations has generally provided good performance in past earthquakes, there are well-known vulnerabilities that have led to large numbers of homes being rendered uninhabitable or even unrepairable following an earthquake. Improved seismic design and seismic retrofitting of these structures will increase the probability that homes are available to provide shelter immediately following moderate to large seismic events. FEMA P-1100, prepared by ATC for the California Earthquake Authority (CEA) and FEMA, provides a methodology to identify and retrofit specific vulnerabilities in wood light-frame dwellings.
2023	FEMA P-2055, ATC-20	In this training, participants learn how to evaluate the safety of buildings following earthquakes. Trainees learn how to perform seismic inspections and safety evaluations of buildings, and to post appropriate safety-status placards. These evaluations and placards can be used in planning and executing evacuation, re-entry, and rebuilding strategies. Under NETAP, ATC-20 training can only be obtained if conducted in conjunction with FEMA P-154 or FEMA P-2055.
2023	FEMA P-2055, ATC-20	In this training, participants learn how to evaluate the safety of buildings following earthquakes. Trainees learn how to perform seismic inspections and safety evaluations of buildings, and to post appropriate safety-status placards. These evaluations and placards can be used in planning and executing evacuation, re-entry, and rebuilding strategies. Under NETAP, ATC-20 training can only be obtained if conducted in conjunction with FEMA P-154 or FEMA P-2055.

Table 6.3.3-3: Trainings conducted by OEM

Date	Location	Topic	Hours	Lead Dept.
April 2021	remote	HMGP and Mitigation Planning for SDAO	~80	OEM
Jan. 2022	remote	Hazard Mitigation Planning 101	~10	OEM
Feb. 2022	remote	Natural Hazards Mitigation Planning for Special Districts	~50	OEM
Feb. 2022	remote	Hazard Mitigation Assistance (HMA) for Special Districts	~50	OEM
Oct. 2022	Eugene	Hazard Mitigation Planning 101	~60	OEM
Dec. 2022	remote	Hazard Mitigation Planning 101	~5	OEM
July 2023	remote	Oregon NHMP and SRAUP	~25	DLCD/OEM
Sept. 2023	remote	FEMA P-1100, Vulnerability-Based Seismic Assessment and Retrofit of One- and Two-Family Dwellings	unknown	NETAP
Oct. 2023	Tigard	FEMA P-2055, ATC-20, Post Earthquake Safety Evaluation of Buildings	unknown	SEAO
May 2024	Bend and remote	Local and Tribal Hazard Mitigation Planning Training	18	OEM
June 2024	Salem and remote	Local and Tribal Hazard Mitigation Planning Training	18	OEM
Nov. 2024	Medford	FEMA P-2055, ATC-20, Post Earthquake Safety Evaluation of Buildings	unknown	SOCICC
Nov. 2024	remote	Hazard Mitigation Planning 101	~10	OEM

6.3.4 Funding and Technical Assistance Process

The State of Oregon strives to build local capacity in developing and implementing risk reduction strategies through NHMP development support, resource sharing, and technical assistance. Local mitigation planning continues to be accomplished in great measure through the planning set-aside associated with the HMGP or via BRIC subgrants which provide funding and technical assistance to tribal or local governments for the purpose of developing or updating existing local natural hazards mitigation plans. The goal is to ensure that each county and municipality in the State of Oregon maintains a FEMA-approved natural hazards mitigation plan.

Because local mitigation plans lose their FEMA approval after five years, the state's strategy is to assist local jurisdictions with plan updates and new plan development on a five-year rotational basis.

DLCD and OEM track (with the assistance of FEMA's weekly plan status updates and communication among the assisting partners) which jurisdictions to target for mitigation planning assistance. Normally we find ourselves ahead of the jurisdictions, preparing to apply for grant funding earlier than they expect because of the long grant processing timelines. After discussion, those interested are asked to provide a letter of interest with all the information necessary to support the grant subapplication.

One of the issues we find is that even the more resource-rich jurisdictions have capacity- and priority-balancing issues. They cannot ask the same stakeholders to be involved in multiple planning projects simultaneously so they must decide which to delay. Others simply don't foresee that they would ever need to apply for mitigation grants and prefer to put their limited capacity to use in other ways.

It has long been the state's goal that at least 90% of Oregon's population is covered by current, effective NHMPs. Currently, 76% of the population is covered, down from 88% in 2020. Potential factors include: (a) an increasing number of NHMPs need to be updated as many special districts have chosen to plan since 2018; (b) the slow pace with which FEMA approves HMGP and BRIC subgrants, key funding sources for local NHMP updates; and (c) the more complex planning standards required by the updated Local Mitigation Planning Policy Guide effective April 19, 2023.

It is important to build capacity in tribal and local governments – and especially among planning consultants – for developing and updating NHMPs. Training is one way to do this. The state should focus on providing more mitigation planning classes. In addition, the state and FEMA have been collaborating on creative ways to deliver the mitigation planning courses that will reach the greatest number of jurisdictions and stakeholders.

One key is capacity building is to train planning consultants in mitigation planning, creating a pool of talent and expertise from which tribal local governments can draw support.

One way to address the lack of vision and the issue of competing priorities is to develop a risk communication and outreach program that clearly demonstrates to local governments and stakeholders the risks and potential consequences of natural hazards events and the value of mitigation planning. The goal of the program would be for local governments with plans (expired or not) to commit to keeping their plans current and using them. Another goal would be to continue to expand NHMP coverage by encouraging cities and special districts without their developing plans. DLCD has been working to do this regularly since the last state update.

On the issue of the divergence of FEMA's and the State's RiskMAP priorities, communication is the key. The State is very grateful that FEMA has funded multi-hazard risk assessments through the CTP program and has found that these risk assessments are vital elements of NHMP updates. If FEMA will continue to support the development of these risk assessments underpinning NHMP updates and new NHMPs, the issue is to agree on the communities for which they will be developed and when. Local communities have expressed confusion in the lack of coordination between RiskMAP and NHMP updates. Continuous and effective communication between the state agencies involved and FEMA is the answer.

6.3.5 Prioritizing Applications for Natural Hazard Mitigation Grants

Each grant program has eligibility requirements, and most have criteria for prioritizing proposals. Once the grant-specific criteria are met, the granting agency may need additional criteria to prioritize proposals. The following criteria are to be used for that additional prioritization, and more generally as a touchstone to ensure the state's priorities are considered in grant decisions.

These criteria could be used for a broad range of applicants including Tribes, counties, cities, special districts, non-profit organizations, and privately owned utilities.

I. Natural Hazards Mitigation Plan

A. The applicant or subapplicant is in the process of developing or updating its natural hazard mitigation plan.

II. Degree of Impact

B. The proposal addresses a low-probability, high-impact natural hazard.

C. The applicant or subapplicant was impacted by a natural disaster, including impacts that were not severe enough to receive a federal major disaster declaration or presidential disaster declaration.

III. Benefits of Risk Reduction

D. The proposal is in an area at the highest risk on FEMA's National Risk Index or the Oregon Natural Hazard Risk Assessment, or an area of underserved cultures, underserved communities, or socially vulnerable populations.

E. The proposal maximizes benefits to a high degree by addressing multiple hazards, adapting to climate change, leveraging other funding, or addressing other priorities. For example, the proposal includes green infrastructure or resilient energy sources.

F. The proposal would reduce risk to a high degree. For example, it would reduce vulnerability to structures, critical facilities, lifelines, or socially vulnerable populations.

G. The proposal considers not only the benefits to the property and property owner, but also the impacts and benefits to surrounding areas. For example, it considers watershed health, ecology, economy, housing, or infrastructure.

H. The proposal anticipates future natural hazards through mitigation actions such as defensible space, engineering for increased snow load or wind speeds, or adopting higher standards for floodplain management.

I. The proposal links climate change adaptation to a risk identified in the Oregon Natural Hazard Risk Assessment, a tribal risk assessment, or a local risk assessment.

IV. Disaster Resilience

J. The proposal would increase community resilience to a high degree. For example, it would raise community awareness, bring the community closer together, or increase trust between government and residents.

K. The proposal includes communicating its benefits to the community.

L. The applicant is an "Economically Disadvantaged Rural Community."

M. The proposal is in a "Community Disaster Resilience Zone."

N. The proposal would integrate a tribal or local natural hazard mitigation plan with a comprehensive plan.

O. The proposal supports energy resilience for critical public service facilities or households. For example, it would diversify fuels, increase energy storage, improve grid resilience, or add alternative energy generation.

V. Managing Development

P. The proposal is in an area under intense development pressure.

Q. The proposal would remove people, structures, critical facilities, or lifelines from a hazard area rather than mitigating risk within the hazard area.

VI. Repetitive or Severe Repetitive Flood Loss

R. The proposal would mitigate a high-risk property, a group of high-risk properties, a repetitive flood loss structure, or a severe repetitive flood loss structure.

S. The proposal would protect historical or current salmonid habitat in an area with no, low, or moderate repeat flood damage.

VII. Dam Safety

T. The semi-quantitative or other risk assessment that meets FEMA criteria is complete.
U. The deterministic analysis of work needed to rehabilitate or remove the dam is complete.
V. The designs and permits are ready.
W. The project has public benefits.
X. The dam is needed for municipal water supply, livelihood, or employment.
Y. The dam owner can provide significant funding and implement the project.

See *Chapter 3, Hazard Identification and Risk Assessment*, Section 3.3.6.15 for information on high hazard potential dam funding.

6.3.6 Local Mitigation Plan Review Process

OEM is responsible for reviewing local jurisdictions' NHMPs prior to submittal to FEMA for review and approval. Once a local jurisdiction has completed a draft plan, it submits the plan to the OEM for review. OEM has set a goal of completing its first review within 30 days and often completes the review more quickly. If OEM finds that the draft plan does not meet all FEMA requirements, it returns the draft to the local jurisdiction for revision. This may happen more than once, and OEM's full review timeline is dependent not only on how long OEM's review takes, but also how long the jurisdiction takes to make any necessary revisions to OEM's satisfaction. Once OEM is satisfied that the draft plan is approvable, it forwards the draft to FEMA for review.

By statute, FEMA is limited to 45 days for its initial review. If FEMA finds deficiencies, it returns the draft to OEM which in turn returns it to the jurisdiction for revision. Again, the full FEMA review timeline is dependent on how quickly FEMA completes its review, how long the jurisdiction takes to make satisfactory revisions, and how long OEM takes to send the draft plan back and forth. OEM is very prompt in managing these handoffs. Once OEM and FEMA are satisfied that the draft is approvable, FEMA issues *Approvable Pending Adoption* (APA) status by letter to the State Hazard Mitigation Officer (SHMO). At this point, the local jurisdiction adopts its NHMP, usually by resolution, and sends a copy of the signed resolution and adopted NHMP to OEM. OEM verifies that the NHMP has not changed substantively since APA status was conferred and forwards the adopted NHMP and resolution to FEMA. Upon receipt and verification that the NHMP has not changed substantively, FEMA issues final approval by letter to the highest elected official of the local jurisdiction. This entire process can take, in general, between four and six months.

In many cases, two or more local jurisdictions collaborate to develop a multi-jurisdictional NHMP. Most often this collaboration is among a county and some or all of its cities, and often some of its special districts. In these cases, the county plan is primary, and the cities and special district plans are addenda to the county plan. The same process is followed, but the county usually adopts and receives final approval from FEMA first, then the cities and special districts follow suit. All jurisdictions that are parties to the plan receive the same effective date as the first jurisdiction to receive FEMA approval.

6.3.6.1 Linking State and Local NHMPs

DLCD works with many tribes, counties, cities and special districts to create or update an NHMP. OPDR creates and updates other NHMPs. OEM assists with and reviews all NHMPs within Oregon. In addition, some local governments develop and update their plans in-house. Occasionally a council of governments

assists, and occasionally a consultant or consulting firm is retained. Approach, data availability, and planning and analytical expertise vary widely. Gathering, analyzing, and coalescing this disparate collection of risk assessments, goals, and mitigation actions into a coherent statewide mitigation strategy embodied by the Oregon NHMP is a challenge indeed, and the State has begun advancing toward this goal.

Counties usually do review the state's goals to inform their own. However, county NHMPs do not consistently reference their review of the State goals in an explicit manner. In some cases, two or more state goals are combined into one local goal.

As an example, Washington County's 2023 NHMP explicitly reviews local jurisdictional mitigation goals along with the 2020 state plan to create seven overarching goals to inform their actions. Similarly, The Confederated Tribes of the Umatilla Indian Reservation's 2021 mitigation strategies list both internal and external coordinating partners on executing implementation. Listing coordinating partners expresses an actionable understanding of state and local mitigation goals and actions.

Further, during a previous Oregon NHMP update, the state found that about half of the state's goals were reflected in local goals, and that several goals that appeared in a number of local NHMPs were not reflected in the state's NHMP. The state added three goals to enhance coordination.

As a result, when assisting local governments with NHMPs, DLCD, OPDR, and OEM have made it a point to review not only the Oregon NHMP's goals, but also mitigation actions and other information for incorporation into local plans to accomplish overall state mitigation strategies.

Technical assistance staff at DLCD, OEM, and other regional coordinators should continue working iteratively and holistically to link state and local mitigation strategies. OEM's goal for the next five years is to work directly with local governments to identify projects to fund to implement the local NHMP.

OEM Mitigation Planning staff will continue to review NHMPs as they are updated and provide comments and guidance to local jurisdictions and tribes in editing their plans in preparation for FEMA review. Staff will also work with FEMA, local jurisdictions, and tribes through the review and adoption process.

6.3.6.2 Tracking & Implementing Mitigation Actions

Most jurisdictions in Oregon use data available from state and federal agencies and in some cases universities as well as any local data sources for their risk assessments. In recent years, FEMA has supported development of local risk assessments of the seven mapped hazards (coastal erosion, earthquakes, floods, landslides, tsunamis, volcanic hazards, and wildfires) through a portion of planning grants awarded through the HMA program and through the Risk MAP Program. The state has been somewhat successful in coordinating the grant funding cycles and preliminary studies to be able to have the risk assessments done for the jurisdictions next in line for NHMP updates and ready at or near the beginning of the mitigation planning process. This work is foundational for these jurisdictions' risk assessments providing a level of data and analysis that is otherwise unavailable. The state's vision is for this partnership to continue in a manner similar to the NHMP update cycle, so that over time all local jurisdictions have the benefit of this work for their NHMP updates. Then the cycle would renew and continue, bringing new and enhanced data to each update.

Similarly, the state has been using a small portion of FEMA planning grants to contract with OCCRI to provide assessments of the impacts of climate change on natural hazards at the county level for local

NHMPs. This work has been very well received by local NHMP steering committee members and has been valuable in assessing changing future conditions. Because the climate change assessments are more easily tailored to each county, they address not only the seven mapped hazards but others as well. Again, the state's vision is for this partnership to endure, continuing to enhance our understanding of the effects of climate change on the frequency, intensity, and emergence of natural hazards.

To coordinate and integrate local risk assessments into the state risk assessment, especially as the state continues to advance its risk assessment methodology and fill data gaps, is complex. FEMA continuing to support the state's production of local risk assessments through the RiskMAP program is key because the data sources and methodology used are the same as or closely aligned with those available for the state's risk assessment. Right now, there are not enough state-produced local risk assessments to meaningfully inform the state risk assessment, but as more and more of them are produced, we will be able to create a statewide picture of risk at a fine-grained local scale.

The first step is to collect all local NHMPs with their existing state-produced and locally produced risk assessments. DOGAMI is in possession of the state-produced risk assessments. The locally produced risk assessments need to be analyzed for data sources, methodology, and compatibility with each other and with the state's data sources and methodology to determine how best to incorporate them into the state risk assessment.

Collecting the latest NHMPs, finalizing them with a cover, effective dates, and approval letters, storing them in a repository where they will be readily available to the public is a project the state is anticipating returning to and completing during calendar year 2026.

Completed NHMPs and state-produced risk assessments will be collected quarterly in conjunction with the plan maintenance process described in Section 4.3.2; tracked by OEM and DLCD; and analyzed by DLCD with assistance from other State IHMT members. As the state further develops its risk assessment methodology, we will determine how best to incorporate the locally produced risk assessment information. The goal is to have an improved state risk assessment methodology incorporating all state-produced local risk assessments and the information that can be incorporated from locally produced risk assessments at the three-year mark in the life of the 2020 Oregon NHMP. We will begin the 2030 update with this information.

As NHMPs are collected, the mitigation goals along with attributes (to be determined) will be entered in a database. The database will be available to local governments and will yield useful information about characteristics and trends of local NHMP goals statewide. This will help the State IHMT determine whether local mitigation goals are connected to local risk assessments; the degree of similarity or disparity among them; and the degree of alignment with state mitigation goals. That information can be used to work with local governments to improve local NHMPs as well as more closely connecting state and local mitigation goals.

It has long been the state's desire to develop a mitigation action tracker for use by state and local governments to better coordinate mitigation planning and management of HMA grants. With the systematic collection of NHMPs, a database of mitigation actions can become a reality. With access to the database, local governments can glean ideas for actions; coordinate their local actions with the state's actions; or identify potential intergovernmental partnerships. The state can gain an understanding of local governments' mitigation priorities and more closely connect local and state mitigation activities. This would also be a way to identify potential mitigation projects for grant subapplications.

Further, the mitigation action database could be designed to include relevant information from related programs and projects, for example the Climate Change Adaptation Framework, advancing integration with statewide plans and initiatives, encouraging local integration as well, and supporting the state's eventual return to enhanced plan status.

6.4 References

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Chapter 7 Planning Process

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7.1 Process

7.1.1 Overview

In January 2022, the Oregon Department of Land Conservation and Development (DLCD) applied through the Oregon Department of Emergency Management (OEM) for Fiscal Year 2021 Building Resilient Infrastructure and Communities (BRIC) grant from FEMA to update the Oregon Natural Hazards Mitigation Plan (OR NHMP). FEMA awarded the grant in February 2024. FEMA did not allow DLCD to use the two pre-award years to prepare to begin the update process immediately upon award. Therefore, only about one year was available update the NHMP while leaving sufficient time for OEM review, FEMA review, state adoption, and FEMA approval.

DLCD started by developing objectives for the updated plan, organizing, establishing project management protocols, identifying and assigning tasks and deliverables, and coordinating to ensure OEM's oversight and communication with FEMA throughout the process to avoid any missteps that would cost time toward the end of the process and during the review and approval period.

DLCD also applied for funding from the Hazard Mitigation Grant Program (HMGP) to upgrade Oregon's natural hazards risk assessment. FEMA awarded that grant in mid-November 2022. Timeline

Late Winter – Late Spring 2024	Organize the planning and public engagement processes; establish project management protocols; coordinate with OEM for oversight and communication with FEMA; and establish and assign tasks and deliverables to planning partners.

Summer 2024	Evaluate the 2020 Oregon NHMP. Plan for fall public meetings to update various parts of the Oregon NHMP: • Review and Revise Mitigation Goals • Develop Criteria for Prioritizing Communities to Receive Grant Funding • Review and Revise Mitigation Actions • Prioritize Mitigation Actions
Fall 2024	Hold public meetings to update various parts of the Oregon NHMP.
Winter 2025	Revisit mitigation actions. Prioritize mitigation actions. Complete updating plan.
Early Spring 2025	Submit Draft Plan to OEM and FEMA for review and approval.
Early Spring – Mid-Summer 2025	Receive FEMA approval pending adoption. Adopt 2025 Oregon NHMP. Receive FEMA final approval.

7.1.2 Evaluating the 2020 Oregon NHMP

The State Interagency Hazards Mitigation Team (IHMT) oversaw development of the 2020 Oregon NHMP and therefore evaluated its performance. DLCD staff worked with State IHMT members to determine the status of each mitigation action in the 2020 Oregon NHMP, noting whether each action was (a) not started, (b) progressing, (c) completed, or (d) not being pursued. The results:

- 13% Not Started
- 76% Progressing
- 4% Completed
- 7% Not Being Pursued

DLCD also surveyed the State IHMT members to determine: (a) to *what degree* the members' work achieved each goal and (b) *how effective* the members' work was toward achieving each goal. DLCD distributed materials to for State IHMT members to reference when answering the survey: (a) the mitigation goals, (b) mitigation actions, (c) a table showing which actions were associated with each goal, (d) the criteria for evaluation listed in the 2020 Oregon NHMP, and (e) the "Opportunities for Improvement" in the 2020 Oregon NHMP Review Tool. On a 1-5 scale (1=Poor, 2=Needs Improvement, 3=Moderate, 4=Good, 5=Excellent), overall results were primarily 3-Moderate and 4-Good for both questions.

Next DLCD held a meeting with State IHMT members to discuss the results of the survey, how to apply them in this update, and the next steps for the plan update process. The discussion was high level with few specific suggestions.

The Oregon Water Resources Department (OWRD) houses the state's Dam Safety Program. Dam Safety staff are members of the State IHMT. Dam Safety staff assisted in evaluating the 2020 Oregon NHMP.

7.1.3 Plan Update Meetings

The Risk Assessment Upgrade project held a meeting on October 1 as planned, but full results were not yet available. The group discussed the risk assessment method, reviewed preliminary results, and gave feedback. This was a setback for the NHMP update process, but given the compressed planning timeline, the process continued with plan update meetings

At the next meeting, participants reviewed and revised the mitigation goals. Participants connected the mitigation goals to the preliminary risk assessment results and the mitigation actions to the mitigation goals. Participants discussed the requirements from the State Mitigation Planning Policy Guide effective April 19, 2023 (State Guidance), definitions of goals, and how to make goals SMART (specific, measurable, achievable, relevant, and time-Bound). The group revised goals, clarified goals, and incorporated the previous stand-alone High Hazard Potential Dams goal into two other goals resulted in 16 mitigation goals for the 2025 Oregon NHMP. The group also re-ordered the goals.

For the next two meetings, participants developed criteria for prioritizing jurisdictions to receive planning and project grants. The group reviewed FEMA's required and suggested criteria, and others suggested by DLCD and OEM. The group made recommendations which DLCD used to develop the final list of criteria.

Next, participants reviewed the list of mitigation actions that were "not started" or "in progress," to winnow it down to a shorter list of actions using the following criteria:

- Will contribute to achieving the mitigation goals.
- Will reduce vulnerability of people and property to natural hazard events.
- Targets specific vulnerabilities in one or more of the most vulnerable areas as shown by the risk assessment.
- Is cost-effective, environmentally sound, and technically feasible.
- Is achievable within five years.
- Is measurable and trackable.
- Is specific.
- Is likely to be equitable.

The participants answered questions to assess each mitigation action against each objective. The work spanned three meetings, and did shorten the list of mitigation actions, but not by a lot.

At the last meeting in early January, the participants revisited and refined the criteria for prioritizing jurisdictions to receive mitigation grants. Later, DLCD reviewed the criteria against those in the new Administrative Plan to avoid inconsistencies or conflicts.

When final risk assessment results became available in January, participants used an online document-sharing platform to review, comment on, and edit the goals and mitigation actions using the risk assessment results, the state capability assessment, and the same set of questions. DLCD finalized the mitigation actions using the participants' comments then posted the final list on the document-sharing platform. Participants prioritized the mitigation actions using a dot exercise modified for the virtual space.

During this process, many State IHMT members and other state agency subject matter experts became more engaged and shared their expertise. DLCD integrated information about plans and programs in these

other agencies into the NHMP including climate change, health, climate adaptation, environmental justice, energy security, public utilities, state buildings, lifelines, resilience hubs, preparedness, and response.

Oregon's Dam Safety staff participated in the meetings, discussing mitigation goals and actions, prioritizing mitigation actions, and developing criteria for prioritizing jurisdictions to receive grants. The Dam Safety Program staff developed the Dam Safety portion of Chapter 3, Risk Assessment. Dam Safety Program staff also integrated their expertise, data, studies, and information into the OR NHMP.

7.2 Participants and Public Engagement

In April 2024, DLCD set up a project website for the Oregon NHMP Update. OEM added a section about the Oregon NHMP Update to its Hazard Mitigation Planning web page and linked to DLCD's project web page. The DLCD project web page explains the update and links to the web page for the Risk Assessment Upgrade project. DLCD provided a comment form on the web page to encourage public comment at any time during the project. DLCD posted dates, times, registration links, agendas, and meeting materials for each meeting. After the meetings, DLCD posted presentations, notes, and recordings.

DLCD made all the project meetings virtual. In-person attendance had always been more difficult for people outside the immediate meeting area. While some tasks are harder virtually, virtual meetings increase attendance.

DLCD invited the nine federally recognized Tribes in Oregon to participate in the Oregon NHMP Update. DLCD's and OEM's Tribal Liaisons supported this effort. Further, throughout the project, DLCD submitted project updates to the State-Tribal Natural Resources Working Group. Tribes chose to participate at varying levels.

Prior to the first public meeting, DLCD invited many potential participants including:

- Everyone involved in the Risk Assessment Upgrade (about 350 people)
- Nine federally recognized tribes in Oregon
- Emergency managers and mitigation planners for Washington and Idaho
- State IHMT members
- Other state agency subject matter experts
- State Climate Change Adaptation Framework Implementation Team members
- Oregon Resilience Officer
- Oregon Climate Change Research Institute director
- Oregon State Climatologist
- Oregon State Archaeologist
- US Army Corps of Engineers staff
- US Geological Survey
- Emergency managers statewide
- Oregon State University professors
- Portland State University professors and staff
- University of Oregon Partnership for Disaster Resilience staff
- METRO staff
- Local government staff
- Council of government staff
- City and county lobbyists
- Individual activists
- Interested property owners
- Representatives of socially vulnerable populations and equity consultants
- Consultants in hazards and related sciences
- Consultants in economics

The State IHMT includes representatives from the following state agencies and universities:

- Governor's Office - State Resilience Officer
- University of Oregon, Institute for Policy Research and Engagement (IPRE), Oregon Partnership for Disaster Resilience (OPDR)
- Department of Administrative Services (DAS)
- Oregon Department of Agriculture (ODA)
- Oregon Department of Consumer and Business Services-Building Codes Division (DCBS-BCD)
- Oregon Department of Consumer and Business Services-Division of Financial Regulation (DCBS-DFR)
- Business Oregon - Infrastructure Finance Authority
- Oregon Climate Change Research Institute (OCCRI)
- Oregon Climate Service (OCS)
- Oregon Department of Energy (ODOE)
- Department of Environmental Quality (DEQ)
- Oregon Department of Fish and Wildlife (ODFW)
- Oregon Department of Forestry (ODF)
- Department of Geology and Mineral Industries (DOGAMI)
- Oregon Health Authority (OHA) State Public Health Division
- Department of Land Conservation and Development (DLCD)
- Department of State Lands (DSL)
- Oregon Department of Emergency Management (OEM)
- Oregon State Fire Marshal (OSFM)
- Oregon Public Utility Commission (PUC)
- Oregon Department of Transportation (ODOT)
- Oregon Water Resources Department (OWRD)
- Oregon Parks and Recreation Department (OPRD)
- Oregon Watershed Enhancement Board (OWEB)

DLCD also used GovDelivery to advertise the Fall 2024 meetings to approximately 2,000 people who had signed up for email updates. The meetings were well attended.

DLCD reached out even more broadly for public review of draft sections of the 2025 Oregon NHMP in February and March. The first set focused on the risk assessment and the second set on the other chapters. DLCD held two public webinars on the risk assessment, and two more on the whole plan. An online comment form included specific and open-ended questions. DLCD and OEM emailed notices or posted to:

- The lists of participants above
- DLCD's and OEM's GovDelivery lists
- DLCD's and OEM's social media accounts
- Oregon Planners Network email list
- OEM's Readiness Report
- DLCD's Oregon NHMP Update project web page
- DLCD's Risk Assessment Upgrade project web page
- OEM's Hazard Mitigation Planning web page
- Emergency management staff for the State of California
- Emergency management staff for the State of Nevada

The two public comment periods lasted two weeks each. DLCD continued to accept comments on the first release through the end of the second comment period. DLCD revised the draft NHMP in response to the comments as warranted and possible given the project timeline and budget. Comments and responses are in Chapter 9 – Appendix.

7.3 Revisions

This update substantially reduced the length of the plan from almost 1,800 pages in 2020. The updated plan eliminates separate risk assessments for each region which accounted for 1,000 pages. Also, regional profiles were consolidated into a statewide profile (Chapter 2, Oregon Profile).

DLCD updated the status of both "Priority" and "Ongoing" mitigation actions from the 2020 Oregon NHMP, but focused on reviewing, revising, and re-prioritizing only the "Priority" mitigation actions, renamed to "Five-Year" actions.

The most important revision is the new risk assessment method. It is more sophisticated and scientifically sound. In addition to assessing physical risk, it uses indicators of vulnerability and resilience. The results are relative, showing areas most at risk from hazards and areas most at risk from hazards given their vulnerability indicators. The state did not use this method for windstorms and winter storms due to lack of data. The state did not use this method for dam failure, due to its different engineering risk assessment methods.

7.4 Monitoring, Evaluating, and Updating

7.4.1 Monitoring

OEM is responsible for monitoring, evaluating, and updating the Oregon NHMP. The State Hazard Mitigation Officer (SHMO) will establish an expectation for State IHMT members to participate in plan monitoring and evaluation discussion and activities during its quarterly meetings. The mitigation goals and other evaluation criteria will guide the process.

One element of monitoring will be to check the status of each of the mitigation actions and determine if changes are necessary. The State IHMT Secretary will document any revisions, noting the reason(s) for revision. Other elements will include noting any capability enhancements or losses; noting any hazard events that have occurred during the quarter whether state or federally declared; need or opportunity for new mitigation actions; state-sponsored outreach and training that has occurred; documenting any mitigation successes; documenting full and effective use of mitigation funding; and documenting coordination and collaboration among state agencies and partners that has advanced state mitigation actions or goals.

Another element of the State of Oregon's system for reviewing progress on achieving our goals will be via an examination using the following criteria:

- Has the state made considerable, moderate, or little progress toward achieving this goal?
- What are the implementation challenges and how might the state better address them?
- What new actions does the state need to better implement this goal?

- To what level of involvement have the State IHMT member and partner agencies engaged?
- Connections to the risk assessment, availability of new data, and how to reflect new data in the plan.
- How can we make this goal more "SMART," i.e., specific, measurable, achievable, relevant, and time-bound?

Further, at a regular quarterly meeting following a declared disaster event in Oregon, the State IHMT will conduct an after-action review of the event in relationship to the Oregon NHMP and provide any necessary direction for updating the Plan. OEM will document this discussion as usual in State IHMT meeting minutes and following the meeting OEM will make necessary updates to the mitigation strategy for FEMA Joint Fields Offices or state mitigation actions.

The State Hazard Mitigation Officer (SHMO) coordinates the mitigation grant review process by systematically monitoring the implementation of state and local subgrantee mitigation actions. Successful implementation requires open communication between the grantee (OEM) and subgrantee to ensure schedules, budgets, and deliverable requirements are met.

The SHMO or designees are responsible for reporting this information to the State IHMT for projects funded by the Hazard Mitigation Grant Program, Pre-Disaster Mitigation (legacy projects), Building Resilient Infrastructure and Communities grants, and Flood Mitigation Assistance programs.

Outside of the traditional FEMA mitigation grant programs, state and local governments identify and often implement mitigation actions and projects using their own capabilities and resources. At the local level, this may include the development and adoption of local ordinances and regulations that have a hazard mitigation component; mitigation codes and standards as part of ongoing transportation and public works programs; hazard-related components of local comprehensive land use plans; and so forth.

While it may not be possible to track and report on every mitigation accomplishment in local mitigation plans, communities will see the positive cumulative impacts of these efforts in reduced disaster losses. The state encourages the seamless integration of mitigation activities into the planning efforts and day-to-day operations of state and local government programs.

7.4.2 Evaluating

OEM will also manage and facilitate the plan evaluation process. The Oregon NHMP's goals will serve as the benchmarks for evaluation, and the following more specific criteria will be assessed as well:

- Progress toward completion of mitigation actions
- Progress toward refining the mitigation actions to more clearly address the greatest hazards and vulnerabilities statewide and establish the foundation for eligibility for project funding
- Progress in coordinating state and tribal-local mitigation planning
- Progress in seamless coordination of funding and the timing of multi-hazard risk assessments produced via RiskMAP, form a foundation for new local NHMPs and NHMP updates
- Progress in building local government capacity to:
  - Develop and update NHMPs and CWPPs
  - Integrate them with each other and with comprehensive or strategic and other plans
  - Implement those plans
  - Track changes in development

    - Develop project applications
- Progress in mitigating flood hazards, particularly for repetitive and severe repetitive loss properties
- Progress in assessing risk of high hazard potential dams and mitigating potential loss of life, property, and state and local critical/essential facilities
- Progress in diversifying funding sources
- Progress in building state capacity to a level that:
    - Allows the state to regain and easily retain enhanced plan status
    - Supports a comprehensive statewide natural hazards mitigation program
    - Supports integration of natural hazards mitigation into other state programs and initiatives
    - Supports the state in coordinating state with local mitigation planning
    - Provides funding to state agencies to participate in the State IHMT and Oregon NHMP monitoring, evaluation, and update activities and to participate in coordination, cooperation, collaboration and integration activities with related state programs and initiatives.

The Oregon Department of Land Conservation and Development will assist OEM by evaluating:

- Accuracy and utility of the State Risk Assessment in the context of any Presidentially declared major disasters or Governor-declared States of Emergency that may have occurred during the update cycle;
- Progress in applying the lessons learned from the risk assessment methodology to enhance it further;
- Progress in developing data for currently data-poor hazards;
- Continued progress in developing data statewide for the data-richer hazards;
- Progress in developing vulnerability data and making choices about the most important vulnerability indicators.

Results of the evaluation will be documented and serve as the basis for updating the Oregon NHMP.

7.4.3 Updating

OEM is responsible for updating the Oregon NHMP every five years. The update process will begin three years before the plan expires. State IHMT members will assist in the update according to their expertise and roles in natural hazards mitigation. Subject matter experts and skilled technical professionals will lead on elements of the plan, such as vulnerabilities and GIS analyses, and provide other resources as required. Work will be done outside of the quarterly State IHMT meetings.

7.5 Assurances

The State of Oregon will comply with all applicable federal statutes and regulations in effect with respect to the periods for which Oregon receives grant funding, including 2 CFR parts 200 and 3002.

The State of Oregon will amend the Oregon Natural Hazard Mitigation Plan whenever necessary to reflect changes in state or federal statutes and regulations.

Chapter 8 Abbreviations and Glossary

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8.1 Abbreviations

A300	ANSI A300, Tree Care Operations Standards
AASHTO	American Association of State Highway and Transportation Officials
ACEP	Agricultural Conservation Easement Program
AH	Flood Insurance Rate Map (FIRM) zone: Areas subject to inundation by 1%-annual-chance shallow flooding (usually areas of ponding) where average depths are between one and three feet. Base Flood Elevations (BFEs) derived from detailed hydraulic analyses are shown in this zone. Mandatory flood insurance purchase requirements and floodplain management standards apply.
AHPS	Advanced Hydrologic Prediction Service
AHZ	Active Hazard Zone
AIA	American Institute of Architects
AKmax	hypothetical maximum Alaska tsunami
AM	Amplitude Modulation (AM)
ANSI	American National Standards Institute
ANSS	Advanced National Seismic System
AO	Flood Insurance Rate Map (FIRM) zone: areas subject to inundation by 1%-annual-chance shallow flooding (usually sheet flow on sloping terrain) where average depths are between one and three feet. Average flood depths derived from detailed hydraulic analyses are shown in this zone. Mandatory flood insurance purchase requirements and floodplain management standards apply. Some Zone AO have been designated in areas with high flood velocities such as alluvial fans and washes. Communities are encouraged to adopt more restrictive requirements for these areas.
AOC	Association of Oregon Counties
APA	American Planning Association
APCO	Association of Public Safety Communications Officials
AR	Atmospheric River
ARES	Amateur Radio Emergency Service

ARRA	American Recovery and Reinvestment Act
ARRL	Amateur Radio Relay League
ASCE	American Society of Civil Engineers
ASDSO	Association of State Dam Safety Officials
ASFPM	Association of State Floodplain Managers
ATC	Applied Technology Council
BCA	Benefit-Cost Analysis
BCD	Building Codes Division (State of Oregon, Department of Consumer and Business Services)
BCE	Before Common Era
BCR	Benefit-Cost Ratio
BFE	Base Flood Elevation
BLM	Bureau of Land Management (United States Department of the Interior)
BMP	Best Management Practice
BNSF	Burlington Northern-Santa Fe Railway
BPA	Bonneville Power Administration
BusOR-IFA	Business Oregon, Infrastructure Finance Authority
CAP	Community Assistance Program (NFIP)
CAP-SSSE	Community Assistance Program — State Support Services Element (NFIP)
CAV	Community Assistance Visit (NFIP)
CB	Coquille Bank
CBRL	Coos Bay Rail Link
CCA	Climate Change Adaptation
CDBG	Community Development Block Grant
CD-ROM	Compact Disc Read-Only Memory
CEI	Critical Energy Infrastructure
CERT	Community Emergency Response Team
CFR	Code of Federal Regulations
CGIAR	Formerly “Consultative Group on International Agricultural Research.” Since 2008, known simply as CGIAR, a global partnership that unites organizations engaged in research for a food secure future
CI	Critical Infrastructure/Essential Public Facilities
CMIP	Coupled Model Intercomparison Project
CMIP5	Coupled Model Intercomparison Project, 5th phase
CMZ	Channel Migration Zone
CNN	Cable News Network

CPO	Climate Program Office
CPW	Community Planning Workshop (University of Oregon)
CRE	Community Resilience Estimate
CREP	Conservation Reserve Enhancement Program
CREW	Cascadia Region Earthquake Workgroup
CRP	Conservation Reserve Program
CRS	Community Rating System (National Flood Insurance Program)
CSC	Community Service Center (University of Oregon)
CSEPP	Chemical Stockpile Emergency Preparedness Program
CSO	combined sewer overflow
CSREES	Cooperative State Research, Education, and Extension Service
CST	Community Solutions Team
CSZ	Cascadia Subduction Zone
CTP	Cooperating Technical Partner (NFIP)
CVO	Cascades Volcano Observatory
CWPP	Community Wildfire Protection Plan
DAS	Department of Administrative Services (State of Oregon)
DAS-CFO	Department of Administrative Services-Chief Financial Office (State of Oregon)
DAS-CIO	Department of Administrative Services-Chief Information Office (State of Oregon)
DAS-EAM	Department of Administrative Services-Enterprise Asset Management (State of Oregon)
DAS-RM	Department of Administrative Services-Risk Management Division (State of Oregon)
DAS-GEO	Department of Administrative Services-Geospatial Enterprise Office (State of Oregon)
DCBS	Department of Consumer and Business Services (State of Oregon)
DCBS-DFR	Department of Consumer and Business-Department of Financial Regulation (State of Oregon)
DEI	Diversity, Equity, and Inclusion
DEM	Digital Elevation Model
DEQ	Department of Environmental Quality (State of Oregon)
DLCD	Department of Land Conservation and Development (State of Oregon)
DMA	Disaster Mitigation Act of 2000 (federal)
DMA2K	Disaster Mitigation Act of 2000
DMV	Department of Motor Vehicles (State of Oregon)
DNR	Department of Natural Resources (Washington State)
DOD-USACE	United States Department of Defense-U.S. Army Corps of Engineers
DOGAMI	Department of Geology and Mineral Industries (State of Oregon)

DP	Demographic Profile
DPSST	Department of Public Safety Standards and Training (State of Oregon)
DR	Alphabetic designation or precursor for Disaster Declaration Number
DRMS	Decision, Risk, and Management Science
DRU	Disaster Resilient University
DSL	Department of State Lands (State of Oregon)
DTM	Digital Terrain Model
EAM	Enterprise Asset Management (State of Oregon Department of Administrative Services)
EAP	Emergency Action Plan
EAS	Emergency Alert System
ECC	Emergency Coordination Center
EDA	Economic Development Administration (U.S.)
EHP	Environmental and Historic Preservation
EIS	Environmental Impact Statement
EMI	Emergency Management Institute (FEMA)
EMPG	Emergency Management Performance Grant (State of Oregon)
ENSO	El Niño Southern Oscillation
EO	Education/Outreach
EOC	Emergency Operations Center
EOP	Emergency Operations Plan
EPA	Environmental Protection Agency (U.S.)
EPCRA	Emergency Planning and Community Right-to-Know Act
EQIP	Environmental Quality Incentives Program
ER	Emergency Relief
ESA	Endangered Species Act
ESD	Education Service District
ESEE	Economic, Social, Environmental, and Energy
EWP	Emergency Watershed Protection (NRCS Program)
FAA	Federal Aviation Administration
FAS	Federal Aid System (U.S. Highway Administration)
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FF	Flash Flood
FHWA	Federal Highway Administration
FIRM	Flood Insurance Rate Map

FIS	Flood Insurance Study
FM	Frequency Modulation
FMA	Flood Mitigation Assistance
FMAGP	Fire Management Assistance Grant Program
FPD	Fire Protection District
FSA/FMAGP	Fire Suppression Assistance/Fire Management Assistance Grant Program
FTA	Federal Transit Administration
FTE	Full Time Equivalent
FY	Fiscal Year
GCM	Global Climate Models
GED	General Education Development
GEO	Geospatial Enterprise Office (State of Oregon, DAS)
GIS	Geographic Information System
GNRO	Governor's Natural Resources Office (State of Oregon)
GO	General Obligation
GPS	Global Positioning System
GSA	General Services Administration (U.S.)
GSTF	Greatest-Savings-to-the-Fund (FEMA)
GTN	Gas Transmission Northwest
GWEB	Governor's Watershed Enhancement Board
H	High
Hazus	Hazards U.S.
HB	House Bill (State of Oregon)
HCD	Housing and Community Development Act of 1974
HFRA	Healthy Forest Restoration Act of 2003
HHPD	High Hazard Potential Dam
HHZ	High Hazard Zone
HM	Hazard Mitigation
HMA	Hazard Mitigation Assistance
HMGP	Hazard Mitigation Grant Program
HMP	Hazard Mitigation Plan
HMSE	Hazard Mitigation and Structural Engineering
HMST	Hazard Mitigation Survey Team
HMTAP	Hazard Mitigation Technical Assistance Program (FEMA)
HR	House Resolution (State of Oregon legislature)

HRFA	Healthy Forest Restoration Act of 2003
HSPR	Health Security, Preparedness, and Response (Oregon Health Authority)
HUD	Housing and Urban Development (U.S.)
HWM	High Water Mark
ICBO	International Conference of Building Officials
ICC	Increased Cost of Compliance (NFIP)
ID	Insurance Division (Oregon Department of Consumer and Business Services)
IDA	Initial Damage Assessment
IEBC	International Existing Building Code
IFA	Infrastructure Finance Authority (Business Oregon)
IHMT	Interagency Hazard Mitigation Team
IMS	Interpretive Map Series (DOGAMI)
IPCC	Intergovernmental Panel on Climate Change
IPPM	Insect Pest Prevention and Management
IR	Indian Reservation
IRIS	Incident Response Information System
ISA	International Society of Arboriculture
ISO	Insurance Services Office
JFO	Joint Field Office (FEMA)
KOG	Keep Oregon Green
KPM	Key Performance Measure
L	Low
LCDC	Land Conservation and Development Commission (State of Oregon)
LEPC	Local Emergency Planning Committee
LFD	Local Fire Department
LFPC	Local Fire Prevention Cooperative
LHZ	Low Hazard Zone (coastal erosion)
LID	Low Impact Development
LLC	Limited Liability Company
LNG	Liquefied Natural Gas
LNHMP	Local Natural Hazards Mitigation Plan
LOC	League of Oregon Cities
LP	Legislative/Policy
LPA	Landowner Preferred Alternative
LU	Land Use/Development

LWI	Local Wetlands Inventory
M	Moderate
MAX	Metropolitan Area Express light rail, operated by Tri-County Metropolitan Transportation District of Oregon (TriMet)
MCDM	Multi-Criteria Decision Method
MH	Multi-Hazard
MHHW	Mean High Water
MJO	Madden Julian Oscillation
MLLW	Mean Lower Low Water
MMI	Modified Mercalli Index
MMMS	Map Modernization Management Support (FEMA)
MP	Mile Post or Maintenance/Planning
MV	Most Vulnerable
MVC	Motor Vehicle Collision
M_W	Moment earthquake magnitude scale
N/A	Not Available / Not Applicable
NARCCAP	North American Regional Climate Change Assessment Program
NASA	National Aeronautics and Space Administration
NASEO	National Association of State Energy Officials
NB	Nehalem Bank
NCC	Northwest Coordination Center
NCHR	Natural, Cultural, and Historical Resources
NDBC	National Data Buoy Center
NDWS	Native Database Web Service (Oracle)
NEHRP	National Earthquake Hazards Reduction Program
NEMIS	National Emergency Management Information System
NENA	National Emergency Number Association
NERC	North American Electric Reliability Corporation
NFIP	National Flood Insurance Program
NFP	National Fire Plan
NFPA	National Fire Protection Association
NGA	National Geospatial-Intelligence Agency
NGDC	National Geophysical Data Center
NGO	Non-Governmental Organization
NHMP	Natural Hazards Mitigation Plan

NID	National Inventory of Dams
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
NRC	National Resource Council
NRCS	Natural Resources Conservation Service (U.S.)
NRI	National Risk Index
NSF	National Science Foundation
NSFHA	No Special Flood Hazard Area
NTHMP	National Tsunami Hazard Mitigation Program
NVEWS	National Volcano Early Warning System
NWAC	Northwest Weather and Avalanche Center
NWN	Northwest (NW) Natural Gas
NWRFC	Northwest River Forecast Center (National Weather Service)
NWS	National Weather Service
OAIRS	Oregon All Incident Reporting System (State Fire Marshal)
OAR	Oregon Administrative Rule
OBSMAP	Oregon Beach and Shoreline Mapping and Analysis Program
OCAR	Oregon Climate Assessment Report
OCCRI	Oregon Climate Change Research Institute
OCMP	Oregon Coastal Management Program
OCS	Oregon Climate Service
OCSRI	Oregon Coastal Salmon Restoration Initiative
ODA	Oregon Department of Agriculture
ODE	Oregon Department of Education
ODF	Oregon Department of Forestry
ODFW	Oregon Department of Fish and Wildlife
ODOE	Oregon Department of Energy
ODOT	Oregon Department of Transportation
ODR	Oregon Department of Revenue
ODTWG	Oregon Distant Tsunami Working Group
OE	Office of Electricity Delivery and Energy Reliability (U.S. Department of Energy)
OECDD	Oregon Economic and Community Development Department (now Business Oregon-IFA)
OEM	Oregon Office of Emergency Management
OEMA	Oregon Emergency Management Association

OERS	Oregon Emergency Response System
OFR	Open File Report
OGDC	Oregon Geologic Data Compilation
OGIC	Oregon Geographic Information Council
OHA	Oregon Health Authority
OHD	Oregon Health Division
OHIRA	Oregon Hazard Identification and Risk Assessment
OHP	Oregon Highway Plan
OIG	Office of Inspector General (U.S.)
OLC	Oregon Lidar Consortium
OMB	Office of Management and Budget (U.S.)
OMD	Oregon Military Department
ONHRA	Oregon Natural Hazards Risk Assessment
OPDR	Oregon Partnership for Disaster Resilience
OPH	Oregon Public Health
OPRD	Oregon Parks and Recreation Department
OPUC	Oregon Public Utility Commission
OR-OSHA	Oregon Occupational Safety and Health Administration
ORP	Oregon Resilience Plan
ORS	Oregon Revised Statutes
OSBEELS	Oregon State Board of Examiners for Engineering and Land Surveying
OSBGE	Oregon State Board of Geologist Examiners
OSFM	Office of State Fire Marshal
OSG	Oregon Sea Grant (Oregon State University)
OSHA	Occupational Safety and Health Administration
OSLR	Oregon Seismic Lifeline Report
OSMB	Oregon State Marine Board
OSP	Oregon State Police
OSSPAC	Oregon Seismic Safety Policy Advisory Commission
OSU	Oregon State University
OUNS	Oregon Utility Notification System
OUS	Oregon University System
OWEB	Oregon Watershed Enhancement Board
OWRD	Oregon Water Resources Department
PA	Public Assistance

PAR	Population at Risk
PAS	Planning Advisory Service (American Planning Association)
PDA	Preliminary Damage Assessment
PDF	Portable Document Format
PDM	Pre-Disaster Mitigation
PDSI	Palmer Drought Severity Index
PFM	Potential Failure Mode
PGE	Portland General Electric
PL	Public Law
PM_{10}	Particulate Matter less than 10 micrometers in diameter
PMT	Project Management Team
PNP	Private Non-Profit organization
PNW	Pacific Northwest
PNWCG	Pacific Northwest Wildfire Coordinating Group
PNWR	Portland & Western Railroad
POTB	Port of Tillamook Bay Railroad
PRISM	Parameter-elevation Relationships on Independent Slopes Model, an interpolation method and name of associated climate group at Oregon State University
PROMETHEE	Preference Ranking METHod for Enrichment Evaluations
PSA	Public Service Announcement
PSAP	Public Safety Answering Point
PSU	Portland State University
PUC	Public Utility Commission (State of Oregon)
PUD	People's Utility District
PVC	Polyvinyl Chloride
RACES	Radio Amateur Civil Emergency Services
RAFT	Rapid Assessment of Flooding Tool
RAPTOR	Real-Time Assessment and Planning Tool for Oregon
RARE	Resource Assistance for Rural Environments (University of Oregon)
RAS-C	Risk Assessment Sub-Committee (State of Oregon IHMT)
RCP	Representative Concentration Pathway
REDARS2	Risks from Earthquake Damage to Roadway Systems
RFC	Repetitive Flood Claim (NFIP)
RFPA	Rangeland Fire Protection Association
RFPD	Rural Fire Protection District

RGP	Regional General Permit (Oregon Department of State Lands)
RHS	Rural Housing Service (U.S. Department of Agriculture (USDA))
Risk MAP	Risk Mapping, Assessment, and Planning Program (FEMA)
RL	Repetitive Loss
RM	Risk Management Division (State of Oregon, Department of Administrative Services)
ROS	Rain on Snow
ROW	Right of Way
RPC	Recovery Planning Cell (State of Oregon Executive Order 08-20)
RVS	Rapid Visual Screening
RWIS	Road Weather Information System
SB	Senate Bill (Oregon Legislature)
SBA	Small Business Administration (U.S.)
SC	Steering Committee (OSLR)
SD	Substantial Damage
SEAO	Structural Engineers Association of Oregon
SES	Social Ecological Systems
SFC-LPA	Southern Flow Corridor — Landowner Preferred Alternative
SFHA	Special Flood Hazard Area
SHMO	State Hazard Mitigation Officer
SI	Substantial Improvement
SJR	Senate Joint Resolution
SLIDO	Statewide Landslide Inventory Database for Oregon
SM	Snowmelt
SMART	Specific, Measurable, Achievable, Realistic, Time-oriented
SMC	State Management Cost
SME	Subject Matter Expert
SNHMP	State Natural Hazards Mitigation Plan
SNOTEL	Snow Telemetry site; part of an automated system of snowpack and related climate sensors operated by the USDA NRCS.
SOI	Southern Oscillation Index
SoVI	Social Vulnerability Index
SRGP	Seismic Rehabilitation Grant Program (State of Oregon)
SRIA	Sandy Recovery Improvement Act of 2013
SRL	Severe Repetitive Loss (NFIP)
SRS	Self-Determination Act

SSF	State Support Function
SUA	State Unit on Aging
SUB	Springfield Utility Board
SWCD	Soil and Water Conservation District
TAG	Technical Assistance Grant (Land Conservation and Development Commission)
TDD	Transportation Development Division (ODOT)
TDR	Transfer of Development Rights
TGM	Transportation and Growth Management Program (Department of Transportation)
THIRA	Threat and Hazard Identification and Risk Assessment
TIM	Tsunami Inundation Map (DOGAMI)
TNC	The Nature Conservancy
TOPSIS	Technique for Order of preference by Similarity to Ideal Solution
TRG	Technical Resource Guide
U.S.C.	United States Code
UASI	Urban Area Security Initiative
UGB	Urban Growth Boundary
UO	University of Oregon
UP	Union Pacific (railroad)
URM	Unreinforced Masonry
US	United States
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USDOC	United States Department of Commerce
USDOE	United States Department of Energy
USDOI	United States Department of the Interior
USDOT	United States Department of Transportation
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
V	Vulnerable
VE	Flood Insurance Rate Map (FIRM) zone: an area inundated by 1% annual chance flooding with velocity hazard (wave action); base flood elevations have been determined.
WACO	Water Availability Committee of Oregon
WHZ	Wildfire Hazard Zone
WRD	Water Resources Department (State of Oregon)

WREP	Wetlands Reserve Enhancement Program
WRH	Western Region Headquarters (NOAA National Weather Service)
WRP	Wetlands Reserve Program
WSSPC	Western States Seismic Policy Council
WSU	Washington State University
WUI	Wildland-Urban Interface
WWRA	West Wide Risk Assessment
WWTP	Wastewater Treatment Plant
YBP	Years Before Present

8.2 Glossary

100-year flood means a flooding condition which has a 1% chance of occurring each year. The 100-year flood is the benchmark upon which the National Flood Insurance Program (NFIP) is based.

Amplification is the modification of frequency or strength of seismic earth movement at a location due to thickness, topography, and physical properties of soft surface sediments.

Ash is composed of fine particles of volcanic rock and glass blown into the atmosphere by a volcanic eruption.

Atmospheric Rivers(ARs) are a key source of flooding in Oregon and are common along the West Coast. During the Winter, long narrow bands of moisture are generated from warm tropical areas of the Pacific. Driven by Pacific Storms, these bands of water vapor release large amounts of rainfall when they interact with coastal topography.

Benefit-Cost Analysis (BCA) is a method that determines the future risk reduction benefits of a hazard mitigation project and compares those benefits to its costs.

Bombs are fragments of tephra (particles ejected into the air during volcanic eruptions) larger than 2.5 inches.

Bedrock shaking is expected earth movement at a location due to seismic activity without considering soft sediment effects such as amplification and liquefaction.

Caldera is a large, generally circular, fault-bounded depression caused by the withdrawal of magma from below a volcano or volcanoes.

Cascadia Subduction Zone is the area where the seafloor plate (the Juan de Fuca or Gorda) is sliding down and below the North American plate.

Catastrophic hazards are regional in scale and scope. Cascadia Subduction Zone earthquakes, and the ground shaking, subsidence, landsliding, liquefaction, and tsunamis that accompany them are catastrophic hazards.

Channel Migration is a natural geologic process, which descrivbes how a stream or river channel moves laterally over time.

Chronic hazards such as beach, dune, and bluff erosion; landslides; slumps; and flooding of low-lying lands during major storms usually cause gradual and cumulative damage.

Cinder is a bubbly (vesicular) volcanic rock fragment that forms when molten, gas-filled lava is thrown into the air, then solidifies as it falls.

Coastal Subsidence is a drop in elevation of land relative to sea level during an earthquake.

Conflagration Act is state legal authority established as a civil defense measure to mobilize structural fire suppression resources for massive urban fires. It must be authorized by the Governor. The act includes authorization for OSFM to assign firefighting forces and equipment beyond mutual aid agreements. It also designates reimbursement for aid to those departments participating.

Conflagration, in the context of this Plan, means Governor-declared fires with an imminent threat to life or structures that have exhausted local and mutual aid suppression resources.

Disaster Mitigation Act of 2000 (DMA2K) amended the Stafford Act, establishing a national program for pre-disaster mitigation; streamlining the administration of disaster relief; changing FEMA's post-disaster programs for individuals and families; establishing minimum standards for public and private structures; requiring local and state natural hazards mitigation plans that meet a FEMA standard (Section 322); revising FEMA funding for the repair, restoration, and replacement of damaged facilities (Section 406); revising FEMA's participation in the costs of WUI fire suppression through an expanded and renamed Fire Management Assistance Grant Program (Section 420); removing the requirement for post-disaster IHMT or HMST meetings and reports; and other amendments.

Distal volcanic hazards have an impact far beyond the active vent. Proximal and distal hazards are individual to each volcano.

El Niño-Southern Oscillation is a cycle in the Pacific Basin involving water and air temperatures that has a profound effect on weather patterns around the world; events typically last 6-18 months.

Emergency Action Plan is defined by Oregon law as a plan that assists a dam owner or operator, and local emergency management personnel, to perform actions to ensure human safety in the event of a potential or actual dam failure.

FireFree is an Oregon and national model developed in Oregon that predates the more recent nationally known Firewise. http://www.firefree.org/

Firewise is a program developed by the National Fire Protection Association (NFPA) featuring templates to help communities reduce risk and protect property from the dangers of wildland fires; an interactive, resource-rich website; and training programs throughout the nation. http://www.firewise.org/

Floodplain is a land area adjacent to a river, stream, lake, estuary, or other water body that is subject to flooding. These areas, if left undisturbed, act to store excess flood water.

Floodway is the channel of a river or other watercourse and adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than one foot.

Flows are rapid to slow mass movement of saturated material moving down a slope. *Debris flows* occur when a landslide moves rapidly downslope as a semi-fluid mass scouring or partially scouring soils from the slope along its path. Other *flow* types include earthflows, mudflows, lahars, debris torrents, and creep.

Foredune is a dune lying parallel to the ocean, occurring at the landward edge of the beach or at the landward limit of the highest tide, which has been stabilized by vegetation.

Goal 7 of the Oregon Statewide Land Use Planning Program calls for local comprehensive plans to include inventories, policies, and implementing measures to guide development in hazard areas with the goal of reducing losses from flooding, landslides, earthquakes, tsunamis, coastal erosion, and wildfires.

Hazard is any situation that has the potential of causing damage to people, property, or the environment.

Hazard Mitigation Grant Program means the program authorized under Section 404 of the Stafford Act and implemented at 44 CFR Part 206, Subpart N, which authorizes funding for certain mitigation measures identified through the evaluation of natural hazards conducted under Section 322 of the Stafford Act. (44 CFR 201.2)

Hazard mitigation means any sustained action taken to reduce or eliminate the long-term risk to human life and property from hazards. (44 CFR 201.2) It aims to enhance the capacity of a community to anticipate, respond, adapt and recover from natural hazard events.

Hazus (**HAZ**ards **U**nited **S**tates) is a loss estimation methodology that is a FEMA software program using mathematical formulas and information about building stock, local geology, and the location and size of potential earthquakes, economic data, and other information to estimate losses from potential earthquakes.

Hazus-MH (Hazus **M**ulti-**H**azards) is a methodology that expands on Hazus (cf.) by estimating potential losses from earthquakes, hurricane winds, and floods.

H**igh hazard potential classification** dams are those where failure or mis-operation will probably cause loss of human life."

Lahar is a type of mudflow that originates on the slopes of volcanoes when volcanic ash and debris become saturated with water and flows rapidly downslope.

Lava is magma that reaches the Earth's surface through a volcanic eruption and when cooled and solidified, forms igneous rock.

Landslide is any detached mass of soil, rock, or debris that moves down a slope or a stream channel.

Lateral spreading is failure on very gentle slopes or flat terrain. The failure is usually associated with water-saturated, loose sediment spreading laterally due to liquefaction during earthquakes or human-caused rapid ground motion.

Lidar (Light Detection and Ranging) is an optical remote sensing technology that can measure the distance to, or other properties of a target by illuminating the target with light, often using pulses from a laser.

Liquefaction is the reaction of saturated soil to seismic earth movement causing the soil to behave like a liquid.

Littoral cells are beaches composed of sand, gravel, or both that may be bounded by prominent headlands limiting sand exchange.

Magma is molten rock that may be completely liquid or a mixture of liquid rock, dissolved gases and crystals.

Pyroclastic flow is an extremely hot mixture of gas, ash and pumice fragments that travels down the flanks of a volcano or along the surface of the ground at speeds of up to 150 miles per hour and tends to flow down valleys.

Magnitude (M) is a measure of the amount of energy released by an earthquake.

Major disaster means any natural catastrophe including any hurricane, tornado, storm, high water, wind-driven water, tidal wave, tsunami, earthquake, volcanic eruption, landslide, mudslide, snowstorm or drought, or, regardless of cause, any fire, flood, or explosion in any part of the United States, which in the determination of the President causes damage of sufficient severity and magnitude to warrant major disaster assistance to supplement the efforts and available resources of states, local governments, and disaster relief organizations in alleviating the damage, loss, hardship, or suffering caused thereby. (44 CFR 206.2)

Megathrust is both the giant fault that separates the two plates in a subduction zone and the giant earthquake that occurs when that fault moves.

National Fire Plan is a federal program that helps manage the impact of wildfire on communities. It has five main components: (a) firefighting, (b) rehabilitation and restoration, (c) hazardous fuel reduction, (d) community assistance, and (e) accountability.

National Flood Insurance Program is the program run by the federal government to improve floodplain management, reduce flood-related disaster costs, and provide flood insurance for residents of flood-prone communities.

Natural Hazards Mitigation Plan means a plan meeting the requirements of 44 CFR 201.4, 201.5, or 201.6.

National Risk Index is a dataset and online tool to help illustrate the United States communities most at risk for 18 natural hazards.

Orographic Lifting is the process by which air is forced to rise over a mountain or other geographical feature. It's a major cause of precipitation in mountainous areas.

Overtopping – wave-induced flood hazards

Pacific Decadal Oscillation is a similar but longer-term cycle than the El Niño-Southern Oscillation with typical events lasting 20-30 years.

Proximal volcanic hazards have an impact limited to a distance of about 30 miles or less from the active vent.

Public Assistance is that part of the disaster assistance program in which the federal government supplements the efforts and available resources of state and local governments to restore certain public facilities or services. Public Assistance includes emergency assistance, debris removal, community disaster loans, and the permanent repair, restoration, or replacement of public and designated private nonprofit facilities damaged or destroyed by a major disaster and is further described under Section 406 of the Stafford Act.

Pyroclastic surge is a dilute version of a pyroclastic flow, which can move even more rapidly and easily moves up and over ridges.

Range fires burn across lands typically open and lacking timber stands or large accumulations of fuel.

Repetitive Loss structure means a structure covered under an NFIP flood insurance policy that (1) has incurred flood-related damage on two occasions, in which the cost of repair, on average, equaled or exceeded 25% of the value of the structure at the time of each such flood event; and (2) at the time of the second incidence of flood-related damage, the contract for flood insurance contains increased cost of compliance coverage

Rock falls are masses of rock fragments that break away from a steep slope and travel mostly by free fall, coming to rest at the base of a slope as talus debris.

Senate Bill 360 in 1997 established the policy and framework for meeting the fire protection needs of the wildland-urban interface.

Severe Repetitive Loss structure means a structure covered under an NFIP flood insurance policy and has incurred flood-related damage (1) for which four or more separate claims have been made under flood insurance coverage, with the amount of each claim (including building and contents payments) exceeding $5,000 and with the cumulative amount of such claims payments exceeding $20,000; or (2) for which at least two separate flood insurance claims payments (building payments only) have been made, with the cumulative amount of such claims exceeding the value of the insured structure

Shield volcano is a gently sloping volcano in the shape of a flattened dome and built almost exclusively of lava flows.

Slides have a distinct zone of weakness that separates the overlying failed material from more stable underlying material. Types of slides include rotational (movement along a curved surface) and translational (movement along a flat surface).

Social vulnerability is the susceptibility of social groups to the adverse impacts of natural hazards, including disproportionate death, injury, loss, or disruption of livelihood.

Special Flood Hazard Area is the land in the floodplain within a community subject to a 1% or greater chance of flooding in any given year. (44 CFR 59.1)

Stafford Act means the Robert T. Stafford Disaster Relief and Emergency Assistance Act (PL 100-707, which amended PL 91-606 and PL 93-288; then was further amended by PL 106-390, the Disaster Mitigation Act of 2000; and PL 109-295, the Post-Katrina Emergency Reform Act).

State Hazard Mitigation Officer is the official representative of state government who is the primary point of contact with FEMA, other federal agencies, and local governments in mitigation planning and implementation of mitigation programs and activities required under the Stafford Act. In Oregon, the State Hazard Mitigation Officer position resides in the Oregon Department of Emergency Management (OEM).

State Interagency Hazard Mitigation Team is a permanent body of state agency officials established in 1997 to understand losses arising from natural hazards and coordinate recommended strategies to mitigate loss of life, property, and natural resources.

Stratovolcano is a relatively long-lived volcano built up of both lava flows and pyroclastic material.

Structural fire protection is protection of structures by established municipal fire departments and rural fire protection districts with specific equipment and training.

Subduction zone is the area between two converging plates, one of which is sliding down and below the other.

Subduction zone earthquake is an earthquake along a subduction zone. In Oregon, it usually refers to the Cascadia Subduction Zone (CSZ), which lies offshore of the Oregon coast.

Subduction is the process of one crustal plate sliding down and below another crustal plate as the two converge.

Surface fault is a fault that ruptures to the Earth's surface.

Tectonic refers to large-scale vertical or horizontal movement of the earth's crust.

Tectonic plate is a slab of rigid lithosphere (crust and uppermost mantle) that moves over the asthenosphere.

Tephra is a general term for all sizes of particles ejected into the air during volcanic eruptions. Tephra includes particles as tiny as volcanic ash and as large as bombs.

Tsunami is a series of waves generated by undersea earthquakes or landslides.

Vulnerability is the susceptibility of life, property, or the environment to damage if a hazard manifests to potential. It is a function of exposure, sensitivity, and capacity to adapt to hazards.

Wave runup is the swash of a broken wave as it travels up the beach face.

Wildfire hazard zone means the portion of a local government jurisdiction that has been determined to be at risk of a catastrophic wildfire.

Wildland-urban interface (also known as wildland interface, forestland-urban interface, interface) is an area where structures are adjacent to or are intermingled with natural vegetative fuels which is prone to the occurrence of wildland fires.

Whole community, as defined by FEMA, refers to the national focus on enabling the participation in national preparedness activities of a wider range of players from the private and nonprofit sectors,

including non-governmental organizations and the public, in conjunction with the participation of all levels of government to foster better coordination and working relationships.

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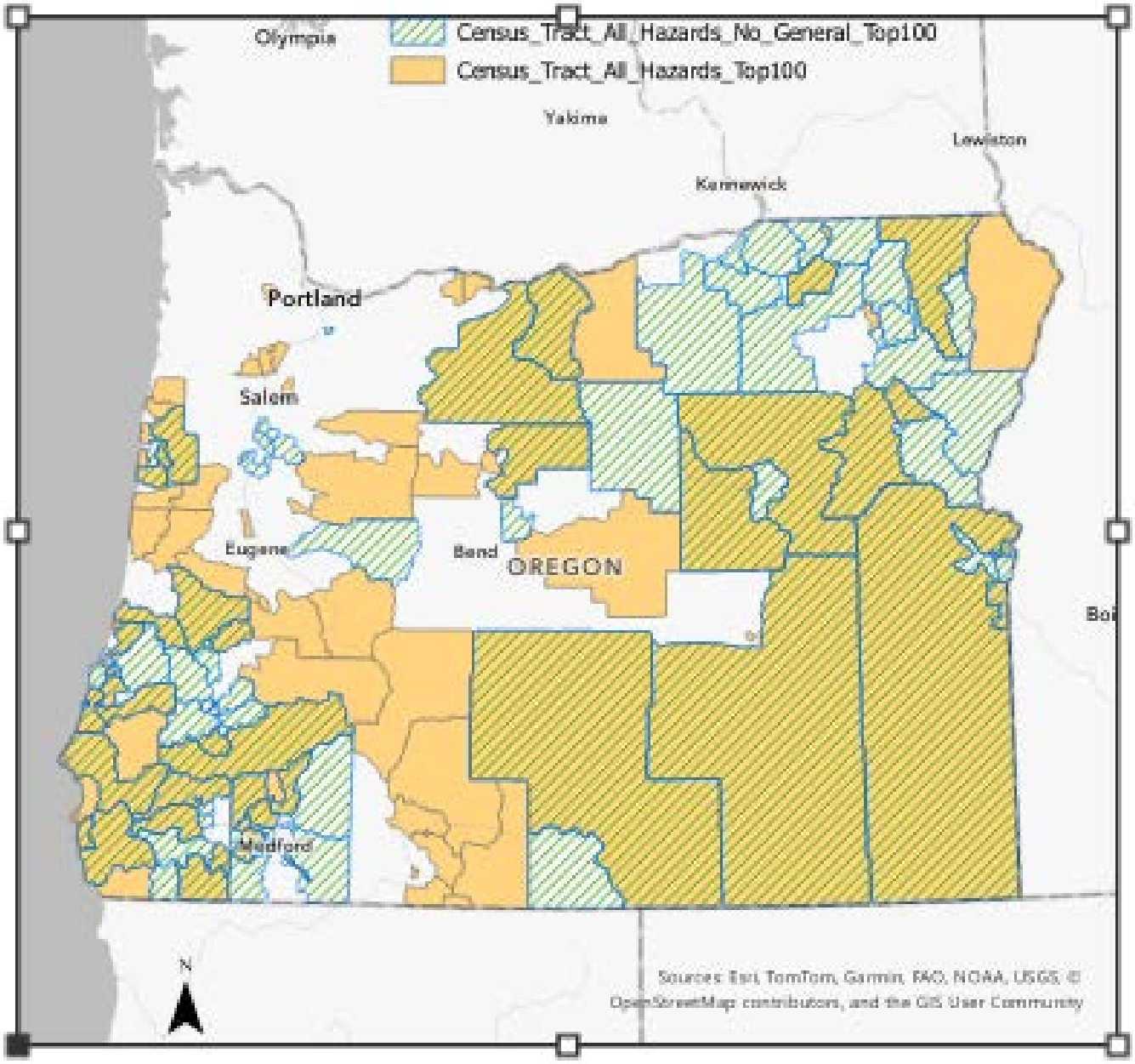
9.1 Risk Assessment Appendix

9.1.1 All Hazards

Many cities and census tracts in the state are exposed to multiple hazards. This section shows places exposed to multiple hazards by combining results from individual hazards analyses. Some of these multiple hazards may occur at the same time or following an initial event. While the state does recognize that harm from multiple hazards can occur and can have synergistic effects, the authors of this assessment were not able to evaluate cascading effects of multiple hazards at this time.

Figure 9.1.1-1 shows modeling results when all evaluated hazards are combined. The polygons represent census tracts that ranked in the top 100 when all evaluated hazards are considered together. The pink census tracts are those that ranked in the top 100 when all indicators are considered. The cross-hatched census tracts are those where only the hazard-specific indicators are considered.

Figure 9.1.1-1: Top 100 Census Tracts, All-hazards with Social Factors and without Social Factors.



Note: Areas that are solid orange in color reflect top 100 all-hazards ranking with socio-economic considerations included. When the solid orange color is overlaid with hatching, the census tract is in the top 100 both with and without socio-economic factors considered. Hatching alone indicates an area in the top 100 with no socio-economic factors included.

Table 9.1.1-1: Top 10 All-hazards Census Tract Rank with Social Factors (Orange polygons from figure above)

All Hazards Rank	Census Tract	County
1	41025960200	Harney
2	41015950100	Curry
3	41015950201	Curry
4	41029002800	Jackson
5	41019200000	Douglas
6	41065970800	Wasco
7	41031960100	Jefferson
8	41023960100	Grant
9	41023960201	Grant
10	41045970900	Malheur

Modeling as of 3/19/2025

Table 9.1.1-2: Top 10 All-hazards Census Tract Rank with No Social Factors (hazards only) (cross hatched polygons from figure above)

All Hazards Rank	Census Tract	County
1	41011000701	Coos
2	41045970600	Malheur
3	41011001002	Coos
4	41033361601	Josephine
5	41045970900	Malheur
6	41011001102	Coos
7	41019190000	Douglas
8	41065970800	Wasco
9	41059950400	Umatilla
10	41023960202	Grant

Model results as of 3/19/2025

9.1.2 State-owned or Leased Buildings

Analysis of state-owned or leased facilities expands on what was accomplished for the 2020 plan. According to the Oregon Department of Administrative Services (DAS), the State of Oregon owns or leases buildings having a total value of nearly $7.3 billion in 2019. Because of this investment it is important the State assess the vulnerability of these structures to Oregon's natural hazards. Data to support this analysis were available for the following hazards: coastal erosion, earthquake, flood, landslide, tsunami, volcano, and wildfire. The Oregon Department of Geology and Mineral Industries (DOGAMI) assembled the best-available statewide natural hazard data and assessed which state-owned/leased buildings are exposed to each hazard. DOGAMI also assessed the vulnerability of local critical facilities to natural hazards throughout the state.

The data for this analysis was furnished by DAS. As a part of the quality control review, DOGAMI removed nearly 400 building points from the original 2019 DAS dataset to build the dataset used in the vulnerability assessment. Many of the buildings were removed based on attributes in the GIS data that indicated that the points represented non-structures (e.g., property grounds). The final data set contained 5,350 state facilities.

Notably, the DAS building data does not identify "critical/essential" facilities. Within the state facilities dataset DOGAMI created a subcategory of critical facilities. DOGAMI and the Department of Land Conservation and Development (DLCD) defined critical facilities as buildings that function as airports, communications, emergency operations, fire stations, hospitals or health clinics, military facilities, police stations, schools, detention centers, or miscellaneous facilities (e.g., ODOT Maintenance Facility) that would be needed during or immediately after a natural disaster. DOGAMI identified 1,674 state critical facilities. Figure xx shows the distribution and dollar value (potential loss) of these 5,350 state-owned/leased facilities within Oregon NHMP Natural Hazard Regions.

DLCD extended analysis conducted for the 2020 plan by overlaying buildings that DOGAMI identified as being located in hazard zones onto the "all-hazards" census tract layer to assign one PROMETHEE ranking score to each exposed building. In most cases a building was not directly exposed to every hazard. Nonetheless, the ranking alerts hazard mitigation planners to buildings that for a variety of reasons may pose challenges during and after an event. Critical facilities located in high-risk census tracts should be managed to maintain a high degree of functionality.

Table 9.1.2-1: State-owned building names and values by all-hazards rank with social factors evaluated – Top 10 all-hazards census tracts only

All Hazards Rank 1 40125960200 - Harney	**Critical or Essential State-owned Facility?**		
Building Name	**No**	**Yes**	**Grand Total**
Alkali Lake MS Deicer Building		$640,565	$640,565
Barn - Pete French Round Barn	$509,322		$509,322
Buchanan Springs RA Shelter	$106,513		$106,513
Hotel (Concession)	$865,639		$865,639

Sagehen SRA Restroom Building	$1,322,406		$1,322,406
Site Systems - King Mountain M/W Grounds		$152,512	$152,512
Site Systems - Steens Radio Operating Exp Grounds		$107,781	$107,781
Stinking Water Scoop Shed	$82,741		$82,741
Stinking Water Mountain Sand Shed	$431,817		$431,817
Total	$3,318,438	$900,858	$4,219,296

All Hazards Rank 2 41015950100 - Curry	**Critical or Essential State-owned Facility?**		
Building Name	**No**	**Yes**	**Grand Total**
Barracks (01) Historic	$370,004		$370,004
Campground Maintenance Shop - Garage/Storage	$281,007		$281,007
Cape Blanco State Airport (5S6)	$60,668		$60,668
Edson Butte M/W Building		$147,355	$147,355
Elk River Hatchery Storage Building	$424,676		$424,676
Garage (03) Historic	$281,356		$281,356
House - Hughes House SA (Historic)	$462,666		$462,666
Life Boat Display Building	$323,969		$323,969
Maintenance Shop - Historic	$226,922		$226,922
Plumbed Type 6-4 RS - Sites 1-27	$489,339		$489,339
Plumbed Type 9-9 RS - A-Loop	$392,923		$392,923
Plumbed Type 9-9 RS - Sites 28-95	$651,255		$651,255
Port Orford Fuel Station		$243,383	$243,383
Port Orford Hazardous Materials Building		$458,532	$458,532
Port Orford Maintenance Station Building		$325,501	$325,501
Port Orford MS Herb		$122,628	$122,628
Port Orford MS Storage Building	$450,953		$450,953
Port Orford Pole Building		$211,401	$211,401
Residence	$672,866		$672,866

Residence (02) Historic	$290,531		$290,531
Shop 2 Bay Storage	$420,940		$420,940
Total	$5,800,075	$1,508,800	$7,308,875
All Hazards Rank 3 41015950201 - Curry	**Critical or Essential State-owned Facility?**		
Building Name	**No**	**Yes**	**Grand Total**
Curry County Circuit Court	$60,668		$60,668
Gas and Oil House (#15) Gold Beach	$2,907,498		$2,907,498
Hunter Creek Maintenance Station Building	$840,392		$840,392
Hunter Creek MS Pole Building	$931,662		$931,662
Total	$4,740,220		$4,740,220
All Hazards Rank 4 41029002800 - Jackson	**Critical or Essential State-owned Facility?**		
Building Name	**No**	**Yes**	**Grand Total**
Vault Double – Boat Ramp/Swimming/DU	$93,457		$93,457
Total	$93,457		$93,457
All Hazards Rank 5 41019200000 - Douglas	**Critical or Essential State-owned Facility?**		
Building Name	**No**	**Yes**	**Grand Total**
Canyonville MS Enclosed Storage		$280,158	$280,158
Canyonville Maintenance Station Building		$976,004	$976,004
Canyonville MS Open Storage		$232,529	$232,529
Lookout Silver Butte	$291,239		$291,239
Total	$291,239	$1,488,691	$1,779,930

All Hazards Rank 6 41065970800 - Wasco	Critical or Essential State-owned Facility?		
Building Name	**No**	**Yes**	**Grand Total**
Cow Creek Rest Area Buildings	2,360,151		2,360,151
Foreman Point M/W Buildings		749,128	749,128
Hulse Ranch M/W Buildings		1,046,295	1,046,295
Oak Springs Hatchery		9,205,512	9,205,512
The Dalles Maintenance Station		9,749,208	9,749,208
White River Wildlife Area	4,324,432		4,324,432
Unidentified Assets	4,611,843		4,611,843
Total	11,296,426	21,477,699	32,774,125

All Hazards Rank 7 41031960100 - Jefferson	Critical or Essential State-owned Facility?		
Building Name	**No**	**Yes**	**Grand Total**
Deer Ridge Correctional Facility		249,747,780	249,747,780
Juniper Butte Scale House	184,422		184,422
Stephenson Mountain M/W		54,188	54,188
Unidentified assets	95,586		95,586
Total	280,008	249,802,238	250,082,246

All Hazards Rank 8 41023960100 – Grant	Critical or Essential State-owned Facility?		
Building Name	**No**	**Yes**	**Grand Total**
Austin Maintenance Station		4,407,243	4,407,243
Bone Point M/W & Radio Operations		66,220	66,220
Carter Rest Area	99,936		99,936
Long Creek Maintenance Station		1,478,031	1,478,031
Lookout Ritter Mountain		148,072	148,072
Smith Pit Stockpile Site	20,480		20,480

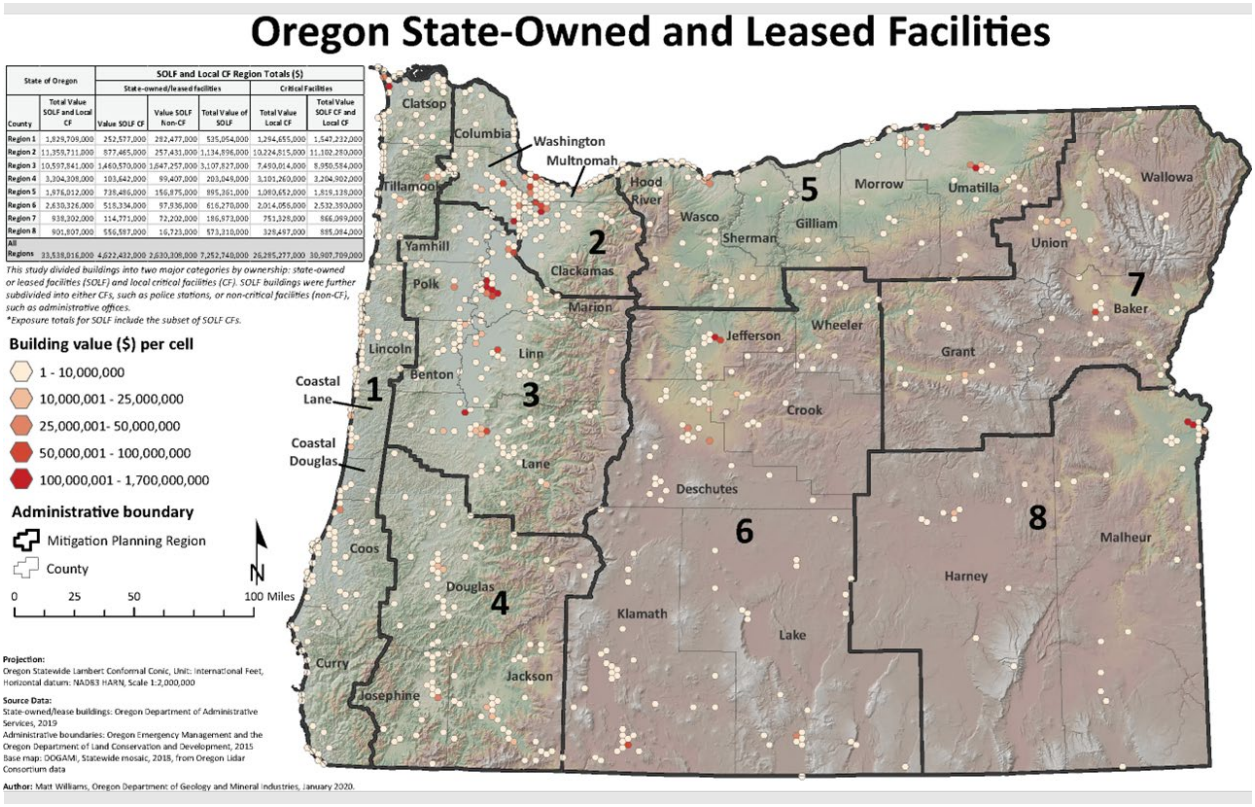
Tamarack m/W & Radio Operations		89,232	89,232
Unidentified Assets	1,978,013		1,978,013
Total	2,098,429	6,188,798	8,287,227
All Hazards Rank 9 41023960201 - Grant	**Critical or Essential State-owned Facility?**		
Building Name	**No**	**Yes**	**Grand Total**
Aldrich Mountain Generator Buildings		156,600	156,600
Phillip W. Schneider office/residence/barn	81,920		81,920
Unidentified assets	1,686,029		1,686,029
Total	1,767,949	156.600	1,924,549
All Hazards Rank 10 41045970900 - Malheur	**Critical or Essential State-owned Facility?**		
Building Name	**No**	**Yes**	**Grand Total**
Black Butte Radio Operations		96,210	96,210
Cottonwood Mountain M/W buildings		67,369	67,369
Coyne Point Radio Buildings		82,356	82,356
Farewell Bend POE Grounds	2,101,187		2,101,187
Mahogony Mountain M/W buildings		48,577	48,577
McDermitt State Airport	20,675		20,675
Ontario Maintenance Station		18,655,543	18,655,543
Pharmacy Hill Operating Grounds	47,671		47,671
Rome State Airport	20,675		20,675
Site Systems -- Basque	20,675		20,675
Snake River Correctional Institution		504,885,082	504,885,082
Succor Creek Operating Exp Grounds	65,328		65,328
Unidentified assets	1,032,477		1,032,477
Total	3,308,688	523,907,850	527,216,538

Grand Total			838,426,463

9.1.3 Critical Facilities

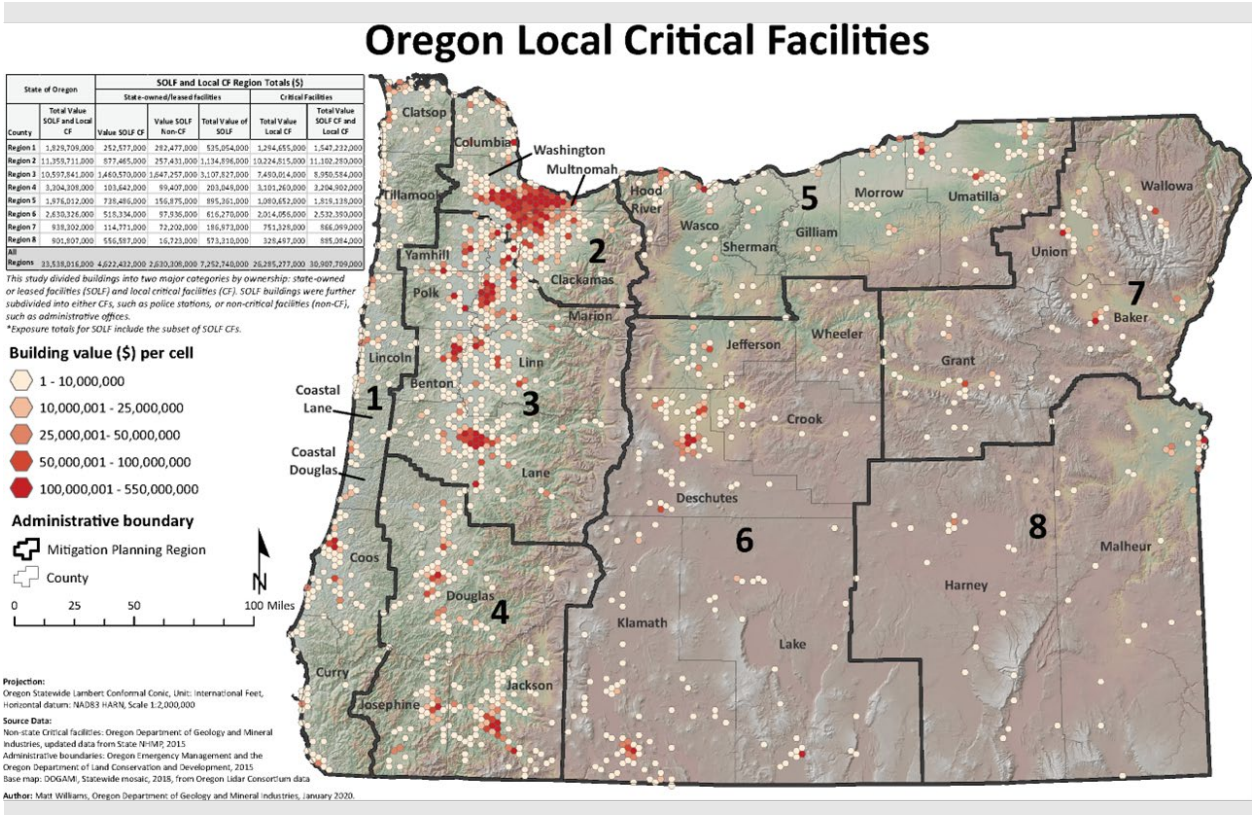
Local critical facilities are a building, or a group of buildings, that either are publicly or privately owned airports, communications, emergency operations, fire stations, hospitals or clinics, military facilities, police stations, schools, detention centers, or miscellaneous facilities, as defined by DOGAMI and DLCD. The dataset that DOGAMI developed and used in the 2020 vulnerability assessment had 8,757 buildings with a total value of $26 billion. Local critical facilities are shown in Figure 9.1.3-2. DLCD assigned a PROMETHEE census tract rank to this list of buildings to arrive at a list of buildings in priority all-hazards mitigation areas or the 2025 plan.

Figure 9.1.3-1: Statewide distribution of state-owned and leased facilities and state-critical facilities



Source: DOGAMI

Figure 9.1.3-2: Statewide distribution of local critical facilities



Source: DOGAMI

9.1.4 Lifelines

9.1.4.1 Road Network Lifelines

An overview of seismic lifeline vulnerabilities is provided in the Oregon Department of Transportation's (ODOT's) 2012 Oregon Seismic Lifeline Report (OSLR) findings, including identification of system vulnerabilities, loss estimates and recommended next steps. OSLR findings have been incorporated into a public facing GIS environment, last updated in 2023 (https://ftp.gis.oregon.gov/framework/transportation/seismic_lifelines.zip). This data is meant to represent a "secure lifeline network of streets, highways and bridges to facilitate emergency services response and to support rapid economic recovery after a seismic disaster."

9.1.4.2 ODOT Climate Adaptation and Resilience Roadmap

The Climate Adaptation and Resilience Roadmap is a broad document that provides policy guidance and actionable strategies to help ODOT institutionalize adaptation and resilience. It outlines a path forward for integrating climate change considerations into ways the agency plans for, invests in, builds, manages,

maintains, and supports the multi-modal transportation system. The roadmap incorporates results from ODOT's statewide climate hazards risk analysis, drawing from corridor-scale risk maps of the state highway system. This information can now be used to inform project planning and prioritization by locating transportation corridors at high risk to climate hazards. The roadmap is also Oregon's FHWA-approved statewide Resilience Improvement Plan (RIP) for PROTECT. Click here or more information about ODOT's PROTECT Program. (copied from ODOT website, accessed 02/04/2025)

Lifelines also include facilities that must remain operational during a natural hazard event. Based on FEMA's definition, they fall into seven categories: safety and security, food water and shelter, health and medical, energy (power and fuel), communications, transportation, hazardous materials. Some lifelines have already been identified as critical facilities as well. Additional lifelines that have not been previously identified by DLCD are listed in Table 9.1.4-1 and Table 9.1.4-2. DLCD identified these from data sources identified on the RAPT website, State of Oregon databases, and Oregon Department of Transportation (ODOT) TransGIS to compile a list of these facilities. Data on wastewater treatment plants, power plants, and principal ports are Homeland Infrastructure Foundation Level Data found on the RAPT website. Primary public safety answering points and hazardous materials storage sites are from the State of Oregon GEOHub Database, the state's authoritative geospatial repository. Data on stormwater control measures, stormwater outfalls, transit stops, Amtrak stops, and POINT Bus Stops (statewide long distance bus lines) are from the Oregon Department of Transportation TransGIS.

Table 9.1.4-1: Counts of community lifelines in top ranked all-hazards mitigation areas

			Food, Water, Shelter			Energy	Communications
All Hazard Rank	Census Tract	County	Wastewater Treatment Plants	Stormwater Control Measures	Stormwater Outfalls	Power Plants	Public Safety Answering Points
1	41025960200	Harney	0	4	0	1	0
2	41015950100	Curry	1	0	0	0	0
3	41015950201	Curry	0	0	0	0	1
4	41029002800	Jackson	1	2	0	0	0
5	41019200000	Douglas	2	2	0	1	0
6	41065970800	Wasco	2	8	0	1	0
7	41031960100	Jefferson	0	2	0	1	0
8	41023960100	Grant	1	0	0	1	0
9	41023960201	Grant	2	0	0	0	0
10	41045970900	Malheur	0	0	0	6	0

Table 9.1.4-2: Counts of community lifelines in top ranked all-hazards mitigation areas continued

			Transportation				Hazardous Materials
All Hazard Rank	Census Tract	County	Transit Stops	Amtrak Stops	POINT Bus Stops	Principal Ports	Hazardous Material Storage
1	41025960200	Harney	3	0	3	0	37
2	41015950100	Curry	1	0	0	0	34
3	41015950201	Curry	1	0	0	0	25
4	41029002800	Jackson	0	0	0	0	12
5	41019200000	Douglas	33	0	0	0	37
6	41065970800	Wasco	0	0	0	0	70
7	41031960100	Jefferson	2	0	0	0	32
8	41023960100	Grant	24	0	0	0	24
9	41023960201	Grant	9	0	0	0	9
10	41045970900	Malheur	2	0	2	0	52

9.2 Assessment Methods

DOGAMI used two primary methods for assessing vulnerability to hazards: Hazus damage estimates for earthquakes and exposure analysis for floods, coastal erosion, volcanic hazards, tsunamis, wildfires, and landslides. This is a simple method to determine which facilities lie within a natural hazard area and which do not. It is an alternative for natural hazards for which Hazus damage functions or high-quality, statewide hazard mapping is not available, and therefore, loss estimation is not possible or recommended.

9.2.1 Hazard Data Limitations

Building-specific information can make an enormous difference when evaluating the actual damaging effects of natural hazards. For example, a modern seismically reinforced building may receive far less or no earthquake damage compared to older un-reinforced buildings next door. The analysis performed by DOGAMI and DLCD does not attempt to account for building- or site-specific characteristics.

9.2.2 Interpreting the Results of Hazard Specific Modeling

The following sections show modeling results for six natural hazards: riverine flooding, coastal hazards, tsunami, drought, extreme heat, landslide, volcano, wildfire, and earthquake. Each hazard section begins with a short description of the event scenario used in the model. A map showing the top 10 ranked census tract is followed by a table naming the census tracts, its modeling rank, and statistics from the National Risk Index. Adjacent to the map is a list of the indicators used to model the event. The indicators category “General” was used as a set for each hazard. The remaining indicators vary by hazard type. Following the maps showing the top 10 census tracts are a set of maps showing the location of an individual census tract along with a bar chart showing a z-score for each indicator.

The z-score measures how many standard deviations the observed value is away from the mean value. Z-scores greater than 1 or less than 1 show where the observed value for the subject census tract is more

than one standard deviation from the mean value of all census tracts used in the analysis. In other words, it is unusual and a likely driver of risk or resilience in the census tract.

Care must be taken when deciding whether an unusual z-score contributes to risk or resilience. The table associated with the hazard-specific top 10 census tracts shows a column labeled “Direction”. If the direction is positive, the indicator contributes to vulnerability. If it is negative it contributes to resilience.

The tables listing state-owned buildings and critical facilities reflect only those buildings and facilities in the census tract that are in the hazard zone. Building values are provided by DAS and reflect 2019 values. If a loss is recorded it is because that building has suffered a loss from the natural hazard event in the past.

9.2.3 Indicator Key

The gold corresponds to indicators modeled in a positive direction (1)
The blue-green corresponds to indicators modeled in a negative direction (-1)

Table 9.2.3-1: Multi-Criteria Analyses Indicator Key

	Gold: bars point to the left on z-score graphs = less vulnerable
	Gold: bars point to the right on z-score graphs = more vulnerable
	Blue-green: bars point to the left on z-score graphs = more vulnerable
	Blue-green bars point to the right on z-score graphs = less vulnerable

Indicator Name	Description	Data Source	Justification
GENERAL (Socio-economic Indicators used for all evaluated hazards)			
EP_MOBILE	Percentage of residential building stock that are mobile homes	2020 Census; **ACS Table(s)**: B25024, B25032	Mobile homes are more likely than site-built homes to be damaged by natural hazard events. Manufactured home parks are often located in hazard zones
EP_MINRTY	Percentage of non-white population		The State of Oregon and the Department of Land Conservation

Indicator Name	Description	Data Source	Justification
			and Development have a “lead with race” policy. The CRE (a social vulnerability indicator) does not include race.
Housing Tenure	Percent of owned homes		Tenure definition from US Census: A unit is owner occupied if the owner or co-owner lives in the unit, even if it is mortgaged or not fully paid for. Owners have more control over mitigation projects and opportunities.
Median_Yrblt	Median year built of general building stock based on HAZUS default data.	Hazus (org. 2020 Census)	Older homes likely are built with less stringent buildings codes. Maintenance status may make them more prone to damage due to natural hazard events.
HospitalDistMile	Distance from tract centroid to nearest hospital.	DOGAMI generated	Distance to the nearest hospital indicates degree of access to medical services in the face of and after a natural hazard event.
NatResrcJobs	Percentage of natural resource jobs.	2020 Census	People employed in natural resource jobs may work outdoors and may face reductions in work

Indicator Name	Description	Data Source	Justification
			hours or access to raw materials during and after a natural hazards event. Short term employment gains may be experienced from rebuilding, but these are short-lived.
PRED3_PE	Percentage of individuals with three plus components of social vulnerability from the Community Resilience Estimate (CRE)	2023 CRE Estimate	Metric for how socially vulnerable people are to the impacts of disasters.
Hosp_Beds	Estimated number of hospital beds based on square footage of hospital building (1500ft^2 per bed)	DOGAMI generated	Indicates the ability of local medical system to address emergencies during and after an event.
Pct_Adherents	Percentage of members to a religious group	2020 US Religion Census	Indicates community cohesion or access to local assistance.
Mitigation	Number of mitigation projects (grouped by zip code and evenly distributed to overlaying tracts)	FEMA: Hazard Mitigation Assistance Projects - v4 | FEMA.gov	Measures degree of mitigation attention that has been paid to the area.
Cultural	Number of cultural-related institutions	Oregon Cultural Trust	Indicates community cohesion by participation in cultural activities
Favors	Average rating from survey of neighborliness: Willing	OHA	Indicates propensity to assist neighbors during and after an event.

Indicator Name	Description	Data Source	Justification
	to do favors for neighbor		
Advice	Average rating from survey of neighborliness: Seeks advice from neighbor	OHA	Indicates propensity to assist neighbors during and after an event.
Parties	Average rating from survey of neighborliness: Attended parties that occur in neighborhood	OHA	Indicates propensity to assist neighbors during and after an event.
Visits	Average rating from survey of neighborliness: Has visited neighbor's house	OHA	Indicates propensity to assist neighbors during and after an event.
Watch	Average rating from survey of neighborliness: Will watch neighbor's house	OHA	Indicates propensity to assist neighbors during and after an event.
CountyTax	County tax rate	Oregon Dept. of Revenue	Indicates capacity of local government to plan, respond to, and mitigate.
CityTax	City tax rate	Oregon Dept. of Revenue	Indicates capacity of local government to plan, respond to, and mitigate.

Hazard Specific Indicators

Indicator Name	Description	Data Source	Justification
COASTAL HAZARDS			
CFL_pct_CF	Percentage of critical facilities (2020 State NHMP data) buildings exposed to coastal flooding based on NFIP flood zones.	DOGAMI generated	Indicates the degree of disruption to critical facilities during a flood event and its aftermath.
Hist_count	Number of historic buildings.	OPRD/Historic Preservation	Indicates cultural significance in the area
Port	Presence of marine port infrastructure	DOGAMI generated	Damage to ports disrupts commerce, jobs, and local economy. May be costly to repair
Bridge_Scour_pct	Percentage of bridges that are scoured from a 100-year flood.	ODOT	A high proportion of damaged bridges in an area indicates reduced ability to find detours.
CRS_Rate	Community Rating System (NFIP program for reduced insurance premiums) score for communities within census tracts (1 – 10 scores with 1 being the best score).	FEMA	Communities that participate in the Community Rating System tend to be better prepared for flood events and to adopt policies to avoid building in flood hazard zones.
ImpervSurf_Pct	Percentage of impervious surface.	Justice40	Areas with a high percentage of impervious surface tend to have flood and drainage problems, leading to the potential for damage.
FIRM_Diff	Number of years difference between	FEMA/2020 Census	Older flood maps tend to misrepresent areas

Indicator Name	Description	Data Source	Justification
	median year built and first Flood Insurance Rate Map date.		subject to flood; newer maps are more reliable indicators of flood hazard.
FL_Haz_Area	Area of tract in 100-year flood hazard.	FEMA	Census tracts with large flood hazard zones are more likely to suffer harm.
RepeatLoss	Number of Repetitive loss structures	FEMA	Indicates historic repetitive losses and opportunity for mitigation.
DROUGHT			
Drght_NRI_rate	Expected annual loss (EAL) rate for drought from the FEMA NATIONAL RISK INDEX.	National Risk Index	EAL rates are designed to reflect the average expected annual percentage loss for the building value, population, and agriculture value within a community
Drght_Events	Number of drought events from the FEMA NATIONAL RISK INDEX.	National Risk Index	
Drght_AL_AG	Expected annual loss (EAL) rate for agriculture from FEMA NATIONAL RISK INDEX.	National Risk Index	EAL rates are designed to reflect the average expected annual percentage loss for the building value, population, and agriculture value within a community
Over90th	Mean number of days that are above the historic 90th percentile temp	OCCRI	Hot days contribute to drought effects.

Indicator Name	Description	Data Source	Justification
Over90F	Mean number of days above 90 degrees Fahrenheit	OCCRI	Hot days contribute to drought effects.
EARTHQUAKE			
LQ_pct_bld	Percentage of STATEWIDE BUILDING FOOOTPRINTS FOR OREGON buildings exposed to Moderate to Very High liquefaction zones based on data compiled in the Oregon Seismic Hazard Dataset (OSHD).	DOGAMI generated	Indicates the degree of disruption within the census tract because of liquefaction and its aftermath.
LQ_pct_CF	Percentage of critical facilities (2020 State NHMP data) buildings exposed to Moderate to Very High liquefaction zones based on data compiled in the Oregon Seismic Hazard Dataset (OSHD).	DOGAMI generated	Indicates the degree of disruption to critical facilities as a result liquefaction.
EQCSZ_pct_CF	Percentage of critical facilities (2020 State NHMP data) buildings that are red or yellow-tagged buildings based on CSZ Deterministic Hazus scenario analysis.	DOGAMI generated	Indicates the degree of disruption to critical facilities because of earthquake.
EQ25_pct_CF	Percentage of critical facilities (2020 State NHMP data) buildings that are red or yellow-tagged buildings	DOGAMI generated	Indicates the degree of disruption to critical facilities because of earthquake.

Indicator Name	Description	Data Source	Justification
	based on 2500 Probabilistic Hazus scenario analysis.		
Hist_count	Number of historic buildings.	OPRD/Historic Preservation	Indicates cultural significance in the area
Hwy_LQ_pct	Miles of major roadway exposed to Moderate to Very High liquefaction zones based on data compiled in the Oregon Seismic Hazard Dataset (OSHD).	ODOT/DOGAMI generated	Damaged roads disrupt transportation and access to services.
Erqk_NRI_rate	Expected annual loss (EAL) rate for earthquake from FEMA NATIONAL RISK INDEX.	National Risk Index	FEMA designed EAL rates to reflect the average expected annual percentage loss for the building value, population, and agriculture value within a community.
LQ_Haz_Area	Area of tract in high or very high liquefaction hazard.	DOGAMI generated	Indicates a potential disruption.
Bridges_LIQ	Number of bridges that are within high or very high liquefaction hazard.	ODOT/DOGAMI generated	Bridges provide critical transportation links and can take time to repair, leading to disruptions.
PGA_2500	Average shaking in tract from 2500-year probabilistic earthquake.	DOGAMI generated	
EXTREME HEAT			

Indicator Name	Description	Data Source	Justification
Heat_Events	Number of heat events.	National Risk Index	
Heat_ALAG	Expected annual loss (EAL) rates to agriculture from heat.	National Risk Index	FEMA designed EAL rates to reflect the average expected annual percentage loss for the building value, population, and agriculture value within a community
Heat_ALPOP	Expected annual loss rate to population from heat.	National Risk Index	FEMA designed EAL rates to reflect the average expected annual percentage loss for the building value, population, and agriculture value within a community
OutdoorJobs	Percentage of jobs that occur outside.	ACS 2021	People who work outdoors are exposed to natural hazards and their consequences.
TreeCan_avg	Tree canopy density	USDA	Indicates potential for shade or cooling.
FLOOD			
Bridge_Scour	Number of bridges that are at risk from scour during a 100-year flood.	Oregon Dept. of Transportation	Bridges provide key transportation links that can be difficult to go around if damaged during a flood. Often require extended repair times.
CRS_Rate	Community Rating System (NFIP program for reduced insurance premiums) score for communities within census tracts (1 – 10	FEMA	Communities that participate in the Community Rating System tend to be better prepared for flood events and to adopt policies to avoid

Indicator Name	Description	Data Source	Justification
	scores with 1 being the best score).		building in flood hazard zones.
FL_pct_bld	Percentage of Statewide Building Footprint for Oregon buildings exposed to flooding based on NFIP flood zones.	DOGAMI generated	Indicates the degree of disruption within the census tract because of flood and its aftermath.
FL_pct_CF	Percentage of critical facilities (2020 State NHMP data) buildings exposed to flooding based on NFIP flood zones.	DOGAMI generated	Indicates the degree of disruption to critical facilities during a flood event and its aftermath.
ImpervSurf_Pct	Percentage of impervious surface.	Justice40	Areas with a high percentage of impervious surface tend to have flood and drainage problems, leading to the potential for damage.
Hwy_FL_pct	Miles of major roadways miles based on ODOT data that are exposed to flood hazard from NFIP data.	ODOT/DOGAMI generated	Flooded roads disrupt transportation and access to services.
Bridge_Scour_pct	Percentage of bridges that are scoured from a 100-year flood.	ODOT	A high proportion of damaged bridges in an area indicates reduced ability to find detours.
FIRM_Diff	Number of years difference between median year built and first Flood Insurance Rate Map date.	FEMA/2020 Census	Older flood maps tend to misrepresent areas subject to flood; newer maps are more reliable indicators of flood hazard.

Indicator Name	Description	Data Source	Justification
FL_Haz_Area	Area of tract in 100-year flood hazard.	FEMA	Census tracts with large flood hazard zones are more likely to suffer harm.
RepeatLoss	Number of Repetitive loss structures	FEMA	Indicates historic repetitive losses and opportunity for mitigation.
Hist_count	Number of historic buildings.	OR agency for Historic Preservation	Indicates cultural significance in the area
CFL_pct_bld	Percentage of STATEWIDE BUILDING FOOOTPRINTS FOR OREGON buildings exposed to coastal flooding based on NFIP flood zones.	DOGAMI generated	Indicates the degree of disruption within the census tract because of flood and its aftermath.
Hwy_FL_pct	Miles of major roadways that are exposed to flood hazard from NFIP data based on ODOT data.	ODOT/DOGAMI generated	Flooded roads disrupt transportation and access to services.
LANDSLIDE			
LSS_pct_bld	Percentage of STATEWIDE BUILDING FOOOTPRINTS FOR OREGON buildings exposed to existing landslide deposit SLIDO.	DOGAMI generated	Indicates the degree of disruption within the census tract as a result of landslide.
LSS_pct_CF	Percentage of critical facilities (2020 State NHMP data) buildings exposed to existing landslide deposit SLIDO.	DOGAMI generated	Indicates the degree of disruption to critical facilities during a landslide event and its aftermath.

Indicator Name	Description	Data Source	Justification
Hwy_LSS_pct	Miles of major roadways based on ODOT data that are exposed to existing landslide deposits based on SLIDO.	ODOT/DOGAMI generated	Damaged roads disrupt transportation and access to services.
Hist_count	Number of historic buildings.	OWRD/Historic Preservation	Indicates cultural significance in the area
LSS_Haz_Area	Area of tract in high or very high landslide hazard.	DOGAMI generated	Indicates the degree of potential disruption and harm to people or property.
TSUNAMI			
TSU_pct_bld	Percentage of STATEWIDE BUILDING FOOOTPRINTS FOR OREGON buildings exposed to any sized (SM-XXL) CSZ tsunami.	DOGAMI generated	Indicates the degree of disruption within the census tract as a result of tsunami.
TSU_pct_CF	Percentage of critical facilities (2020 State NHMP data) buildings exposed to any sized (SM-XXL) CSZ tsunami.	DOGAMI generated	Indicates the degree of disruption to critical facilities because of tsunami.
Port	Presence of marine port infrastructure	DOGAMI generated	Damage to ports disrupts commerce, jobs, and local economy. May be costly to repair
Bridges_TSU	Number of bridges that are within a tsunami inundation zone.	ODOT/DOGAMI generated	Bridges provide critical transportation links, particularly on the coast where detour routes are few and far between.

Indicator Name	Description	Data Source	Justification
Hist_count	Number of historic buildings.	OPRD/Historic Preservation	Indicates cultural significance in the area
VOLCANO			
LAH_pct_bld	Percentage of STATEWIDE BUILDING FOOOTPRINTS FOR OREGON buildings exposed to volcanic lahar hazard of any size based on USGS and DOGAMI lahar zones for Cascade volcanoes.	DOGAMI generated	Indicates the degree of disruption within the census tract, including harm to people and property.
LAH_pct_CF	Percentage of critical facilities (2020 State NHMP data) buildings exposed to volcanic lahar hazard of any size based on USGS and DOGAMI lahar zones for Cascade volcanoes.	DOGAMI generated	Indicates the degree of disruption to critical facilities during a volcanic event and its aftermath.
Hist_count	Number of historic buildings.	OPRD/Historic Preservation	Indicates cultural significance in the area
WILDFIRE			
WF_pct_bld	Percentage of STATEWIDE BUILDING FOOOTPRINTS FOR OREGON buildings exposed to Medium and High Burn Probability based on PNW Quantitative database.	Oregon Dept. of Forestry/DOGAMI	Indicates the degree of disruption within the census tract, including harm to people and property.
WF_pct_CF	Percentage of critical facilities (2020 State NHMP data) buildings	Oregon Dept. of Forestry/DOGAMI	Indicates the degree of disruption to critical facilities during a flood

Indicator Name	Description	Data Source	Justification
	exposed to Medium and High Burn Probability based on PNW Quantitative database.		event and its aftermath.
BurnProb	Burn probability from the QPNW		
Hwy_WF_pct	Percentage of highway miles within High Burn Probability Zones		Addresses transportation and evacuation issues.
Hist_count	Number of historic buildings.	OPRD/Historic Preservation	Indicates cultural significance in the area
Over 90th	Mean number of days that are above the historic 90th percentile temp	OCCRI	Hot days contribute to fire risk,
Over90F	Mean number of days above 90 degrees Fahrenheit	OCCRI	Hot days contribute to fire risk.

9.2.4 Hazard Scenarios

Table 9.2.4-1: Hazard scenario data sources

Hazard	Data Name	Data Source
Earthquake	Liquefaction	Oregon Seismic Hazard Database (OSHD) – DOGAMI (Madin and others, 2021)
	CSZ Hazus Analysis (Co-seismic landslide and liquefaction, and NEHRP)	OSHD – DOGAMI (Madin and others, 2021)
	2475-year Hazus Analysis (4 ground motions)	OSHD – DOGAMI (Madin and others, 2021)
Flood & Coastal Flooding	Flood Hazard Area	FEMA – National Flood Hazard Program

Hazard	Data Name	Data Source
Channel Migration	Channel migration zones	DOGAMI (multiple pubs)
Tsunami	Tsunami inundation zones	DOGAMI (multiple pubs)
Landslide	Statewide Landslide susceptibility	DOGAMI (multiple pubs)
Wildfire	Burn probability	Oregon Dept. of Forestry (McEvoy and others, 2023)
	Wildfire annualized loss	National Risk Index
Volcano	Lahar inundation zones	USGS (Mt. Jefferson, Sisters, Crater Lake)
	Lahar inundation zones	Mt. Hood – DOGAMI (Burns and others, 2011)
Drought	Drought annualized loss	National Risk Index
Heat	Heat annualized loss	National Risk Index
	Tree canopy	USDA, US Forest Service

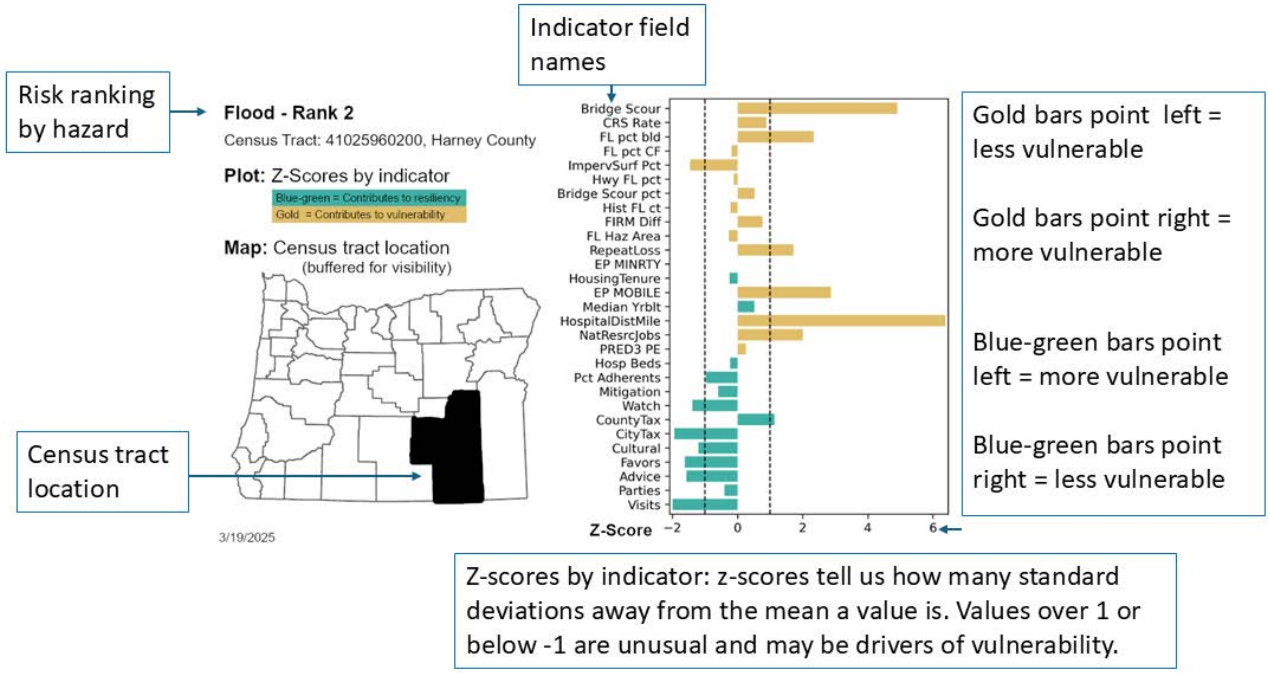
DRAFT prepared by: Matt Williams DOGAMI 12/3/2024

9.2.5 How to Interpret Risk Assessment Results Graphs

The following graphs show z-scores for the top 10 most vulnerable census tracts by hazard. A z-score measures how far away a value is from the mean or average of all values considered. In our case, the dataset includes all 993 Oregon inhabited census tracts, except for the coastal hazards which include 77 census tracts. So, for hazards except for coastal hazards, the z-score represents how far away the indicator value is away from the average of all Oregon census tracts. The z-scores for coastal hazards represents how far the indicator value is away from the average of all coastal census tracts. A z-score of 1 tells us that the indicator value is one standard deviation above the average, while a z-score of –1 tells us that the indicator value is one standard deviation below the average. Z-scores above or below 1 tell us that the indicator value is unusually high or low. These unusual values can be interpreted as drivers of risk or resilience.

Most of the indicators used in this model point towards vulnerability or increased risk. These are labeled on the map that introduces each hazard as “Direction.” A Direction of 1 tells us that the indicator contributes to vulnerability or risk. A Direction of –1 tells us that the indicator contributes to resilience. (Future versions of these graphs will color code which indicators point to more or less risk.). Figure 9.2.5-1 provides a visual explanation of the top 10 hazard graphs.

Figure 9.2.5-1: Visual explanation of how to interpret hazard graphs



9.3 Top 10 Census Tracts by Hazard

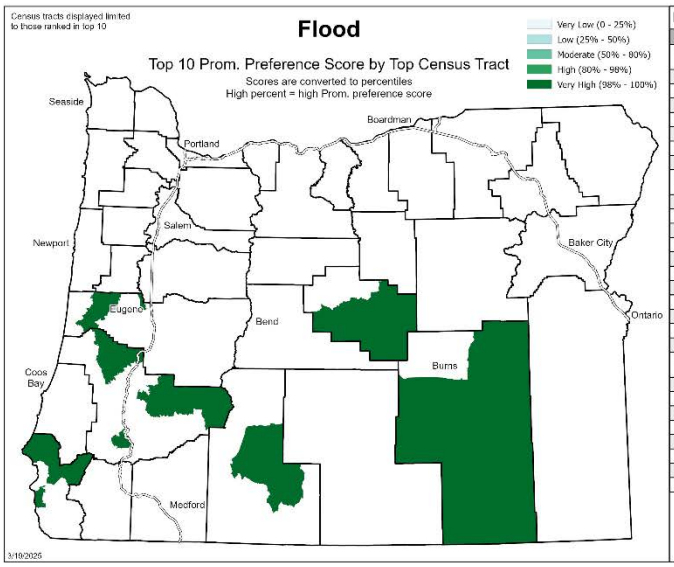
9.3.1 Riverine Flood

9.3.1.1 Hazard Scenario

Exposure was based on 1% annual chance floods as depicted on Federal Emergency Management Agency Flood Insurance Rate Maps. GIS layers were obtained from digital flood insurance rate maps, where possible. The Oregon Department of Geology and Mineral Industries digitized flood zones boundaries in areas where FEMA has not provided digitized information.

9.3.1.2 Top Ranked Riverine Flood Risk Areas

Figure 9.3.1-1: Top 10 flood hazard census tracts



Indicators used for the hazard Hazard indicators are worth 35% of the total weight.

Hazard	Indicator Name	Direction	Weight	Short Description
Flood	Bridge_Scour	1	0.032	Number of bridges that are at risk from scour during a 100-year flood.
Flood	CRS_Rate	1	0.032	Community Rating System (NFIP) score for communities.
Flood	FL_pct_bld	1	0.032	Percentage of SBFO buildings exposed to flooding.
Flood	FL_pct_CF	1	0.032	Percentage of critical facilities buildings exposed to flooding.
Flood	ImpervSurf_Pct	1	0.032	Percentage of impervious surface.
Flood	Hwy_FL_pct	1	0.032	Major roadways number of miles that are exposed to flood hazard.
Flood	Bridge_Scour_pct	1	0.032	Percentage of bridges that are scoured from a 100 year flood.
Flood	Hist_FL_ct	1	0.032	Percentage of historic buildings exposed to flooding.
Flood	FIRM_Diff	1	0.032	Number of years difference between median year built and FIRM date.
Flood	FL_Haz_Area	1	0.032	Area of tract in 100-year flood hazard.
Flood	RepeatLoss	1	0.032	Repetitive loss structures
General	EP_MINRTY	1	0.046	Percentage of Black, Indigenous, and People of Color (2020 Census).
General	HousingTenure	-1	0.046	Housing tenure from the US Census.
General	EP_MOBILE	1	0.046	Percentage of people that live in mobile homes
General	Median_Yrblt	1	0.046	Median year built of general building stock based on HAZUS default.
General	HospitalDistMile	1	0.046	Distance from tract centroid to nearest hospital.
General	NatResrcJobs	1	0.046	Rate of natural resource jobs.
General	PRED3_PE	1	0.046	Community Resilience Estimate
General	Hosp_Beds	-1	0.046	Estimated number of hospital beds based on square footage .
General	Pct_Adherents	-1	0.046	Percentage of members to a religious group
General	Mitigation	-1	0.046	Number of migitation projects (grouped by zip code and evenly distributed to overlaying tracts)
General	Watch	-1	0.046	Neighborliness: Will watch neighbor's house
General	CountyTax	-1	0.046	County tax rate
General	CityTax	-1	0.046	City tax rate
General	Cultural	-1	0.009	Number of cultural-related buildings
General	Favors	-1	0.009	Neighborliness: Willing to do favors for neighbor
General	Advice	-1	0.009	Neighborliness: Seeks advice from neighbor
General	Parties	-1	0.009	Neighborliness: Attended parties that occur in neighborhood
General	Visits	-1	0.009	Neighborliness: Has visited neighbor's house

Table 9.3.1-1: Oregon Natural Hazard Risk Assessment Rank Compared to the National Risk Index

Census Tract Number	County in which census tract is located	Oregon Risk Assessment Rank – Riverine Flood	National Risk Index Classification*	People Exposed to 1% annual chance flood**
41039000500	Lane	1	Relatively moderate	667
41025960200	Harney	2	Relatively low	159
41035970201	Klamath	3	Relatively high	178
41015950201	Curry	4	Relatively high	186

Census Tract Number	County in which census tract is located	Oregon Risk Assessment Rank – Riverine Flood	National Risk Index Classification*	People Exposed to 1% annual chance flood**
41039000404	Lane	5	Relatively high	2387
41015950100	Curry	6	Relatively high	90
41019030000	Douglas	7	Relatively high	821
41019100000	Douglas	8	Relatively high	156
41013950402	Crook	9	Relatively low	53
41019200000	Douglas	10	Relatively high	235

*Compared to census tracts nationwide

** From NRI, accessed on 2/5/2025, 03/25/2025

Table 9.3.1-2: Top 10 Census Tract Demographics

Census Tract	Flood Risk Rank	2020 Population[1]	2023 Population[2]	% Change in Population	2016 SVI[3]	2022 SVI[4]	Change in SVI
41039000500	1	2244	2148	-4%	0.53	0.56	0.02
41025960200	2	2165	2261	4%	0.50	0.71	0.21
41035970201	3	2012	1450	-28%	#N/A	0.41	#N/A
41015950201	4	3513	3730	6%	#N/A	0.80	#N/A
41039000404	5	4010	4409	10%	0.83	0.74	-0.08
41015950100	6	3296	3226	-2%	0.66	0.56	-0.10
41019030000	7	4047	4107	1%	0.39	0.35	-0.04
41019100000	8	3103	3283	6%	0.56	0.56	0.00
41013950402	9	2397	2739	14%	#N/A	0.51	#N/A
41019200000	10	4902	4912	0%	0.87	0.91	0.04

[1] 2020 Decennial Census Census Tract Level Population Data HC2020.P1 - 2020 data was used rather than 2018 due to changes in census tract boundaries in 2020

[2] 2023 ACS 5-Year Estimates Census Tract Level Age and Sex Data S0101

[3] 2016 US CDC Social Vulnerability Index - "#N/A" cells represent census tracts that did not exist before changes to census tract boundaries in 2020

[4] 2022 US CDC Social Vulnerability Index

Flood Risk Rank 1 – Lane County, Mapleton vicinity 41039000500

This rural census tract includes the unincorporated community of Mapleton. The NRI reports a moderate risk of flooding, with a score of 89. Approximately 30% of the census tract population is exposed to flood risk (667 people). The Oregon risk assessment shows a much higher than statewide average repetitive losses due to flood. A higher than stateside average percent of buildings in the census tract are exposed to flood risk. The risk assessment also shows a higher than stateside average highway miles, bridge scour potential. Hospital distance is further than statewide average. The census tract has a higher-than-average CRE score (PRED3_PE) and lower social cohesion scores (Watch, Favors, Advice, Parties, Visits) indicating relatively high social vulnerability.

Figure 9.3.1-2: First ranked census tract for flood hazard

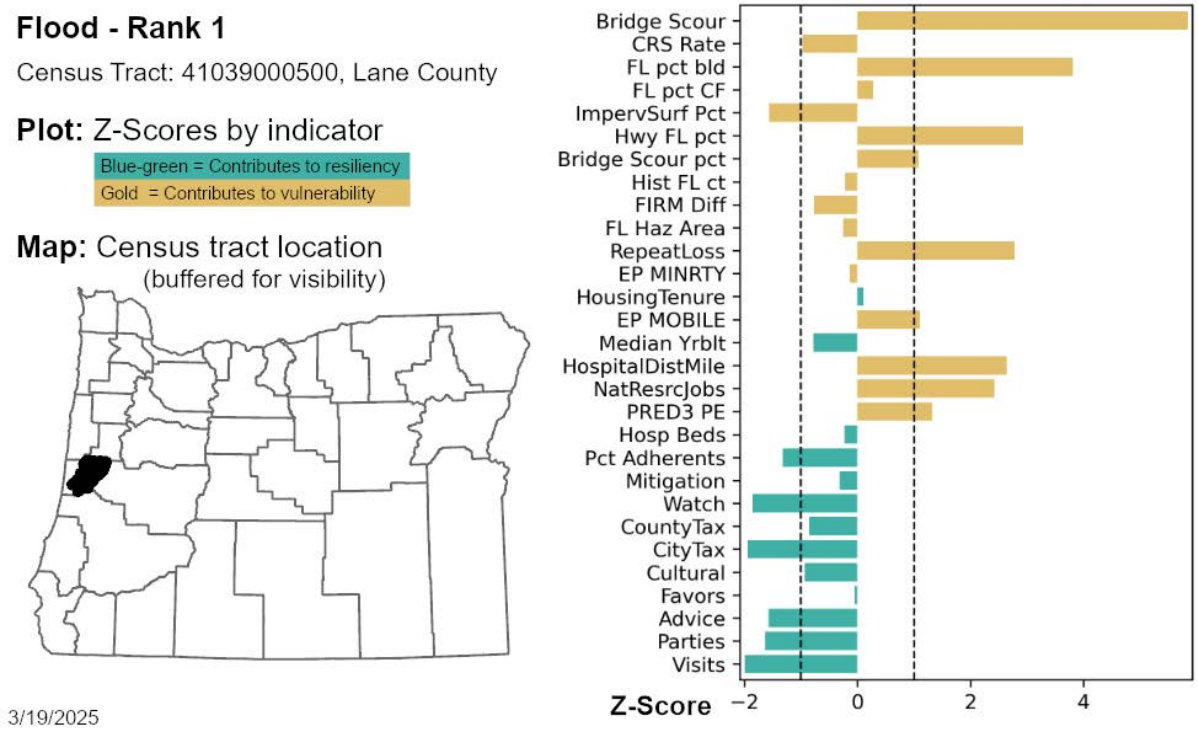


Table 9.3.1-3: Critical facilities identified in 1% annual chance flood zone

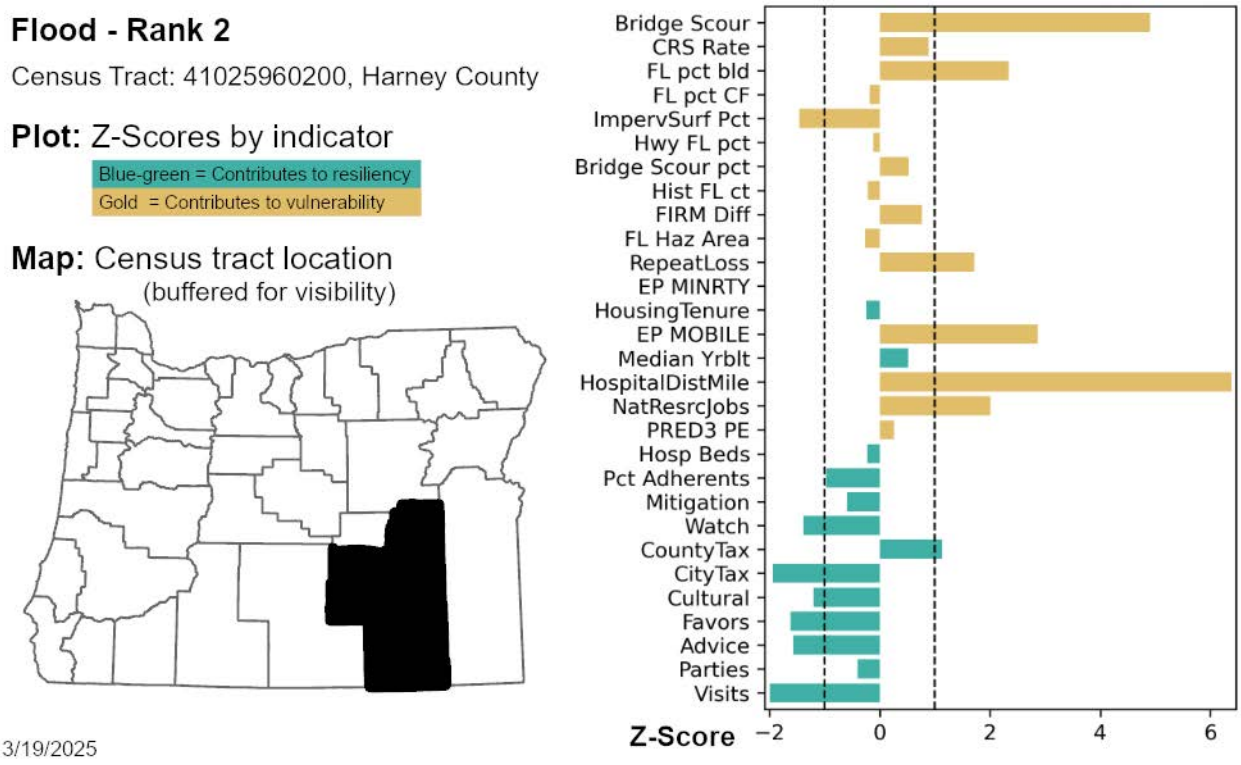
	Building Name 41039000500	Value ($)	Flood Losses ($)
Critical Facility	Mapleton Fire Department	143,695	15,530
Critical Facility	Mapleton School	70,416	6,843
Critical Facility	Swisshome Deadwood RFPD Station 2	82,008	

No state-owned buildings located in the 1% annual chance flood zone.

Flood Rank 2 – Harney County, unincorporated area south of the City of Burns 41025960200

This large census tract is in Harney County, south of the City of Burns. It rural and flat. The NRI reports a relatively low risk due to riverine flooding, with a score of 57.3. About 7 percent of the census tract population is exposed to flood hazards. The census tract has a higher than statewide average of proportion of building stock exposed to flood, and a higher than statewide average of repetitive losses. Hospitals are further away than for most census tracts. There are a higher proportion of natural resource jobs than the statewide average. County property tax rates are lower than statewide average. Social cohesion scores are also lower than statewide average.

Figure 9.3.1-3: Second ranked census tract for flood hazard

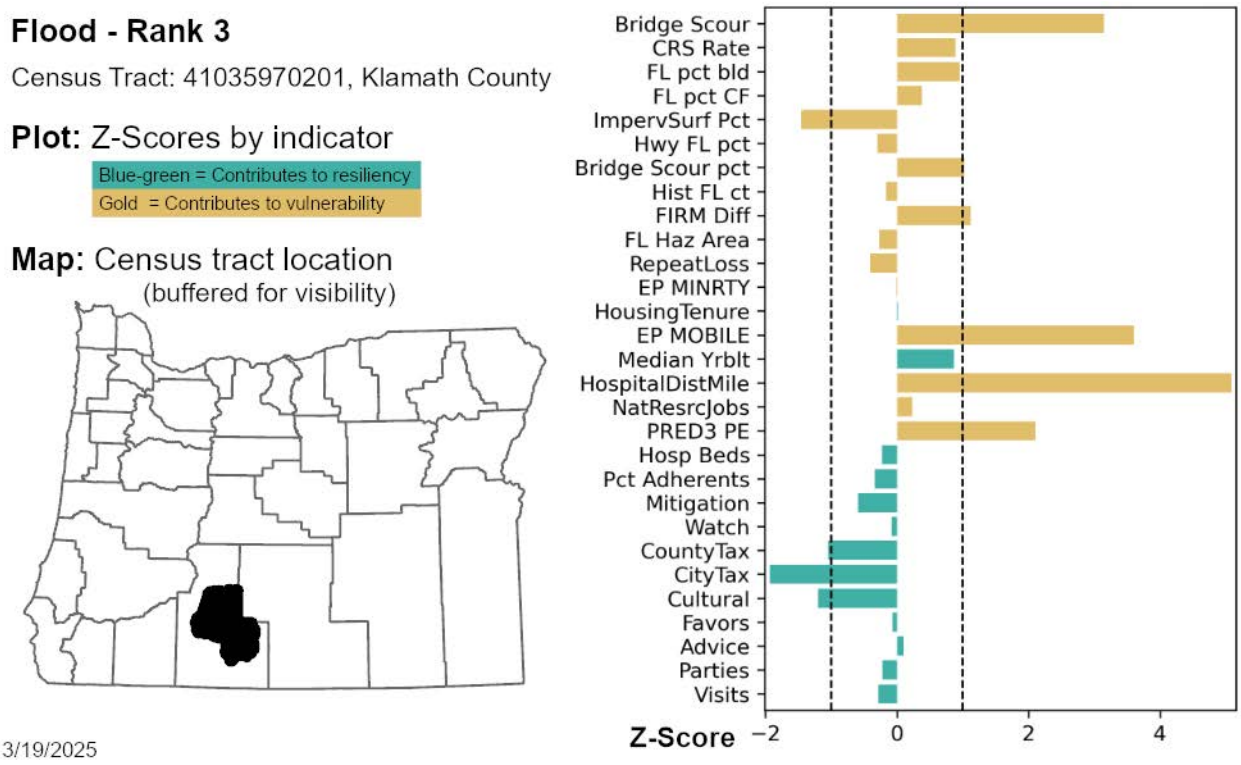


No state-owned buildings or critical facilities identified in the 1% annual chance flood zone.

Flood Rank 3 – Klamath County unincorporated area east of Chiloquin 41035970201

This extremely rural census tract has a relatively high NRI riverine flood rating of 96.1, with approximately 9% of the census tract population exposed to a flood hazard. Flood risk is driven by a much higher than statewide average percent of bridges with scour potential, and a much higher than statewide average percent of mobile homes. The CRE score indicates a lack of community resilience. Census Bureau reports that over half the population is over the age of 65. Distances to a hospital are above statewide average.

Figure 9.3.1-4: Third ranked census tract for flood hazard



No state-owned buildings or critical facilities identified in the 1% annual chance flood zone. 41035970201

Flood Rank 4 – Curry County including the City of Gold Beach 41015950201

This census tract includes the City of Gold Beach. The NRI ranks this census tract as having a relatively high riverine flood risk, with a score of 98.5. About 5 percent of the census tract population is potentially directly exposed to riverine floods. The riverine flooding source is Hunter Creek. The census tract is characterized by above statewide average repetitive losses, mobile homes, and natural resource jobs. County property tax rates are significantly lower than the statewide average whereas city taxes are just slightly below. “People associated with religious organizations” is below the statewide average, but “community cohesion” is about average.

Figure 9.3.1-5: Fourth ranked census tract for flood hazard

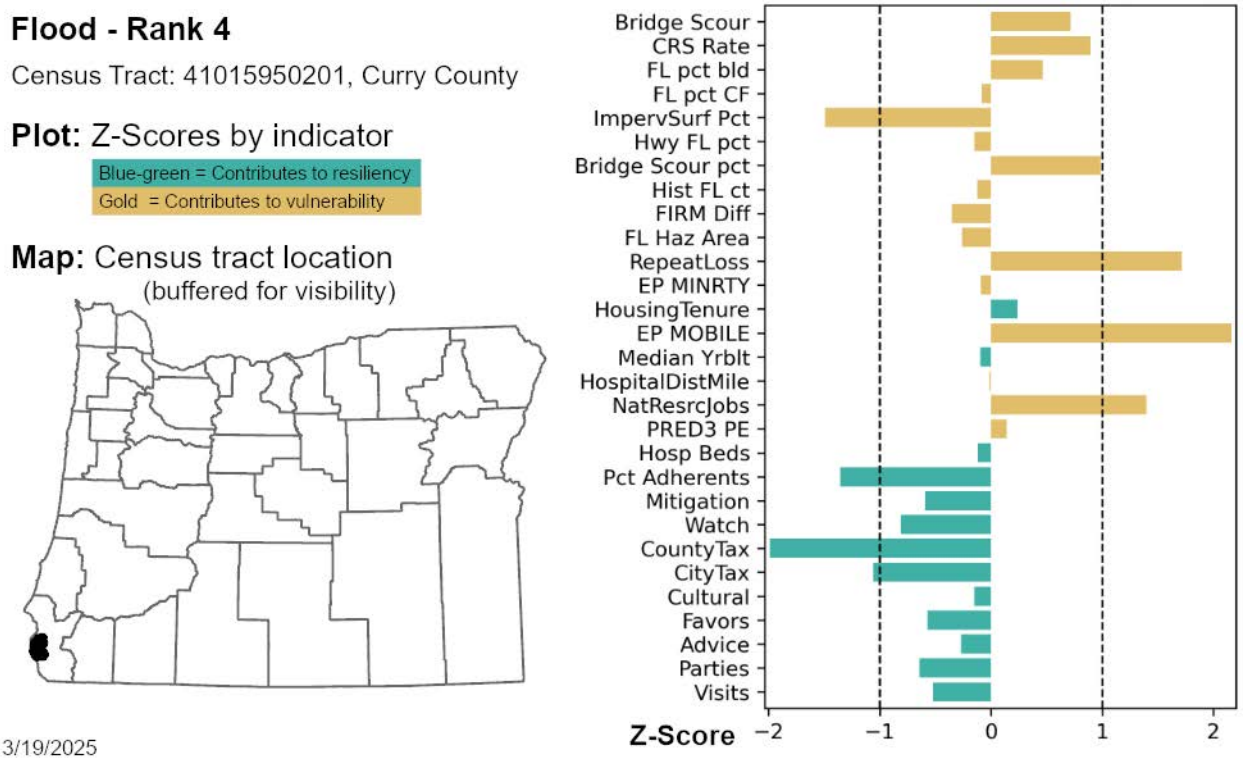


Table 9.3.1-4: Critical facilities identified in 1% annual chance flood zone

	Building Name 41015950201	Value ($)	Flood Losses ($)
Critical facility	Gold Beach Muni	2,088,716	484,641
Critical facility	Communications Structure	1,679,700	259,953

No state-owned building located in the 1% annual chance flood zone.

Flood Rank 5 – Lane County, Junction City to Harrisburg 41039000404

This census tract includes portions of Junction City and the City of Harrisburg, including part of the Junction City State Hospital campus. The census tract is characterized by a mix of urban development and agricultural land. The NRI reports a relatively high risk of flooding, with a score of 97. Almost 60 percent of the census tract population is exposed to flood risk according to the NRI (2387 people). The Oregon risk assessment confirms the extent of potential flooding with flood area, exposed buildings, exposed critical facilities, and exposed highway miles far exceeding statewide average. Bridge scour potential also exceeds statewide average. CRE is similar to statewide average while social cohesion indicator values are slightly below statewide average.

Figure 9.3.1-6: Fifth ranked census tract for flood hazard

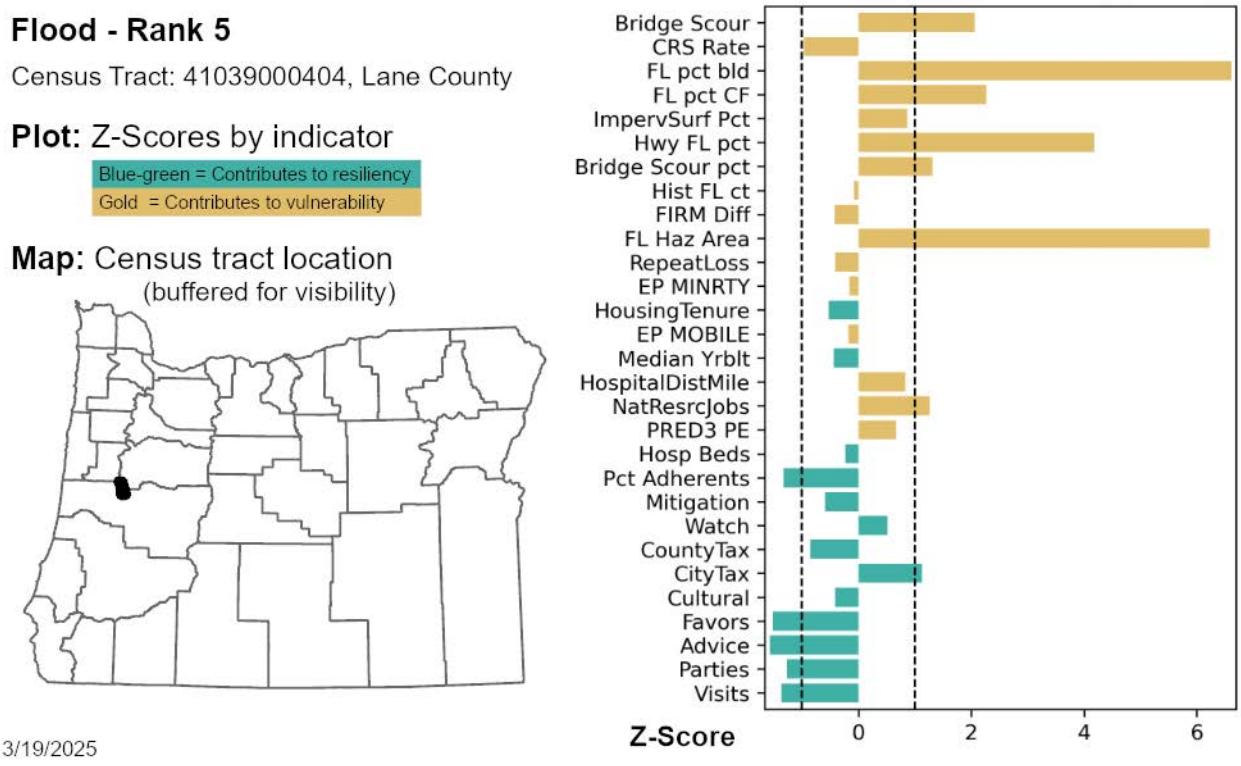


Table 9.3.1-5: State-owned buildings and critical facilities identified in 1% annual chance flood zone

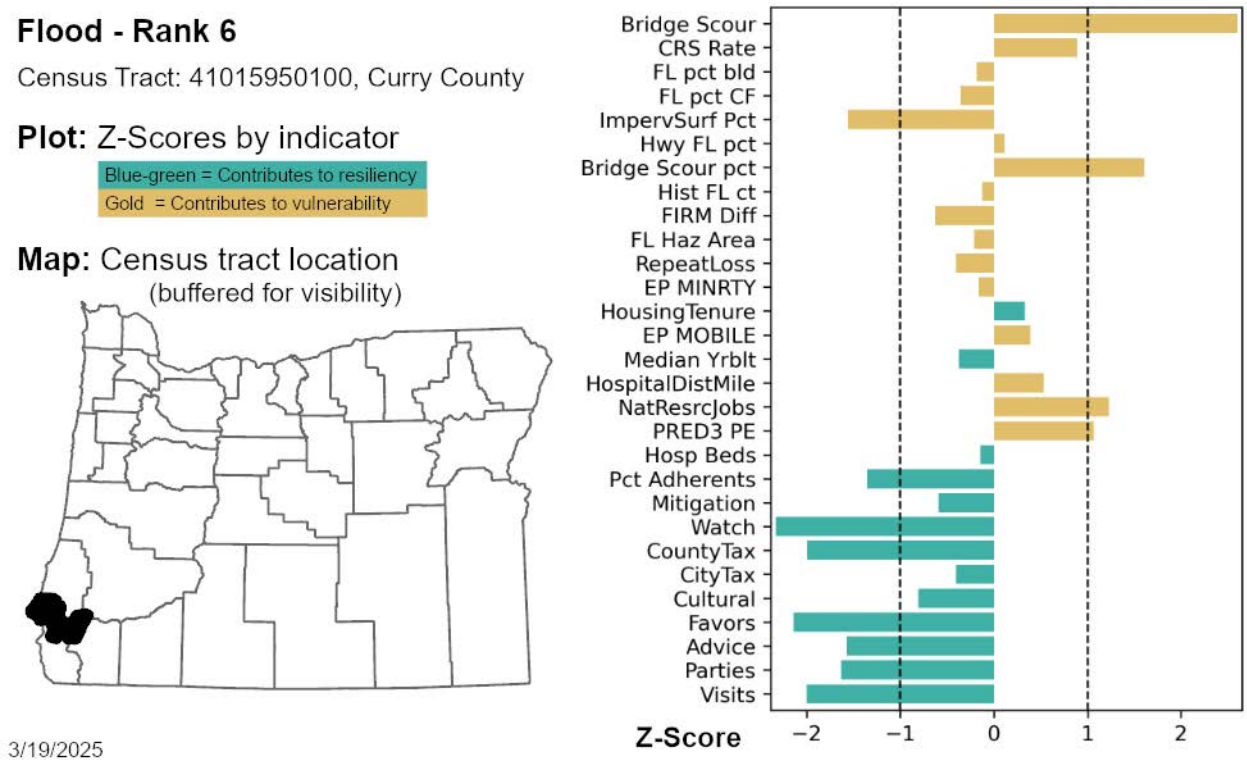
	Building Name 41039000404	Value ($)
State-owned	State Hospital Junction City	117,098,414
State-owned	Marshall Island Boat Ramp, Park, Restrooms	69,239
Critical Facility	Nature Discovery School	1,430,250

	Building Name 41039000404	Value ($)
Critical Facility	Junction City Public Works	1,564,800
Critical Facility	Communications Structure	750,000
Critical Facility	Communications Structure	3,114,600

Flood Rank 6 – Curry County, including Port Orford 41015950100

This largely rural census tract includes the small city of Port Orford. The main drivers of vulnerability appear to be percent and miles of bridges exposed to scour. Social factors indicate potential social vulnerabilities and a lack of community cohesion. Taxes in the unincorporated portion of the tract are very low compared to other counties indicating a lack of government capacity to develop mitigation projects.

Figure 9.3.1-7: Sixth ranked census tract for flood hazard



No state-owned buildings or critical facilities located in the 1% annual chance flood zone.

Flood Rank 7 – Douglas County, Drain, Elkton, and coastal mountains west of Drain 41019030000

This census tract includes the small cities of Drain and Elkton and the rural area in between. The FEMA NRI ranks this census tract as at very high flood risk with a score of 98.6. The NRI estimates that approximately 20% of the census tract population is exposed to a flood hazard (821 people). The Oregon risk assessment shows a larger than average percent of highway miles in the flood zone with very high percent of bridges in the census tract subject to scour. A higher-than-statewide average estimated percentage of mobile homes and buildings located in the flood zone increases risk. Residents have a higher-than-statewide average distance to hospitals. Both city and county tax rates are lower than the statewide average.

Figure 9.3.1-8: Seventh ranked census tract for flood hazard

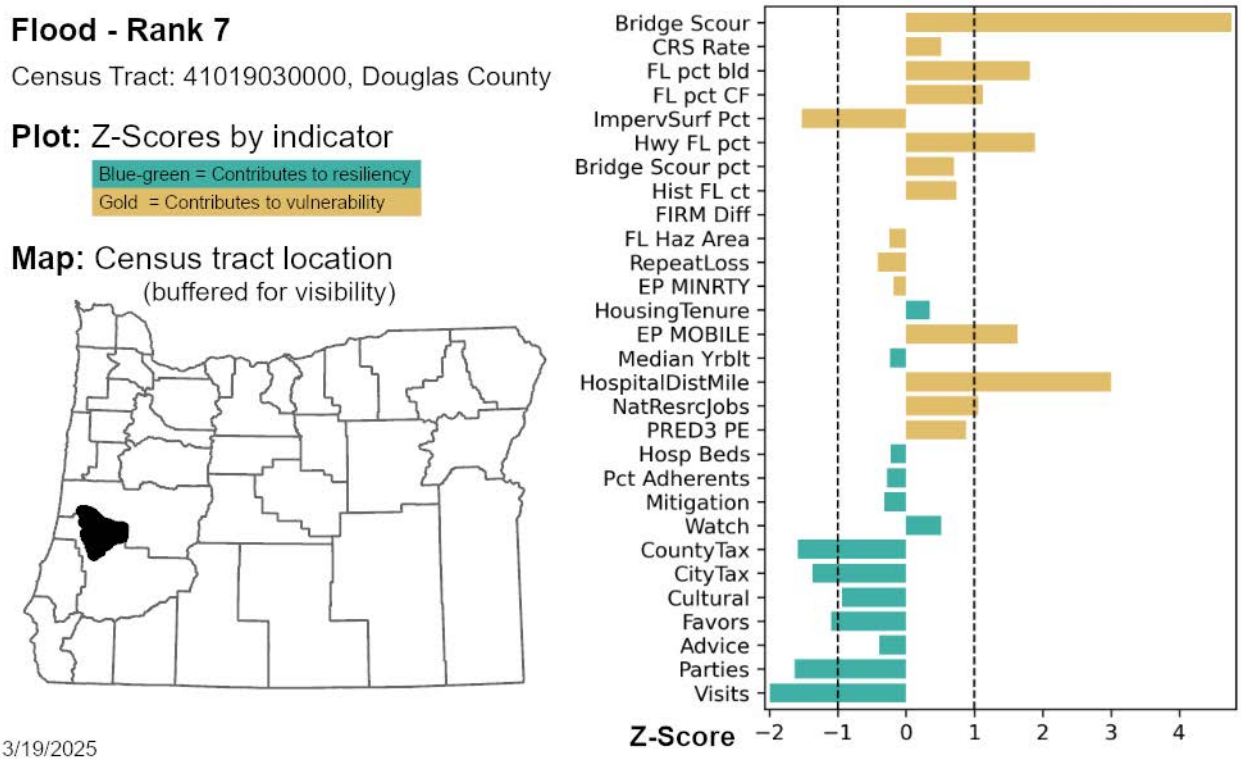


Table 9.3.1-6: State-owned buildings or critical facilities identified in 1% annual chance flood zone

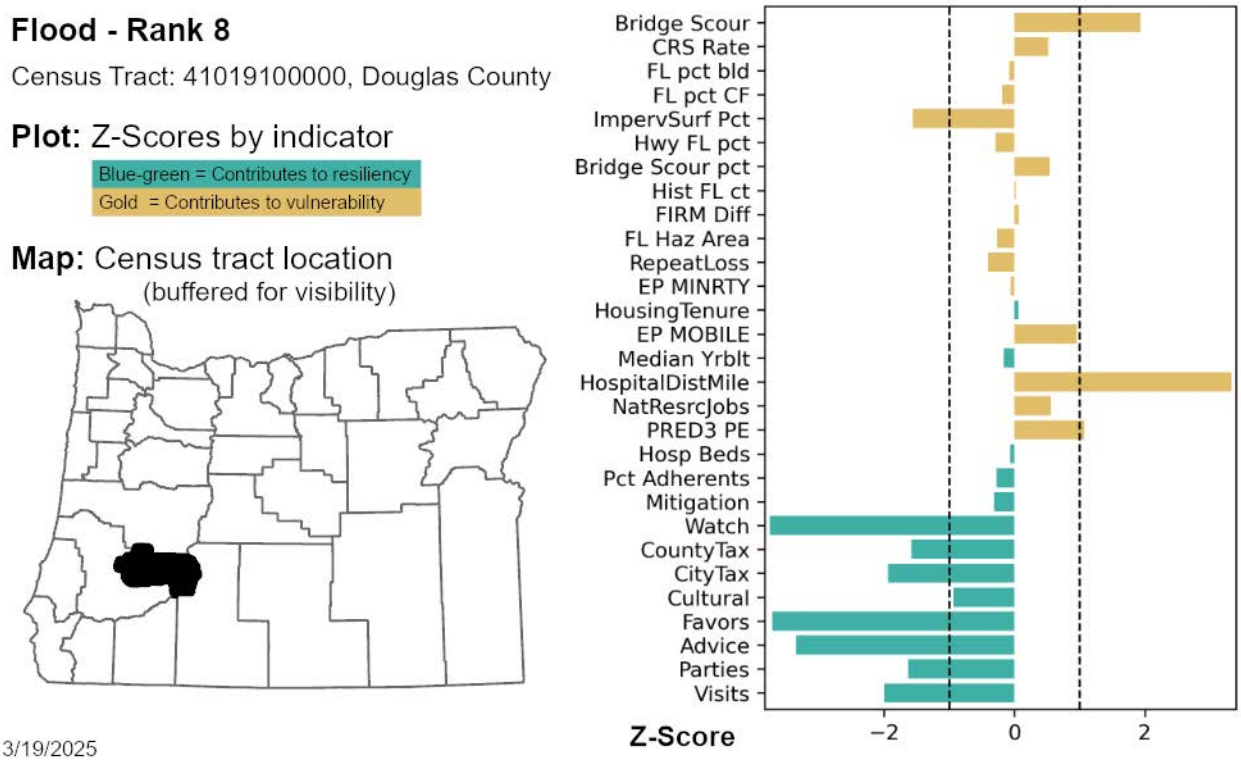
	Building Name 41019030000	Value ($)
State-owned	Unknown	95,675
State-owned	Unknown	136,002
Critical facility	Douglas County Sheriff's Office, Drain Substation	786,450
Critical facility	Drain STP	125,100
Critical facility	Drain City Shop	1,342,950

	Building Name 41019030000	Value ($)
Critical facility	Douglas County Public works	854,850
Critical facility	Douglas County Fire & EMS, annex	190,950
Critical facility	Douglas County Fire & EMS	1,102,200
Critical facility	Elkton High School	4,927,950

Flood Rank 8 – Douglas County, largely rural census tract along Umpqua River 41019100000

This rural census tract includes the small city of Glide and numerous recreational and camping sites along Highway 138. The highway follows close to the river. Hwy 138 links the City of Roseburg to Highway 97 to the east. The FEMA mapped floodplain is mostly centered on the City of Glide with the rural area floodplain left unmapped. The primary flood source is the Umpqua River. The NRI classifies the flood risk in the census tract as relatively high on a national scale, with a score of 93.3. Approximately 5 percent of the census tract population is expected to be affected (156 people). About half the population in this census tract lives in or very near the City of Glide. The Oregon risk assessment results are dominated by very low social cohesion scores, although these may be an artefact of about a third of the residents being over 65 years of age, and therefore not surveyed in the PRAMS protocol. City and county tax rates are lower that the statewide average.

Figure 9.3.1-9: Eighth ranked census tract for flood hazard

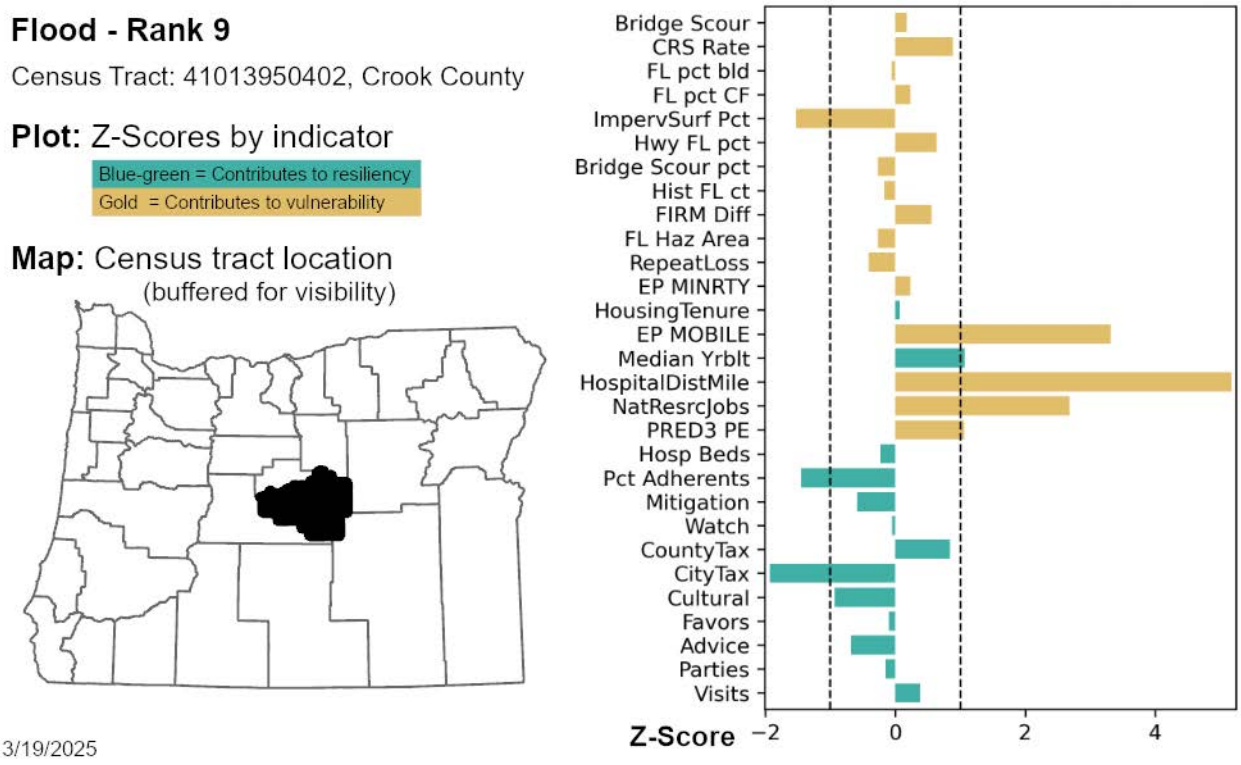


No state-owned buildings or critical facilities identified in the 1% annual chance flood zone.

Flood Rank 9 – Crook County, including the city of Prineville 41013950402

Vulnerabilities in this census tract center on a high rate of mobile homes, long distances to medical attention, and a high percentage of natural resource jobs. City tax rates are quite low compared to other cities in Oregon.

Figure 9.3.1-10: Ninth ranked census tract for flood hazard

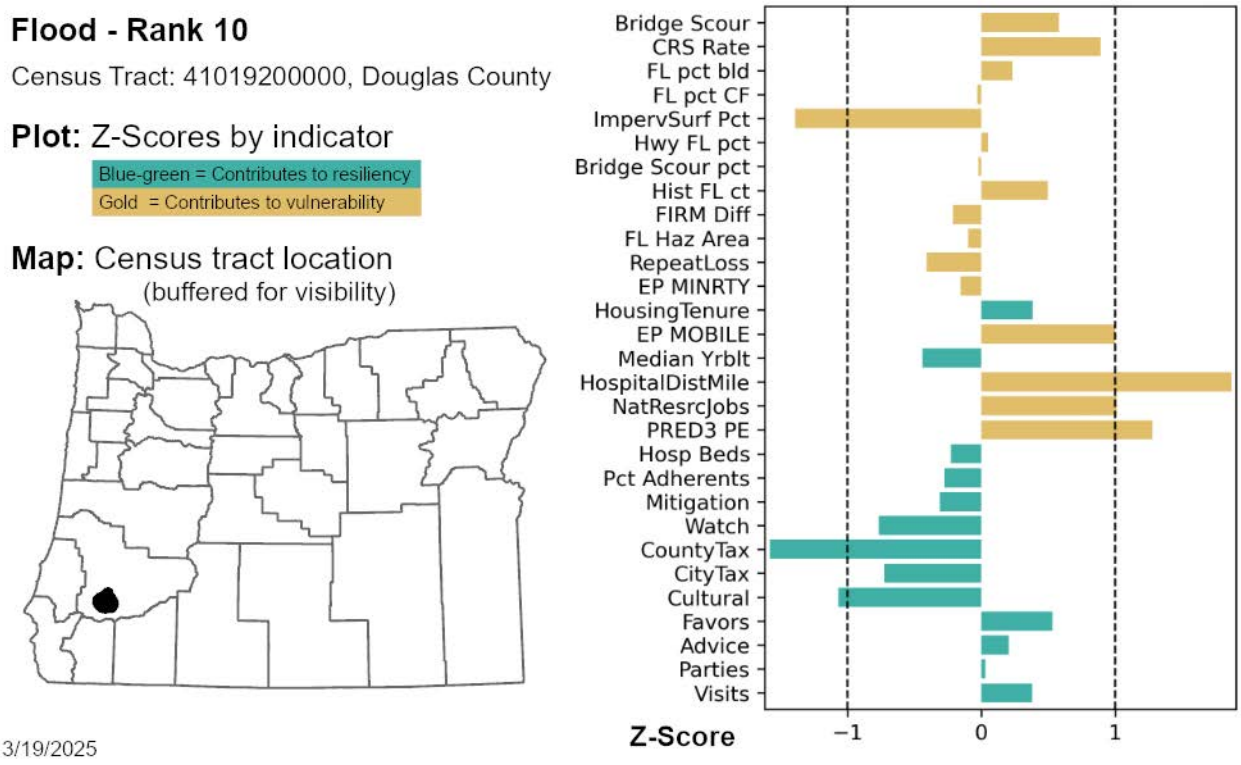


No state-owned buildings or critical facilities identified in the 1% annual chance flood zone.

Flood Rank 10 – Douglas County 41019200000

This is a mostly rural census tract that includes the small cities if Canyonville and Riddle. Vulnerabilities in this census tract arise from high social vulnerabilities and very low county tax rates. Distances to hospitals are long.

Figure 9.3.1-11: Tenth ranked census tract for flood hazard



No state-owned buildings or critical facilities identified in the 1% annual chance flood zone.

9.3.2 Coastal Zone Hazards

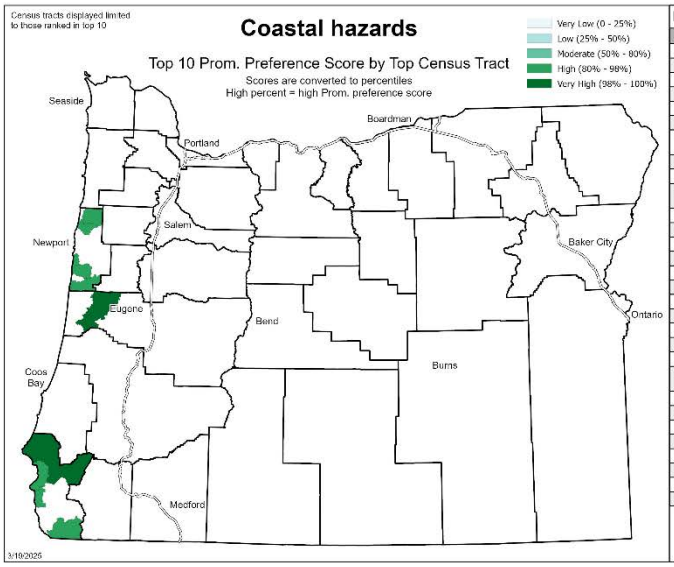
"Coastal hazards" includes coastal erosion zones and FEMA 1% annual chance flood zones for riverine and oceanfront velocity zones.

9.3.2.1 Hazard Scenario

Exposure was based on 1% annual chance floods as depicted on Federal Emergency Management Agency Flood Insurance Rate Maps. GIS layers were obtained from digital flood insurance rate maps. "Coastal hazards" also includes coastal erosion obtained from the Oregon Department of Geology and Mineral Industries.

9.3.2.2 Top Ranked Coastal Flood Risk Areas

Figure 9.3.2-1: Top Ranked Risk Areas in the Coastal Zone



Indicators used for the hazard Hazard indicators are worth 35% of the total weight.

Hazard	Indicator Name	Direction	Weight	Short Description
Coastal hazards	CFL_pct_bld	1	0.029	Percentage of SBFO buildings exposed to coastal flooding.
Coastal hazards	Hwy_FL_pct	1	0.029	Major roadways number of miles that are exposed to flood hazard.
Coastal hazards	CFL_pct_CF	1	0.029	Percentage of critical facilities exposed to coastal flooding.
Coastal hazards	Hist_CE_ct	1	0.029	Percentage of historic buildings exposed to coastal erosion.
Coastal hazards	SBFO_CE_pct	1	0.029	Percentage of SBFO buildings exposed to coastal erosion.
Coastal hazards	Port	1	0.029	Presence of marine port infrastructure
Coastal hazards	Bridge_Scour	1	0.029	Number of bridges that are at risk from scour during a 100-year flood.
Coastal hazards	CRS_Rate	1	0.029	Community Rating System (NFIP) score for communities.
Coastal hazards	ImpervSurf_Pct	1	0.029	Percentage of impervious surface.
Coastal hazards	FIRM_Diff	1	0.029	Number of years difference between median year built and FIRM date.
Coastal hazards	FL_Haz_Area	1	0.029	Area of tract in 100-year flood hazard.
Coastal hazards	RepeatLoss	1	0.029	Repetitive loss structures
General	EP_MINRTY	1	0.046	Percentage of Black, Indigenous, and People of Color (2020 Census).
General	HousingTenure	-1	0.046	Housing tenure from the US Census.
General	EP_MOBILE	1	0.046	Percentage of people that live in mobile homes
General	Median_Yrblt	-1	0.046	Median year built of general building stock based on HAZUS default.
General	HospitalDistMile	1	0.046	Distance from tract centroid to nearest hospital.
General	NatResrcJobs	1	0.046	Rate of natural resource jobs.
General	PRED3_PE	1	0.046	Community Resilience Estimate
General	Hosp_Beds	-1	0.046	Estimated number of hospital beds based on square footage .
General	Pct_Adherents	-1	0.046	Percentage of members to a religious group
General	Mitigation	-1	0.046	Number of migitation projects (grouped by zip code and evenly distributed to overlaying tracts)
General	Watch	-1	0.046	Neighborliness: Will watch neighbor's house
General	CountyTax	-1	0.046	County tax rate
General	CityTax	-1	0.046	City tax rate
General	Cultural	-1	0.009	Number of cultural-related buildings
General	Favors	-1	0.009	Neighborliness: Willing to do favors for neighbor
General	Advice	-1	0.009	Neighborliness: Seeks advice from neighbor
General	Parties	-1	0.009	Neighborliness: Attended parties that occur in neighborhood
General	Visits	-1	0.009	Neighborliness: Has visited neighbor's house

Table 9.3.2-1: Oregon Natural Hazard Risk Assessment Rank Compared to the National Risk Index

Census Tract	County	Oregon Rank Coastal Hazards	National Risk Index Classification*	People Exposed to Coastal Flooding **
41039000500	Lane	1	Relatively moderate	3
41015950100	Curry	2	Relatively low	111
41015950201	Curry	3	Relatively moderate	95
41015950202	Curry	4	Relatively moderate	49

Census Tract	County	Oregon Rank Coastal Hazards	National Risk Index Classification*	People Exposed to Coastal Flooding **
41041951700	Lincoln	5	Relatively low	71
41041950601	Lincoln	6	Relatively high	338
41041950100	Lincoln	7	Relatively moderate	19
41041951200	Lincoln	8	Relatively moderate	47
41015950401	Curry	9	Relatively moderate	41
41041951500	Lincoln	10	Relatively moderate	128

*Compared to census tracts nationwide

**From the FEMA NRI

Table 9.3.2-2: Top 10 Census Tract Demographics

Census Tract	Coastal Flooding Risk Rank	2020 Population[1]	2023 Population[2]	% Change in Population	2016 SVI[3]	2022 SVI[4]	Change in SVI
41039000500	1	2244	2148	-4%	0.53	0.56	0.02
41015950100	2	3296	3226	-2%	0.66	0.56	-0.10
41015950201	3	3513	3730	6%	#N/A	0.80	#N/A
41015950202	4	1923	2074	8%	#N/A	0.34	#N/A
41041951700	5	2475	2163	-13%	0.67	0.77	0.11
41041950601	6	2662	2758	4%	0.35	0.28	-0.08
41041950100	7	3450	2639	-24%	0.55	0.66	0.11
41041951200	8	2166	2501	15%	0.24	0.46	0.22
41015950401	9	2925	2723	-7%	#N/A	0.53	#N/A
41041951500	10	2953	3040	3%	0.19	0.21	0.02

[1] 2020 Decennial Census Census Tract Level Population Data HC2020.P1 - 2020 data was used rather than 2018 due to changes in census tract boundaries in 2020

[2] 2023 ACS 5-Year Estimates Census Tract Level Age and Sex Data S0101

[3] 2016 US CDC Social Vulnerability Index - "#N/A" cells represent census tracts that did not exist before changes to census tract boundaries in 2020

[4] 2022 US CDC Social Vulnerability Index

Coastal Flood Rank 1, Lane County in the vicinity of Mapleton 41039000500

This rural census tract includes the unincorporated community of Mapleton. The NRI reports a relatively moderate risk of coastal and riverine flooding, with a score of 94.7 and 89 respectively. Approximately 30% of the census tract population is exposed to flood risk (669 people). The Oregon risk assessment shows a much higher than statewide average repetitive losses due to flood. A higher than stateside average percent of buildings in the census tract are exposed to flood risk. The risk assessment also shows a higher than stateside average highway miles, bridge scour potential. Hospital distance is further than statewide average. The census tract has a higher-than-average CRE score and lower social cohesion scores indicating social vulnerability.

Figure 9.3.2-2: First ranked census tract for coastal hazards

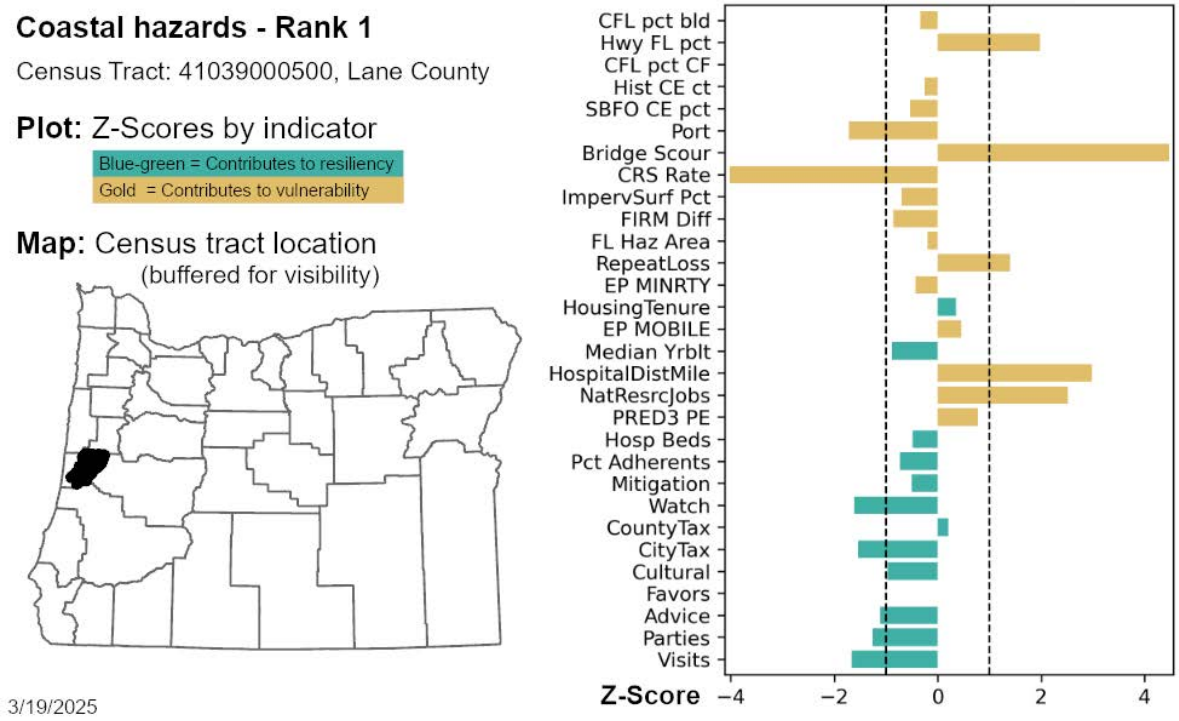


Table 9.3.2-3: Critical Facilities identified in the coastal hazard zone

	Building Name 41039000500	Value	Flood Losses
Critical facility	Mapleton Fire Department	143,695	15,530
Critical facility	Mapleton School	70,416	6,843
Critical facility	Swisshome Deadwood RFPD Station 2	82,008	

No state-owned buildings identified in the coastal hazard zone.

Coastal Flood Risk 2 – Curry County including Port Orford 41015950100

This rural census tract includes the City of Port Orford. The NRI classifies the census tract as low risk for coastal flood and high risk of riverine flood, with scores of 92.3 and 97.5 respectively. Three percent of the census tract population is exposed to these hazards. The Oregon risk assessment indicates that risk is driven by high bridge scour potential, high number of natural resources jobs, low county tax rates, and low social cohesion relative to other coastal census tracts.

Figure 9.3.2-3: Second ranked census tract for coastal hazards

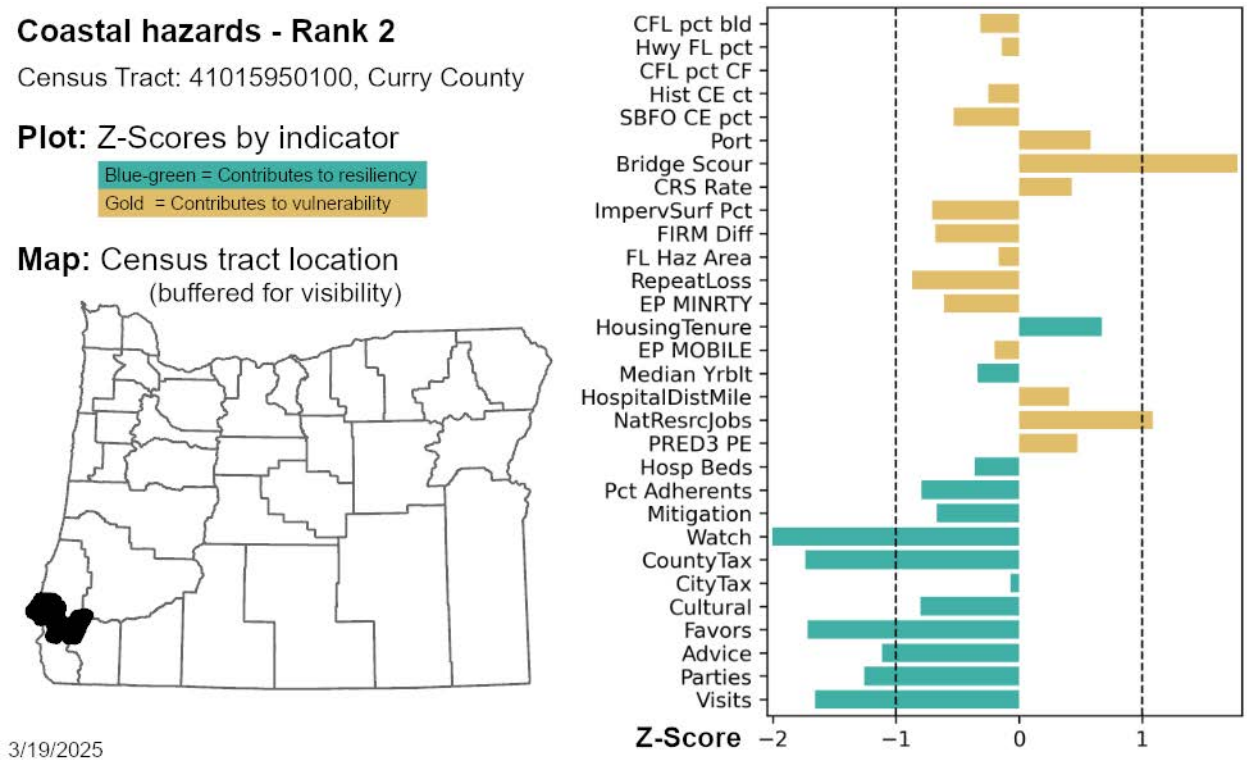


Table 9.3.2-4: State-owned Buildings identified in the coastal hazard zone

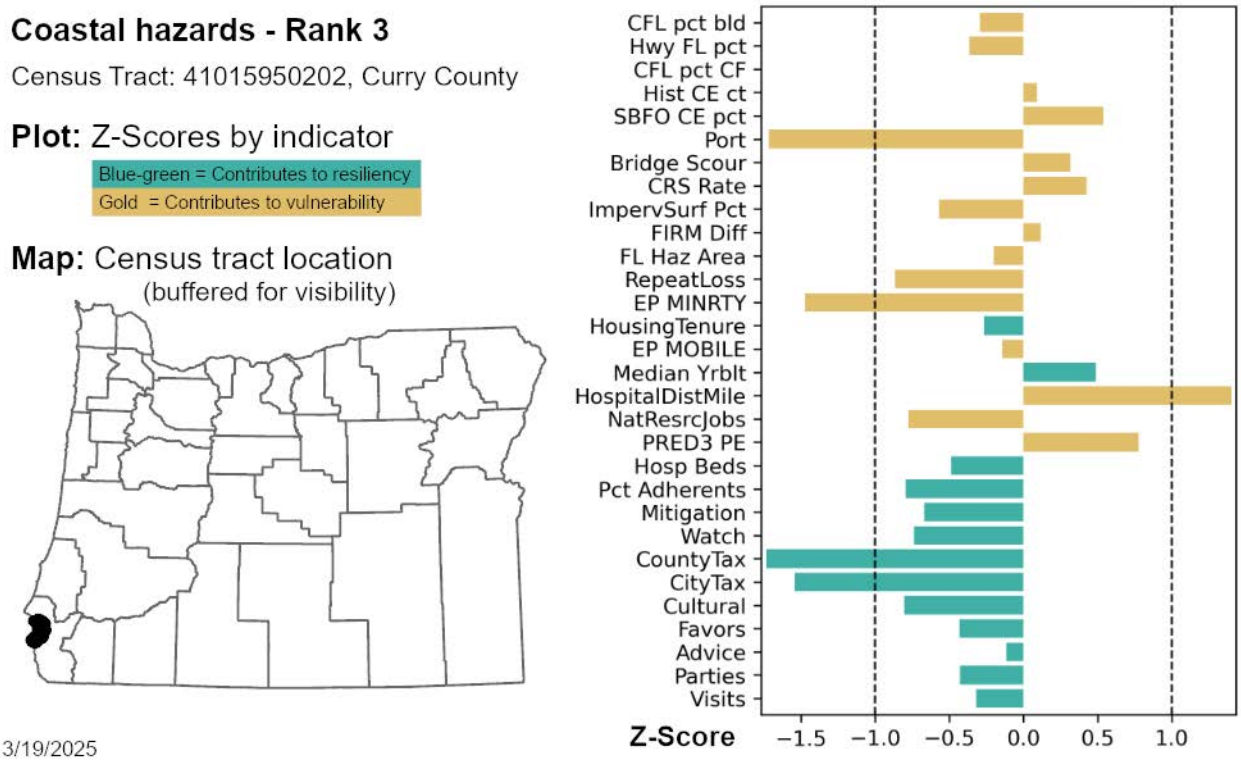
	Building Name 41015950100	Value ($)
State-owned	Communications Structure	463,050
State-owned	Cape Blanco Airport	60,668

No critical facilities located in the coastal hazard zone.

Coastal Flood Rank 3 -- Curry County including the unincorporated communities of Nesika and Wedderburn, north of the City of Gold Beach 41015950202

This census tract is mostly rural but includes the unincorporated communities of Nesika and Wedderburn. The NRI rates the census tract as having a moderate risk of coastal flooding and a very high risk of riverine flooding, with scores of 94.1 and 99.1 respectively. Approximately 12 percent of the census tract population is exposed to flood risk (224 people). The Oregon risk assessment indicates that drivers of risk include long distance to a hospital and low county tax rates when compared to other coastal census tracts.

Figure 9.3.2-4: Third ranked census tract for coastal hazards



No state-owned buildings or critical facilities identified in the coastal hazard zone.

Coastal Flooding Rank 4 – Curry County, including Gold Beach 41015950201

This coastal census tract includes the City of Gold Beach. The NRI ranks this census tract as having moderate coastal flood risk and high riverine flood risk, with scores of 93.5 and 98.5 respectively. Eight percent of the census tract population is exposed to these hazards (281 people). The Oregon risk assessment indicates that a high number of mobile homes, high number of natural resource jobs, and low county tax rates drive risk when compared to other coastal census tracts.

Figure 9.3.2-5: Fourth ranked census tract for coastal hazards

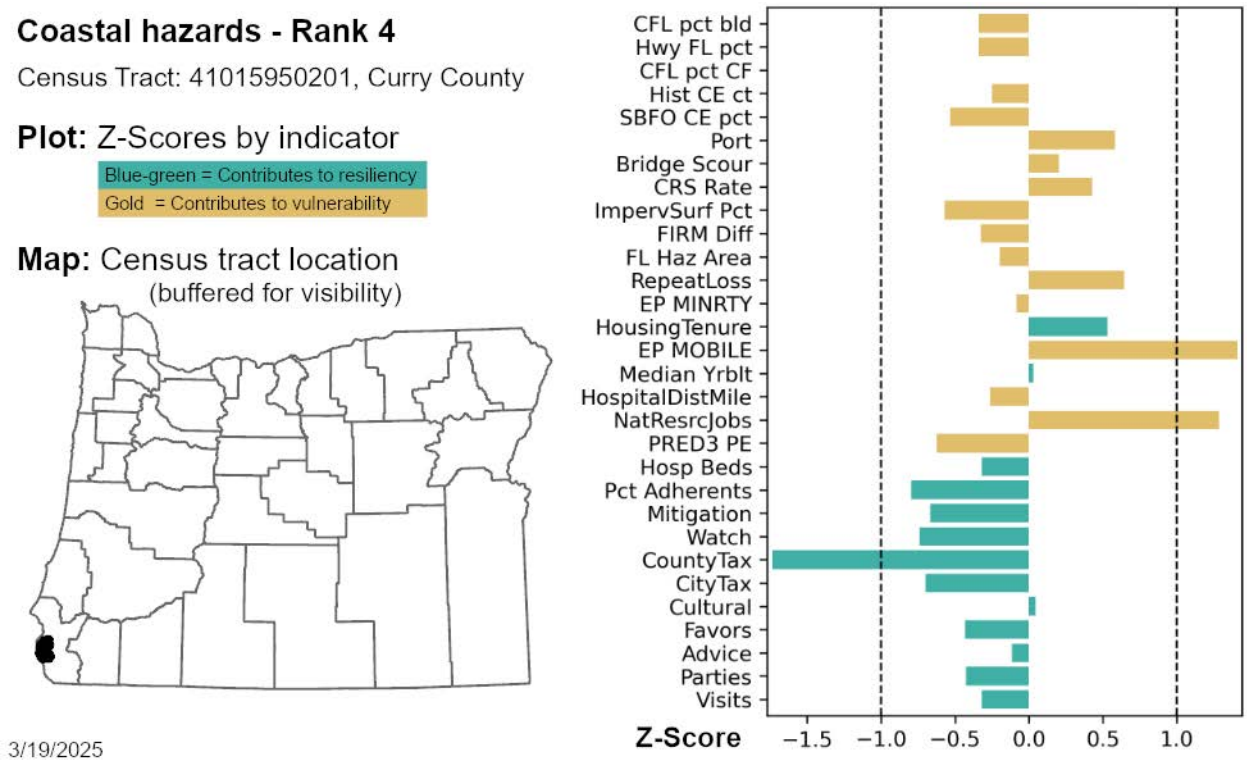


Table 9.3.2-5: Critical Facilities identified in the Coastal Hazard Zone

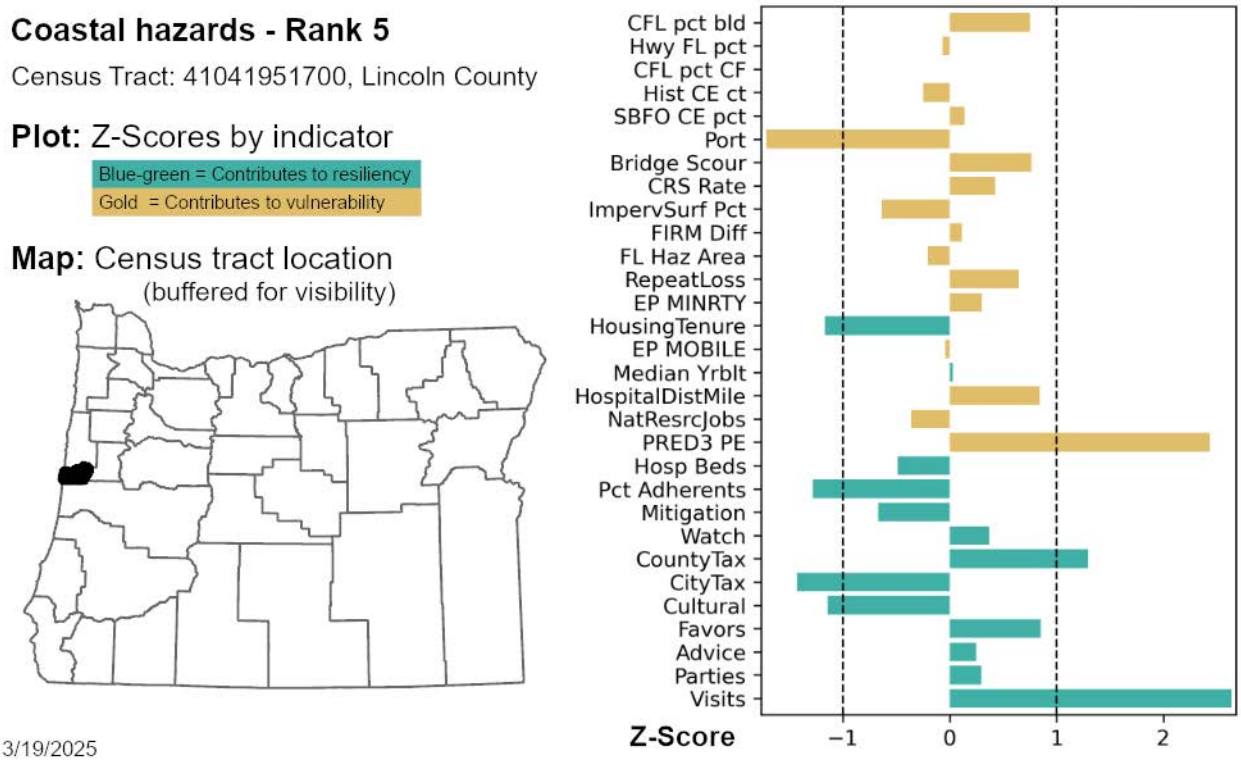
	Building Name 41015950201	Value	Flood Losses
Critical facility	Communications Structure	1,679,700	259,993
Critical facility	Gold Beach Muni	2,088,716	484641

No state-owned buildings identified in the coastal hazard zone.

Coastal Flooding Rank 5 – Lincoln County including the City of Yachats 41041951700

This mostly rural coastal census tract includes the City of Yachats. The NRI ranks the census tract low for coastal flooding and moderate for riverine flooding, with scores of 92.6 and 90.7 respectively. Approximately 9 percent of the census tract population is exposed to these flood hazards (222 people). The Oregon risk assessment finds that risk is dominated by low community resilience although social cohesion scores are near average for the coastal census tracts. City tax rates are also lower than for other coastal census tracts, but county tax rate is higher.

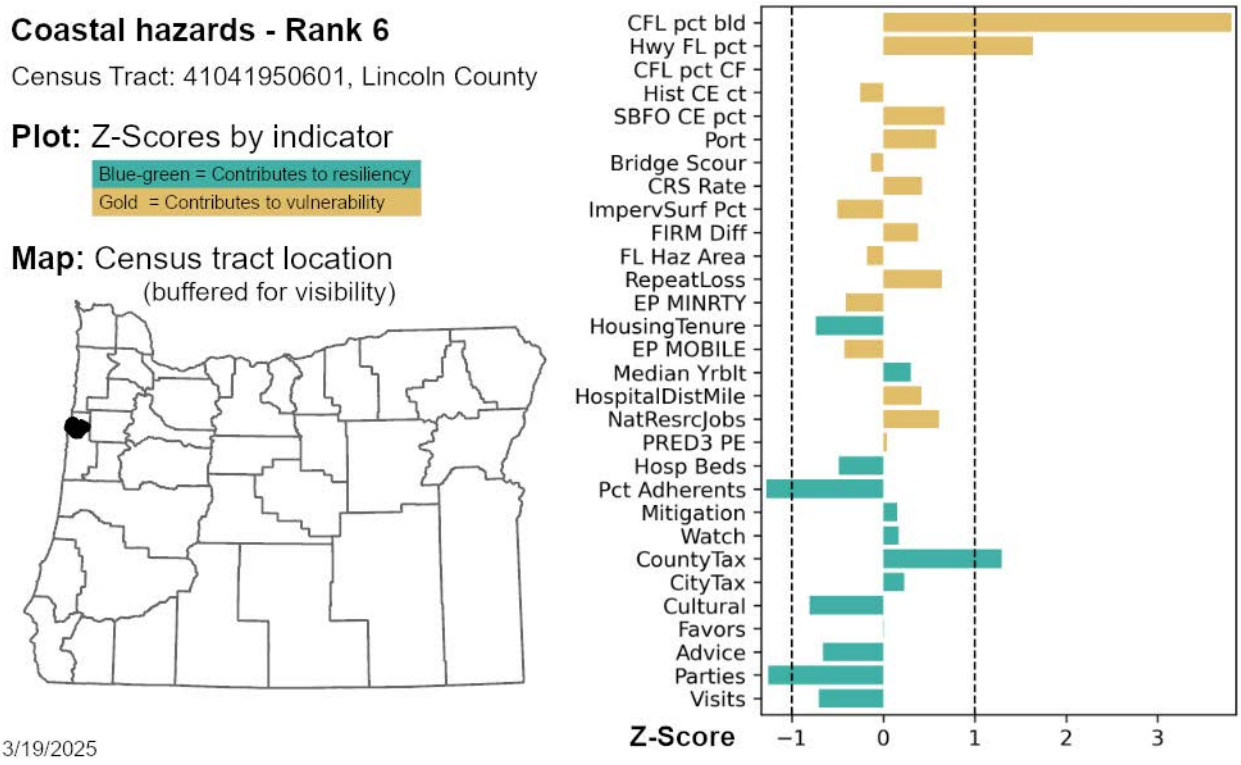
Figure 9.3.2-6: Fifth ranked census tract for coastal hazards



No state-owned Buildings or Critical Facilities identified in the coastal hazard zone. 41041951700

Coastal Flooding Rank 6 – Lincoln County in the vicinity of Otis and Rose Lodge 41041950601

Figure 9.3.2-7: Sixth ranked census tract for coastal hazards

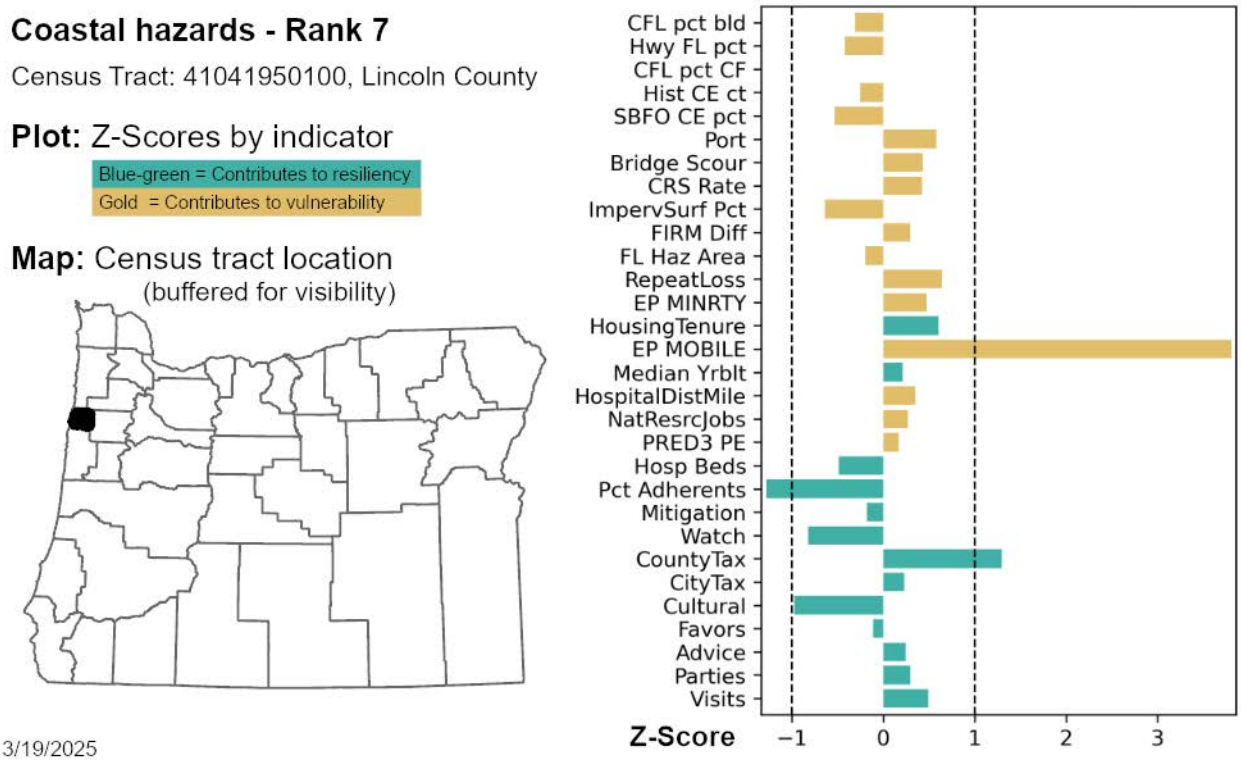


No state-owned buildings or critical facilities identified in coastal flood hazard zone.

Coastal Flooding Rank 7 – Lincoln County in the vicinity of Otis and Rose Lodge 41041950100

The NRI ranks this rural census tract as at moderate risk of coastal and riverine flooding, with scores of 95.6 and 88.8 respectively. Seven percent of the census tract population is exposed to these flood hazards (251 people). Risk is dominated by a much higher than average number of mobile homes when compared to other coastal census tracts.

Figure 9.3.2-8: Seventh ranked census tract for coastal hazards

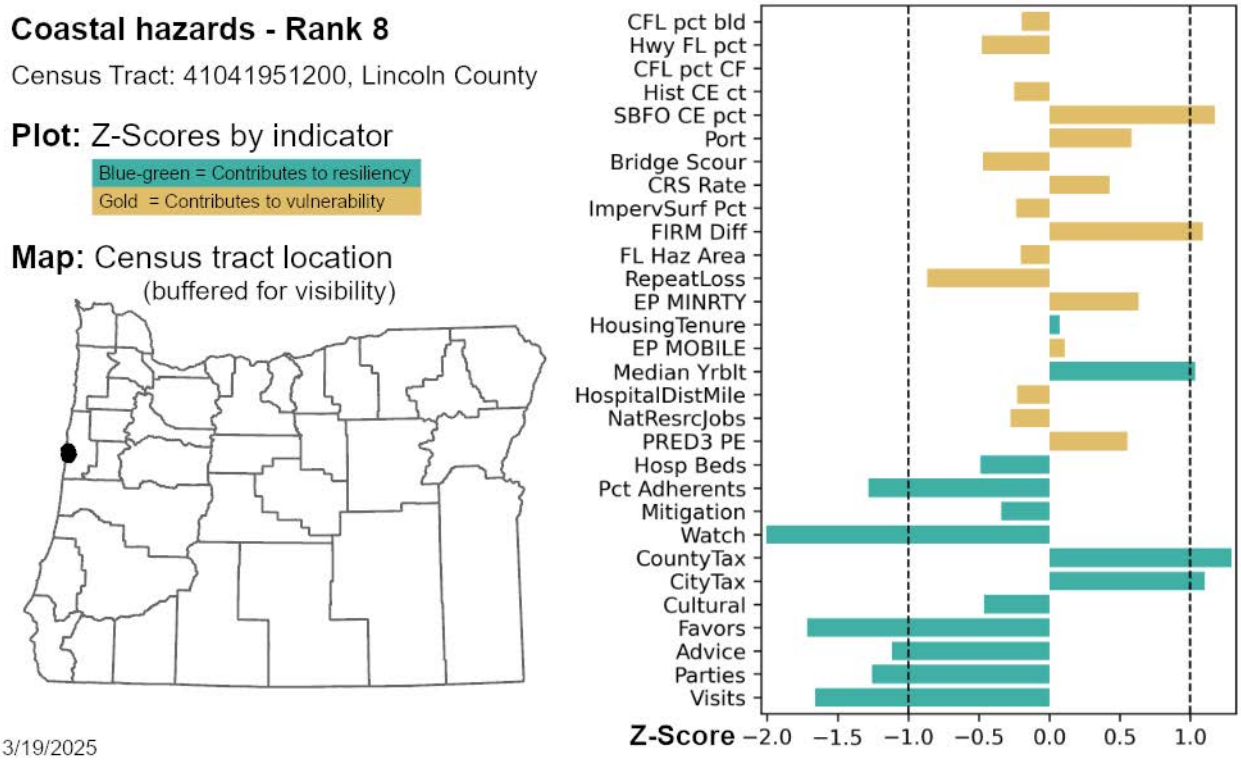


No state-owned buildings or critical facilities identified in coastal hazard zones.

Coastal Flooding Rank 8– Lincoln County 41041951200

Risk in this census tract is driven by a high percentage of buildings located in coastal erosion zone.

Figure 9.3.2-9: Eighth ranked census tract for coastal hazards



No state-owned buildings or critical facilities identified in coastal hazard zones.

Coastal Hazards 9 – Curry County 41015950401

This census tracts abuts 41015950301 (Coastal Hazards rank 9). It is also rural and includes unincorporated communities near the Chetco River. According to the NRI it is at relatively moderate risk of coastal flooding and relatively high risk for riverine flooding. Together approximately 4 percent of census tract population is exposed to flood risks. Oregon risk assessment risk drivers include percentage of buildings and highway miles in the census tract that are located in the flood zones relative to other coastal census tracts.

Figure 9.3.2-10: Tenth ranked census tract for coastal hazards

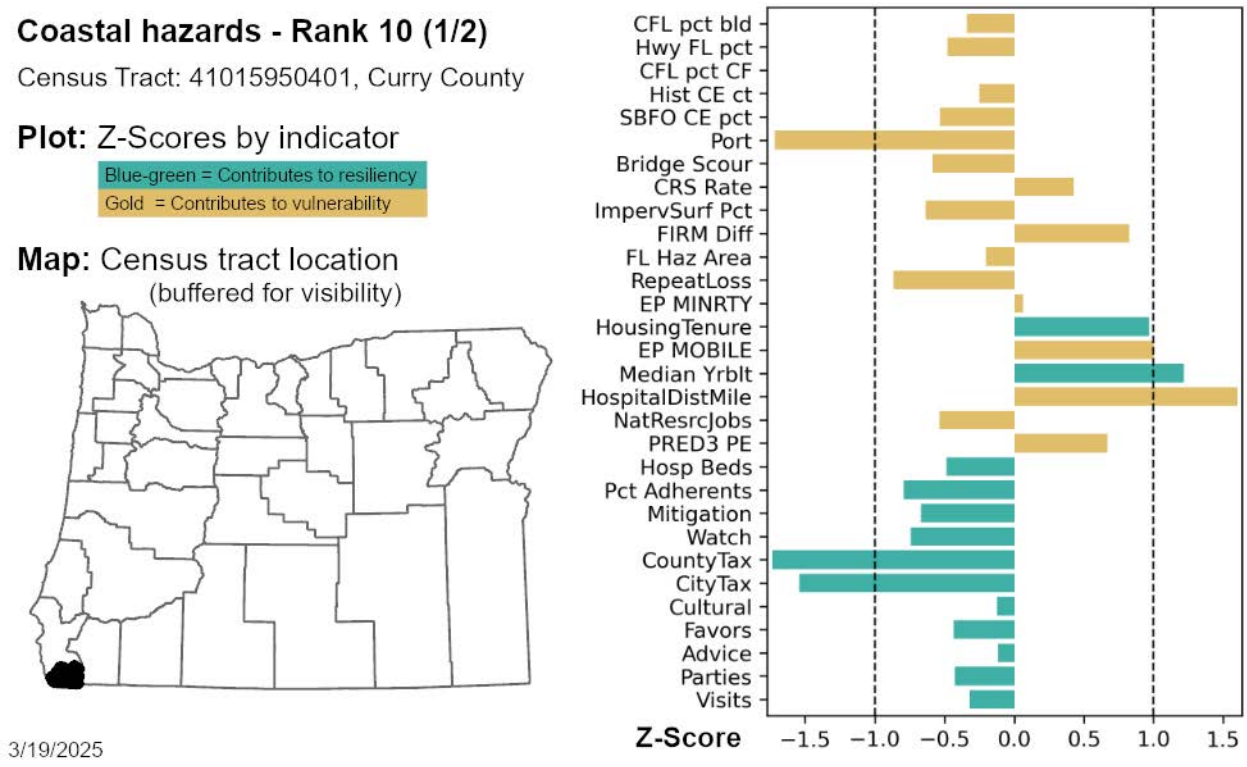


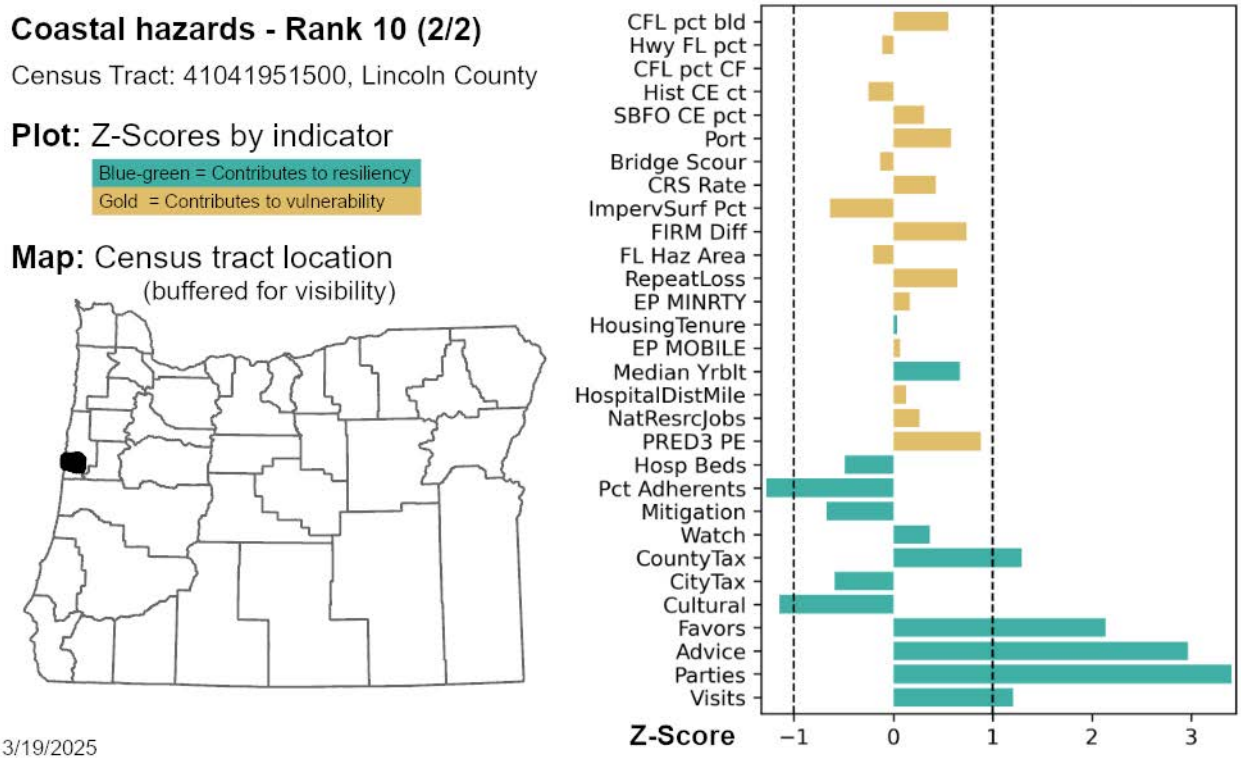
Table 9.3.2-6: State-owned Buildings identified in the coastal hazard zone

	Building Name 41015950401	Value ($)
State-owned	Crissey Field Welcome Center	3,959,447

No critical facilities identified in the coastal hazard zone.

Coastal Hazards 10 – Lincoln 41041951500

Figure 9.3.2-11: Tenth ranked census tract for coastal hazards



No state-owned buildings or critical facilities identified in the coastal hazard zone.

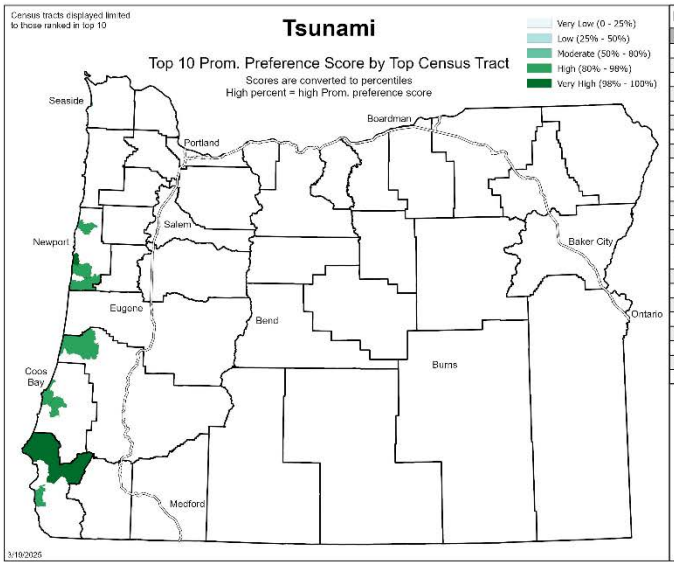
9.3.3 Tsunami

9.3.3.1 Hazard Scenario

Tsunami risks were evaluated based on exposure to any size (SM-XXL) CSZ tsunami.

9.3.3.2 Top Ranked Tsunami Risk Areas

Figure 9.3.3-1: Top Ranked Risk Areas in the Tsunami Zone



Indicators used for the hazard Hazard indicators are worth 35% of the total weight.

Hazard	Indicator Name	Direction	Weight	Short Description
Tsunami	TSU_pct_bld	1	0.07	Percentage of SBFO buildings exposed to any sized CSZ tsunami.
Tsunami	TSU_pct_CF	1	0.07	Percentage of critical facilities exposed to any sized CSZ tsunami.
Tsunami	Port	1	0.07	Presence of marine port infrastructure
Tsunami	Bridges_TSU	1	0.07	Number of bridges that are within a tsunami inundation zone.
Tsunami	Hist_Tsu_cf	1	0.07	Percentage of historic buildings exposed to any sized CSZ tsunami.
General	EP_MINRTY	1	0.046	Percentage of Black, Indigenous, and People of Color (2020 Census).
General	HousingTenure	-1	0.046	Housing tenure from the US Census.
General	EP_MOBILE	1	0.046	Percentage of people that live in mobile homes
General	Median_Yrblt	-1	0.046	Median year built of general building stock based on HAZUS default.
General	HospitalDistMile	1	0.046	Distance from tract centroid to nearest hospital.
General	NatResrcJobs	1	0.046	Rate of natural resource jobs.
General	PRED3_PE	1	0.046	Community Resilience Estimate
General	Hosp_Beds	-1	0.046	Estimated number of hospital beds based on square footage .
General	Pct_Adherents	-1	0.046	Percentage of members to a religious group
General	Mitigation	-1	0.046	Number of migitation projects (grouped by zip code and evenly distributed to overlaying tracts)
General	Watch	-1	0.046	Neighborliness: Will watch neighbor's house
General	CountyTax	-1	0.046	County tax rate
General	CityTax	-1	0.046	City tax rate
General	Cultural	-1	0.009	Number of cultural-related buildings
General	Favors	-1	0.009	Neighborliness: Willing to do favors for neighbor
General	Advice	-1	0.009	Neighborliness: Seeks advice from neighbor
General	Parties	-1	0.009	Neighborliness: Attended parties that occur in neighborhood
General	Visits	-1	0.009	Neighborliness: Has visited neighbor's house

Table 9.3.3-1: Oregon Natural Hazard Risk Assessment Rank Compared to the National Risk Index

Oregon Rank	Census Tract	County	National Risk Index Classification*	People Exposed to Tsunami**
1	41015950100	Curry	Relatively high	1402
2	41041951200	Lincoln	Relatively high	896
3	41041951700	Lincoln	Relatively high	2187
4	41041950601	Lincoln	Relatively moderate	1704
5	41015950201	Curry	Relatively high	2187
6	41007950900	Clatsop	Relatively high	4861
7	41011000502	Coos	Relatively moderate	1926
8	41019010000	Douglas	Relatively moderate	1538

Oregon Rank	Census Tract	County	National Risk Index Classification*	People Exposed to Tsunami**
9	41041951500	Lincoln	Relatively moderate	1203
10	41011000902	Coos	Relatively Low	185

*Compared to census tracts nationwide
** From the NRI accessed 03/26/2025

Table 9.3.3-2: Top 10 Census Tract Demographics

Census Tract	Tsunami Risk Rank	2020 Population[1]	2023 Population[2]	% Change in Population	2016 SVI[3]	2022 SVI[4]	Change in SVI
41015950100	1	3296	3226	-2%	0.66	0.56	-0.15
41041951200	2	2166	2501	15%	0.24	0.46	0.95
41041951700	3	2475	2163	-13%	0.67	0.77	0.16
41041950601	4	2662	2758	4%	0.35	0.28	-0.21
41015950201	5	3513	3730	6%	#N/A	0.80	#N/A
41007950900	6	4861	4793	-1%	0.89	0.86	-0.04
41011000502	7	2977	2494	-16%	0.66	0.56	-0.15
41019010000	8	2320	2434	5%	0.79	0.44	-0.44
41041951500	9	2953	3040	3%	0.19	0.21	0.13
41011000902	10	3684	3390	-8%	#N/A	0.81	#N/A

[1] 2020 Decennial Census Census Tract Level Population Data HC2020.P1 - 2020 data was used rather than 2018 due to changes in census tract boundaries in 2020

[2] 2023 ACS 5-Year Estimates Census Tract Level Age and Sex Data S0101

[3] 2016 US CDC Social Vulnerability Index - "#N/A" cells represent census tracts that did not exist before changes to census tract boundaries in 2020

[4] 2022 US CDC Social Vulnerability Index

Tsunami Rank 1 – Curry County including the City of Port Orford 41015950100

Tsunami risk in this census tract is dominated by a higher-than-average number of bridges within the tsunami inundation zone, a higher-than-average number of natural resource dependent jobs, lower than average county property tax rates, and lower than average social cohesion. The NRI estimates that 1402 or 42 percent of the census tract population is exposed to the tsunami inundation area. The NRI rates this census tract as relatively high for tsunami risk.

Figure 9.3.3-2: First ranked census tract for tsunami hazard

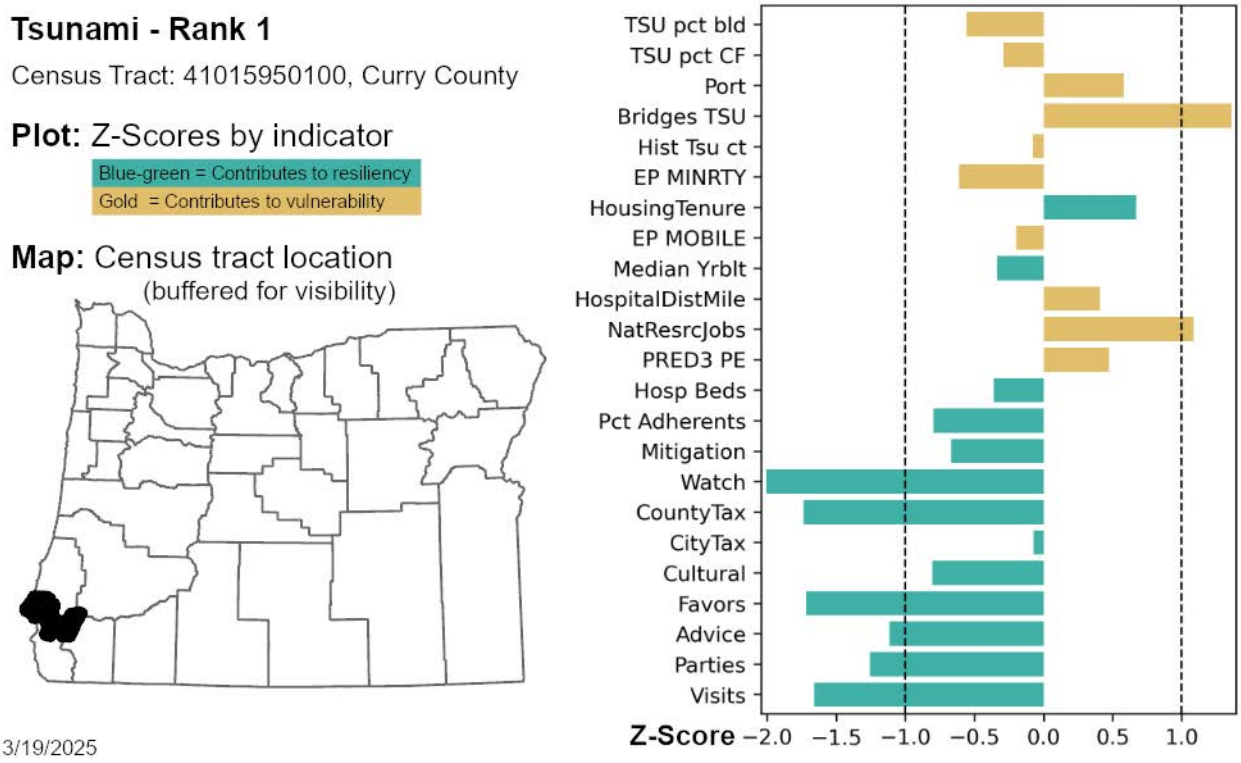


Table 9.3.3-3: Critical Facilities in Tsunami SM-XXL Zone

	Building Name 41015950100	Value ($)	Source
Critical facility	Driftwood Elementary School	997771	DOGAMI/DAS
Critical facility	CURRY FAMILY MEDICAL	178464	DOGAMI/DAS
Critical facility	PORT ORFORD POLICE DEPARTMENT	173340	DOGAMI/DAS
Critical facility	Port Orford RFPD	273150	DOGAMI/DAS

No state-owned buildings identified in tsunami zone.

Tsunami Rank 2 -- Lincoln County 41041951200

Tsunami risk in this census tract is driven by the high percentage of people exposed to the hazard. The NRI estimates that 896 people or 41 percent of the population are exposed. The Oregon risk assessment finds a higher-than-average number of historic buildings exposed to the hazard. The Yaquina Bay and Yaquina Head Lighthouses are located in the XXL tsunami zone. The area is characterized by lower-than-average social cohesion. The NRI rates this census tract as being at relatively high risk for harm caused by tsunami.

Figure 9.3.3-3: Second ranked census tract for tsunami hazard

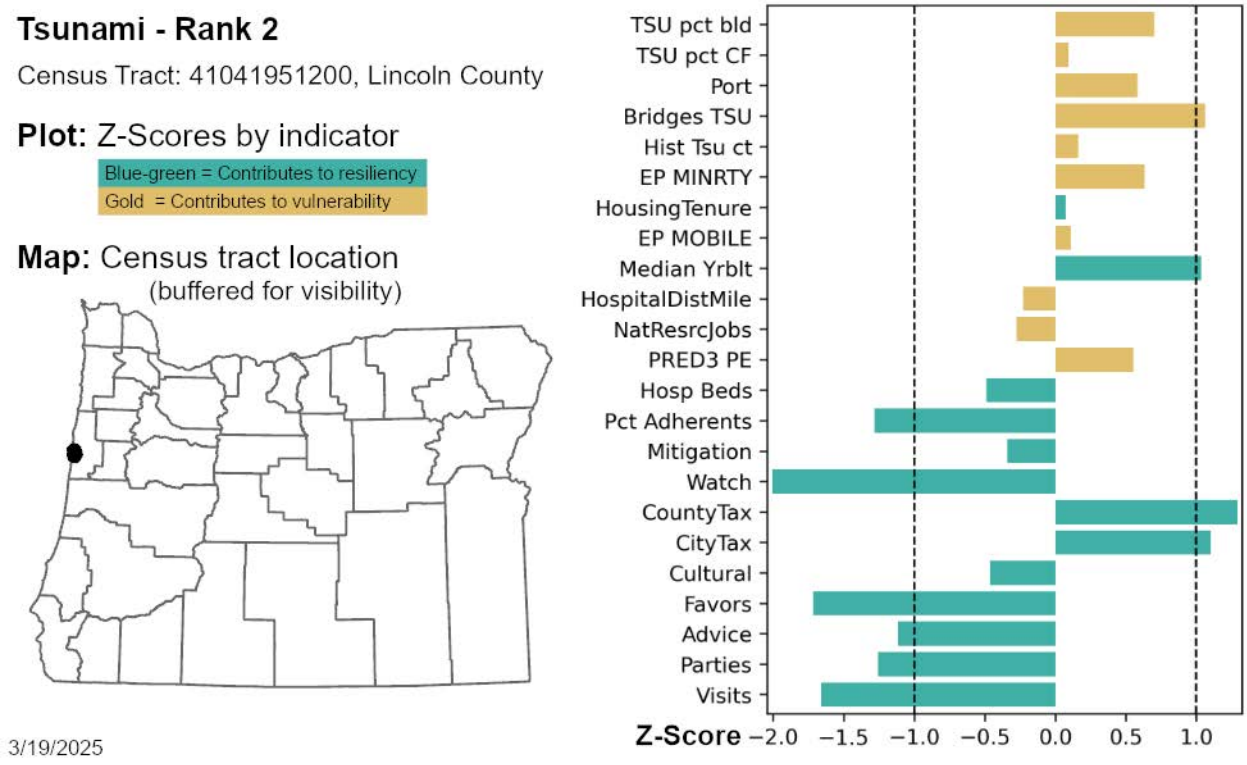


Table 9.3.3-4: State-owned Buildings or Critical Facilities in Tsunami SM-XXL Zone

	Building Name 41041951200	Value ($)	Source
State-owned	Ona Beach	179311	DOGAMI/DAS
State-owned	Lost Creek State Park Day Use	101603	DOGAMI/DAS
State-owned	South Beach State Park	6528638	DOGAMI/DAS
State-owned	Yaquina Bay Lighthouse	unknown	RAPT
State-owned	Marine Resources Program	3523355	DOGAMI/DAS
Critical facility	Communication Structure	1651200	DOGAMI/DAS
Critical facility	Communication Structure	103650	DOGAMI/DAS

Tsunami Rank 3 – Lincoln County in the vicinity of Yachats 41041951700

Figure 9.3.3-4: Third ranked census tract for tsunami hazard

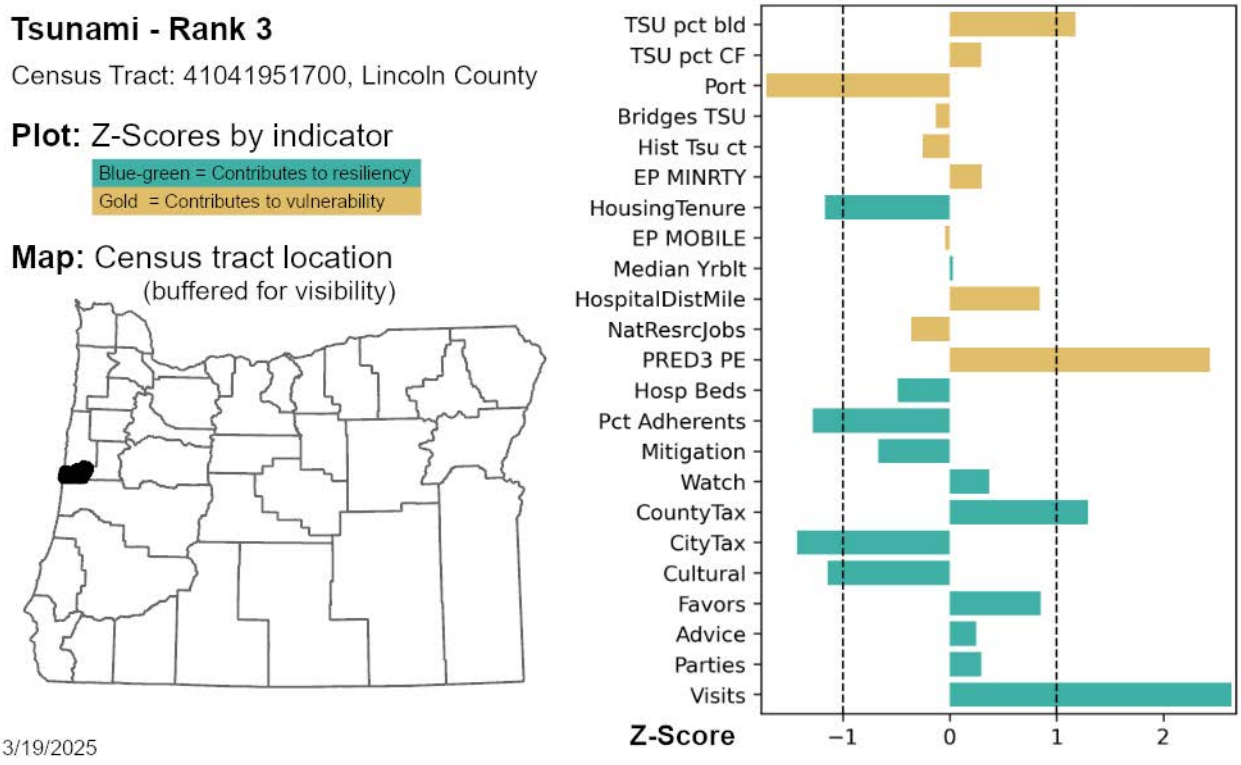


Table 9.3.3-5: Critical Facilities in Tsunami SM-XXL Zone

	Building Name 41041951700	Value	Source
Critical facility	Yachats Rural Fire Protection District Station 8200	unknown	RAPT
Critical facility	Yachats Rural Fire Protection District, South Station	unknown	RAPT
Critical facility	Yachats STP (wastewater)	unknown	RAPT

No state-owned buildings identified in tsunami zone.

Tsunami Rank 4 – Lincoln County in the vicinity of Kernville 41041950601

This census tract includes significant development with the Oregon risk assessment showing a higher-than-average percentage of buildings, critical facilities, and historic sites when compared to other coastal census tracts. The NRI estimates 1704 people or 65 percent of the population of the census tract is exposed to the hazard. The NRI classifies the area as at relatively moderate risk of harm from tsunami.

Figure 9.3.3-5: Fourth ranked census tract for tsunami hazard

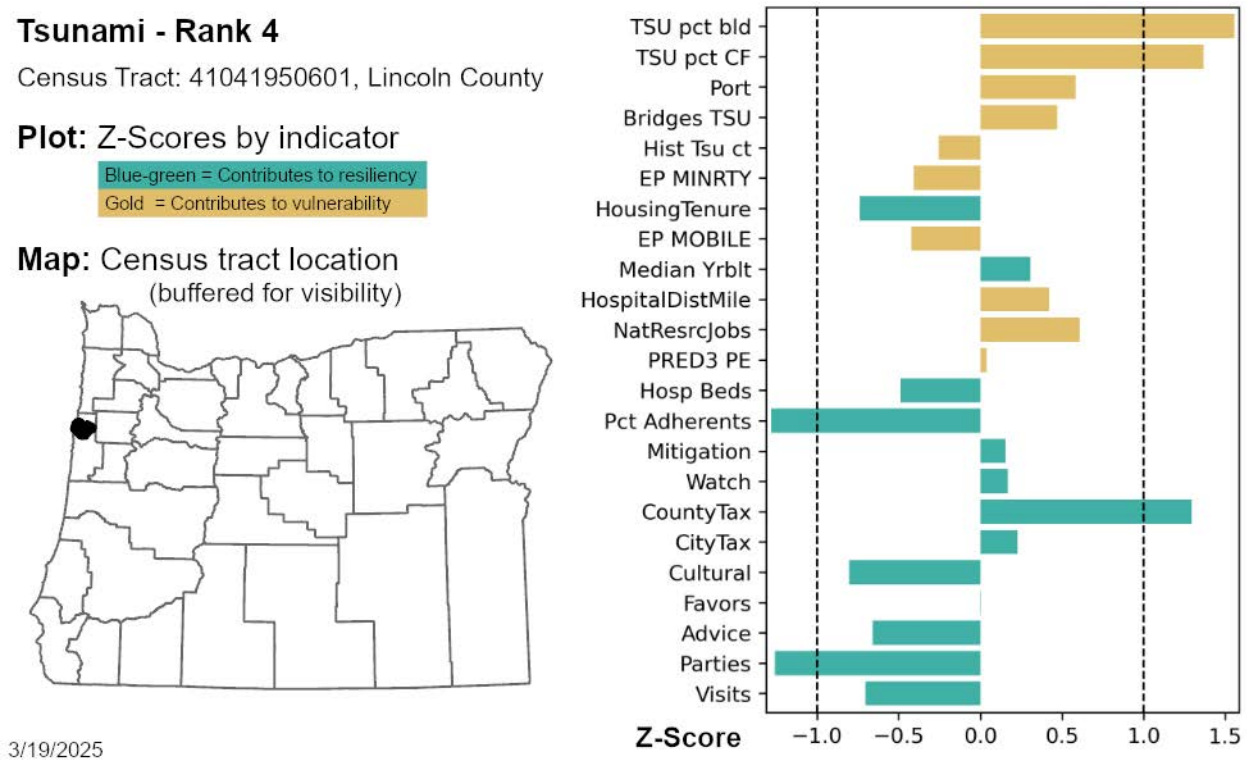


Table 9.3.3-6: State-owned Buildings or Critical Facilities in Tsunami SM-XXL Zone

	Building Name 41041950601	Value ($)	Source
State-owned	Gleneden Beach Recreation Area	358410	DOGAMI/DAS
Critical facility	Communication Structure	16957	DOGAMI/DAS
Critical facility	Communication Structure	16957	DOGAMI/DAS
Critical facility	Depoe Bay Fire District - Station 2200	422087	DOGAMI/DAS
Critical facility	North Lincoln Fire and Rescue - Kernville Station 1700	115940	DOGAMI/DAS
Critical facility	SALISHAN STP	85650	DOGAMI/DAS

	Building Name 41041950601	Value ($)	Source
Critical facility	LINCOLN CITY, CITY OF	601350	DOGAMI/DAS

Tsunami Rank 5 – Curry County including the City of Gold Beach 41041951700

Sixty-two percent of people living in this census tract are directly exposed to tsunami risk, 2187 people. The area is characterized in the Oregon risk assessment as having a higher-than-average percent when compared to other coastal census tracts of critical facilities, people living in mobile homes, and people dependent on natural resource jobs exposed to the hazard. County property taxes are lower than average. The NRI rates this census tract as at relatively high risk of tsunami damage.

Figure 9.3.3-6: Fifth ranked census tract for tsunami hazard

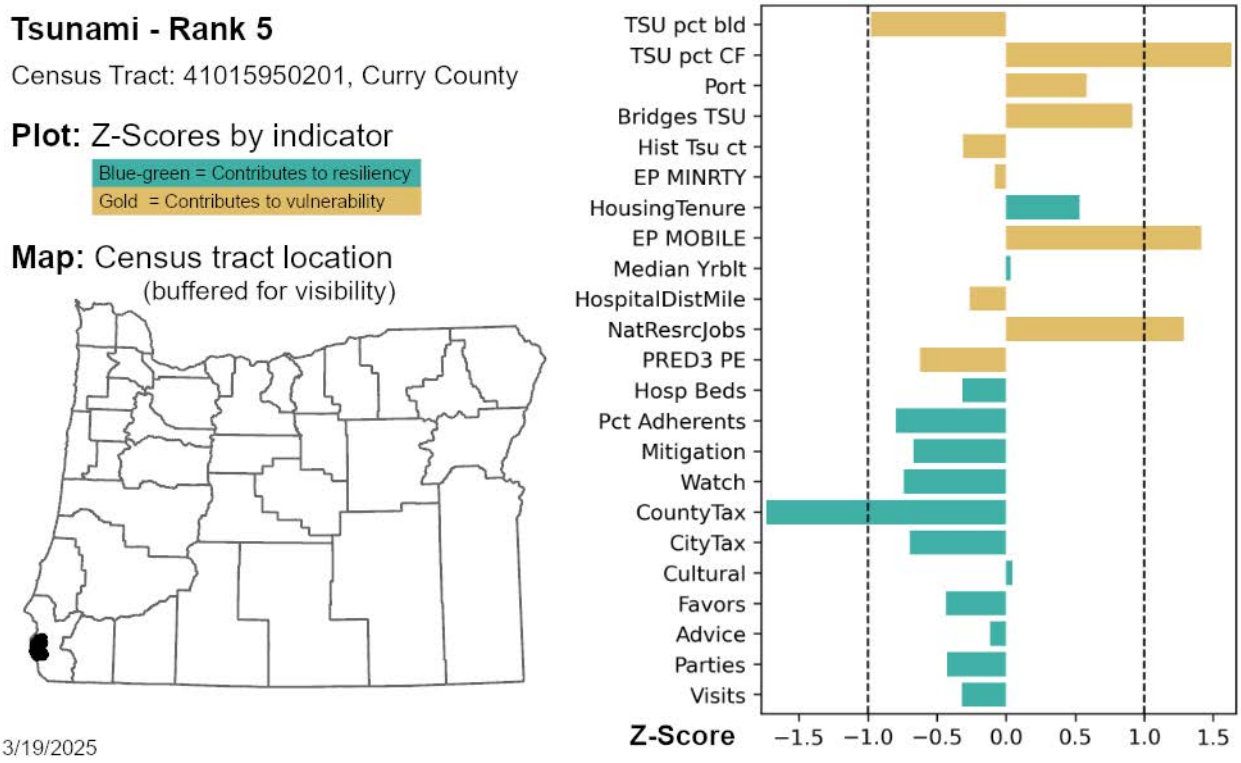


Table 9.3.3-7: State-owned Buildings or Critical Facilities in Tsunami SM-XXL Zone

	Building Name 41041951700	Value ($)	Source
State-owned	Hunter Creek Maintenance Station Grounds	249130	DOGAMI/DAS
State-owned	Hunter Creek Maintenance Station Grounds	840392	DOGAMI/DAS
State-owned	Hunter Creek Maintenance Station Grounds	682532	DOGAMI/DAS
State-owned	Unknown	929953	DOGAMI/DAS
State-owned	OR State Police Gold Beach Work Site	unknown	RAPT
State-owned	Curry County Circuit Court	60668	DOGAMI/DAS

	Building Name 41041951700	Value ($)	Source
Critical facility	Riley Creek Elementary School	3245302	DOGAMI/DAS
Critical facility	Riley Creek Elementary School	96624	DOGAMI/DAS
Critical facility	Riley Creek Elementary School	364100	DOGAMI/DAS
Critical facility	Gold Beach High School	2985321	DOGAMI/DAS
Critical facility	Gold Beach High School	219421	DOGAMI/DAS
Critical facility	Gold Beach High School	173833	DOGAMI/DAS
Critical facility	Gold Beach High School	501716	DOGAMI/DAS
Critical facility	Gold Beach High School	97350	DOGAMI/DAS
Critical facility	Gold Beach Public Works, multiple buildings	495860	DOGAMI/DAS
Critical facility	Communication Structure	1679700	DOGAMI/DAS
Critical facility	Communication Structure	496850	DOGAMI/DAS
Critical facility	Communication Structure	730650	DOGAMI/DAS
Critical facility	Curry General Hospital - Gold Beach	555600	DOGAMI/DAS
Critical facility	NORTH BEND MEDICAL CENTER-GOLD BEACH	950400	DOGAMI/DAS
Critical facility	North Bend Medical Center duplicate?	950400	DOGAMI/DAS
Critical facility	Curry General Hospital	189300	DOGAMI/DAS
Critical facility	CURRY COUNTY SHERIFFS OFFICE and JAIL	2731050	DOGAMI/DAS
Critical facility	GOLD BEACH POLICE DEPARTMENT	516229	DOGAMI/DAS
Critical facility	ROGUE RIVER-SISKIYOU NATIONAL FOREST LAW ENFORCEMENT - GOLD BEACH RANGER DISTRICT	425100	DOGAMI/DAS
Critical facility	Gold Beach Fire Department	536643	DOGAMI/DAS
Critical facility	Pistol River RFPD	1960	DOGAMI/DAS
Critical facility	Pistol River RFPD	4259	DOGAMI/DAS
Critical facility	Gold Beach Muni	2088716	DOGAMI/DAS
Critical facility	Curry Emergency Operations Center	2731050	DOGAMI/DAS

Tsunami Rank 6 – Clatsop County, including the City of Seaside 4107950900

Risk in this census tract is driven by the high percentage of buildings and critical facilities located in the tsunami zone.

Figure 9.3.3-7: Sixth ranked census tract for tsunami hazard

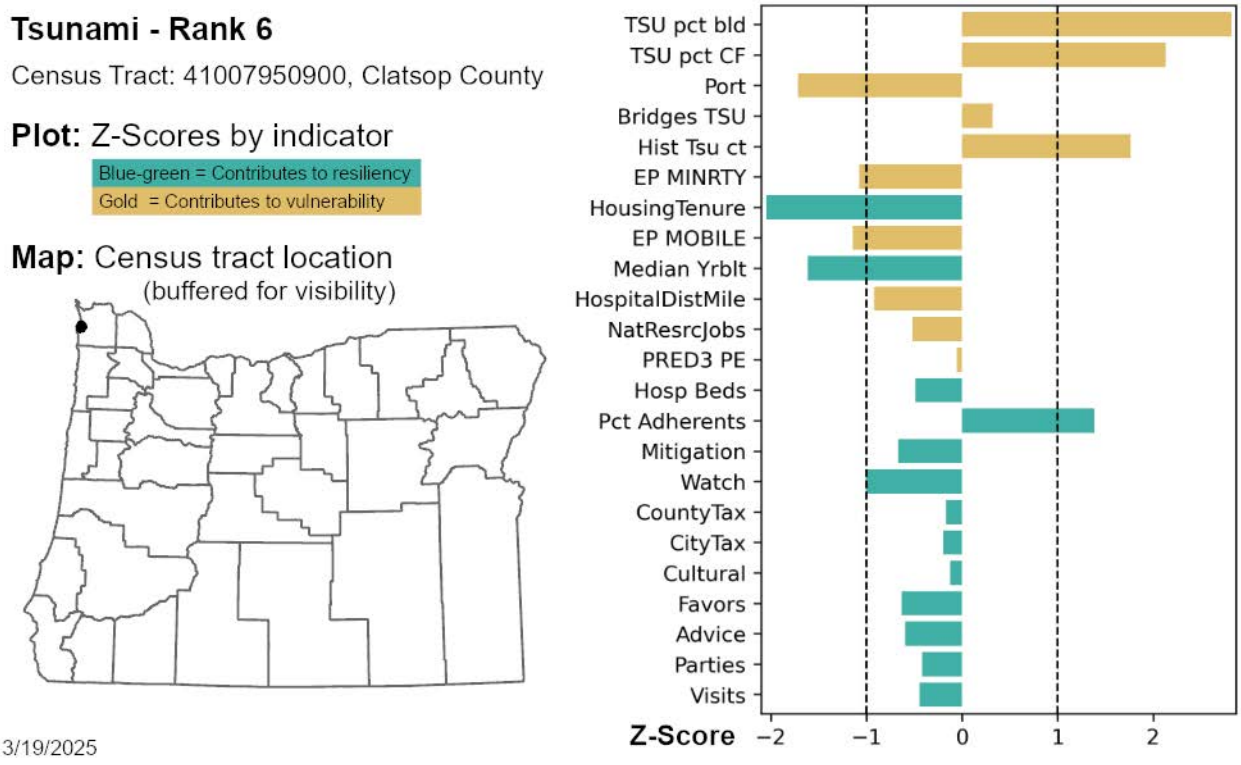


Table 9.3.3-8: Critical Facilities in Tsunami SM-XXL Zone

	Building Name 41007950900	Value ($)	Source
Critical facility	Seaside Fire Station	unknown	RAPT
Critical facility	Seaside Police Department	unknown	RAPT

No state-owned buildings identified.

Tsunami Rank 7 – Coos County including Sunset Bay and Shore Acres State Parks 4101100502

This census tract is characterized in the Oregon risk assessment as having a higher-than-average percentage of buildings, critical facilities, historic buildings, and people living in mobile homes when compared to other coastal census tracts. Approximately 1926 people are directly exposed to the hazard, or 44 percent of the census tract population. The NRI rates the areas as having a relatively moderate risk due to tsunami.

Figure 9.3.3-8: Seventh ranked census tract for tsunami hazard

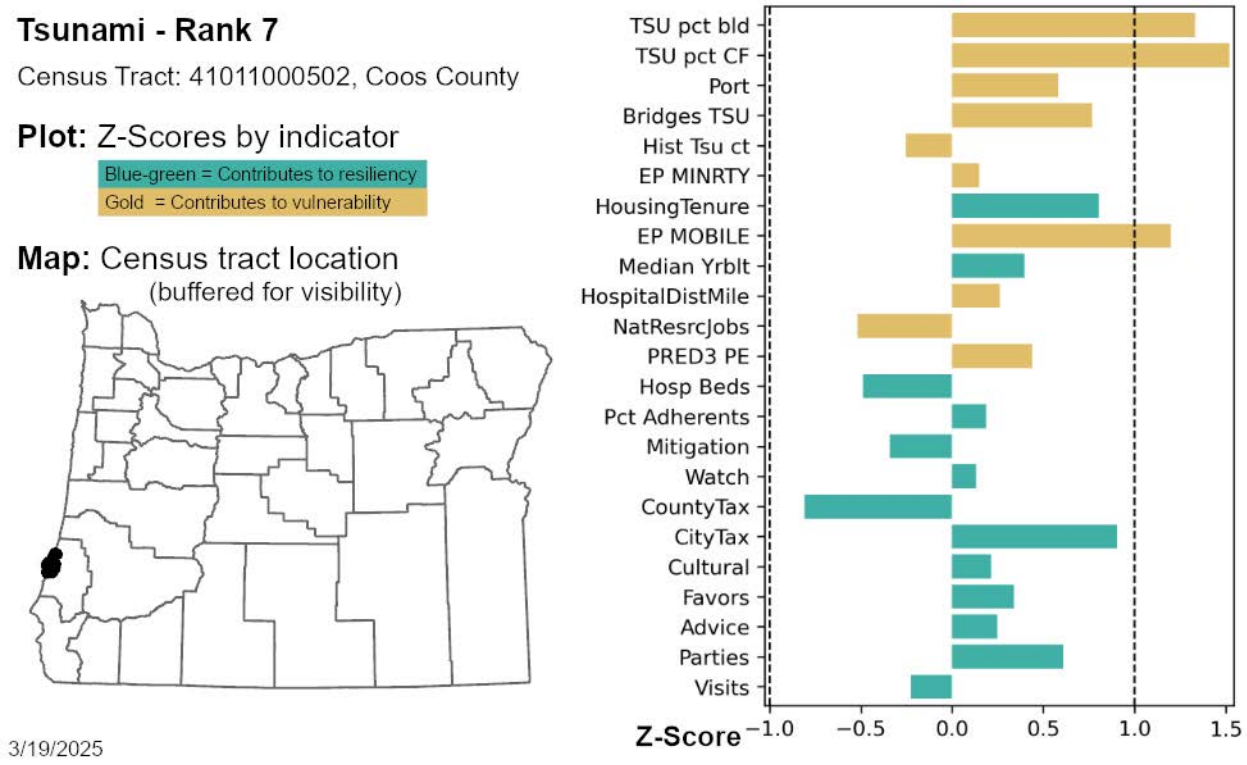


Table 9.3.3-9: State-owned Buildings or Critical Facilities in Tsunami SM- XXL Zone

	Building Name 4101100502	Value ($)	Source
State-owned	Seven Devils Recreation Site	335287	DOGAMI/DAS
State-owned	Sunset Bay Campground	2421487	DOGAMI/DAS
State-owned	Unknown structures near Cape Argo	970505	DOGAMI/DAS
State-owned	Charleston District Office Building	44635	DOGAMI/DAS
Critical facility	Communication Structure	81150	DOGAMI/DAS
Critical facility	US Coast Guard - Station Coos Bay	2042006	DOGAMI/DAS

	Building Name 4101100502	Value ($)	Source
Critical facility	US Coast Guard - Navigation Team Coos Bay	1047136	DOGAMI/DAS
Critical facility	Charleston RFPD - Station 3	993482	DOGAMI/DAS
Critical facility	Charleston RFPC – Station 1		RAPT

Tsunami Rank 8 – Douglas County including the City of Reedsport 41019010000

The NRI rates this census tract, which includes the City of Reedsport, as relatively moderate risk of harm due to tsunami. Sixty-six percent, or 1538 people are directly exposed to the hazard according to the NRI. A higher than average when compared to other coastal census tracts of buildings, critical facilities, and bridges is reported by the Oregon risk assessment. Distance to hospital facilities is longer than average. County property tax rates are also relatively lower than in other census tracts. The US Census Bureau finds the tract to have high social vulnerability as compared to other coastal census tracts.

Figure 9.3.3-9: Eighth ranked census tract for tsunami hazard

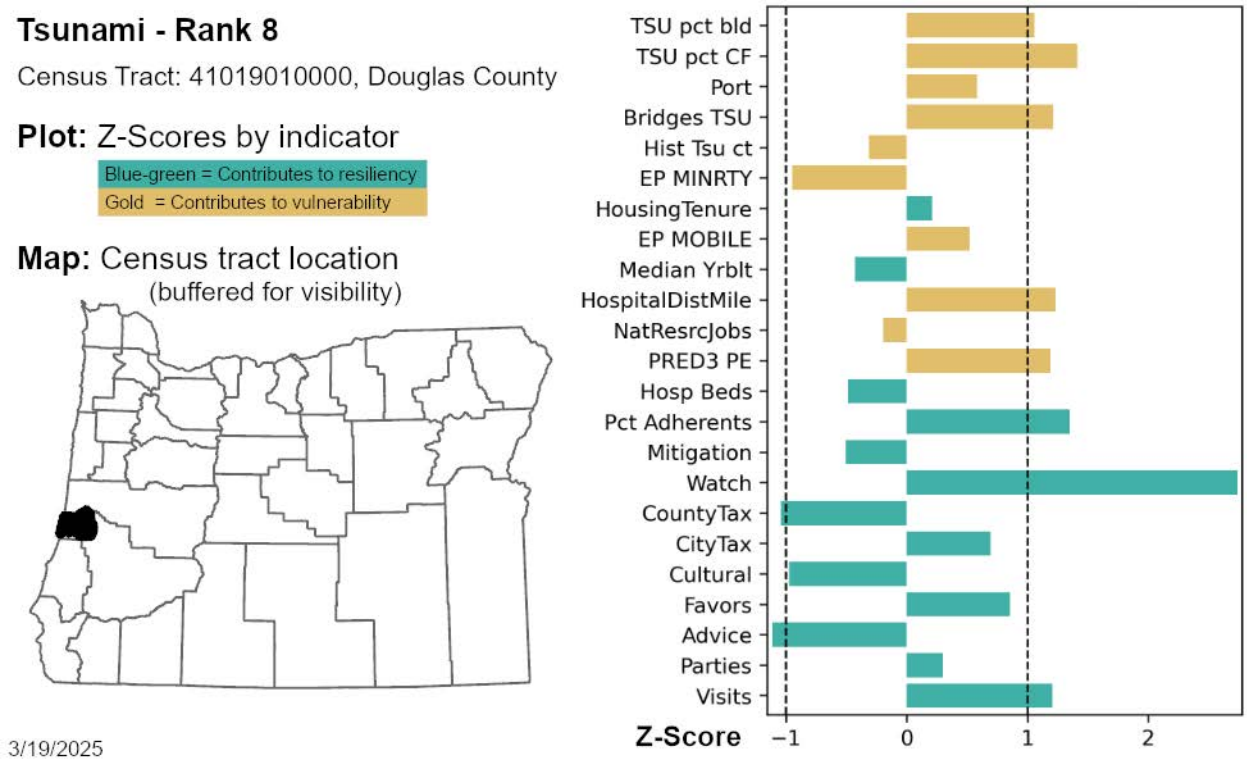


Table 9.3.3-10: State-owned Buildings or Critical Facilities in Tsunami SM-XXL Zone

	Building Name 41019010000	Value ($)	Source
State-owned	Reedsport Maintenance Station Grounds	2262958	DOGAMI/DAS
Critical facility	Public Works - City Shop	88470	DOGAMI/DAS
Critical facility	Public Works - City Shop	34037	DOGAMI/DAS
Critical facility	Public Works - City Shop	8729	DOGAMI/DAS
Critical facility	Reedsport Public Works	97438	DOGAMI/DAS

	Building Name 41019010000	Value ($)	Source
Critical facility	Reedsport Public Works	68708	DOGAMI/DAS
Critical facility	Reedsport Public Works	31809	DOGAMI/DAS
Critical facility	Reedsport Public Works	12724	DOGAMI/DAS
Critical facility	Communication Structure	150900	DOGAMI/DAS
Critical facility	REEDSPORT POLICE DEPARTMENT	553960	DOGAMI/DAS
Critical facility	DOUGLAS COUNTY SHERIFFS OFFICE - REEDPORT SUBSTATION	850024	DOGAMI/DAS
Critical facility	Gardiner RFPD	204336	DOGAMI/DAS
Critical facility	Reedsport Fire Department - Station 1	553960	DOGAMI/DAS
Critical facility	REEDSPORT STP	214950	DOGAMI/DAS

Tsunami Rank 9 – Lincoln County 41041951500

Figure 9.3.3-10: Ninth ranked census tract for tsunami hazard

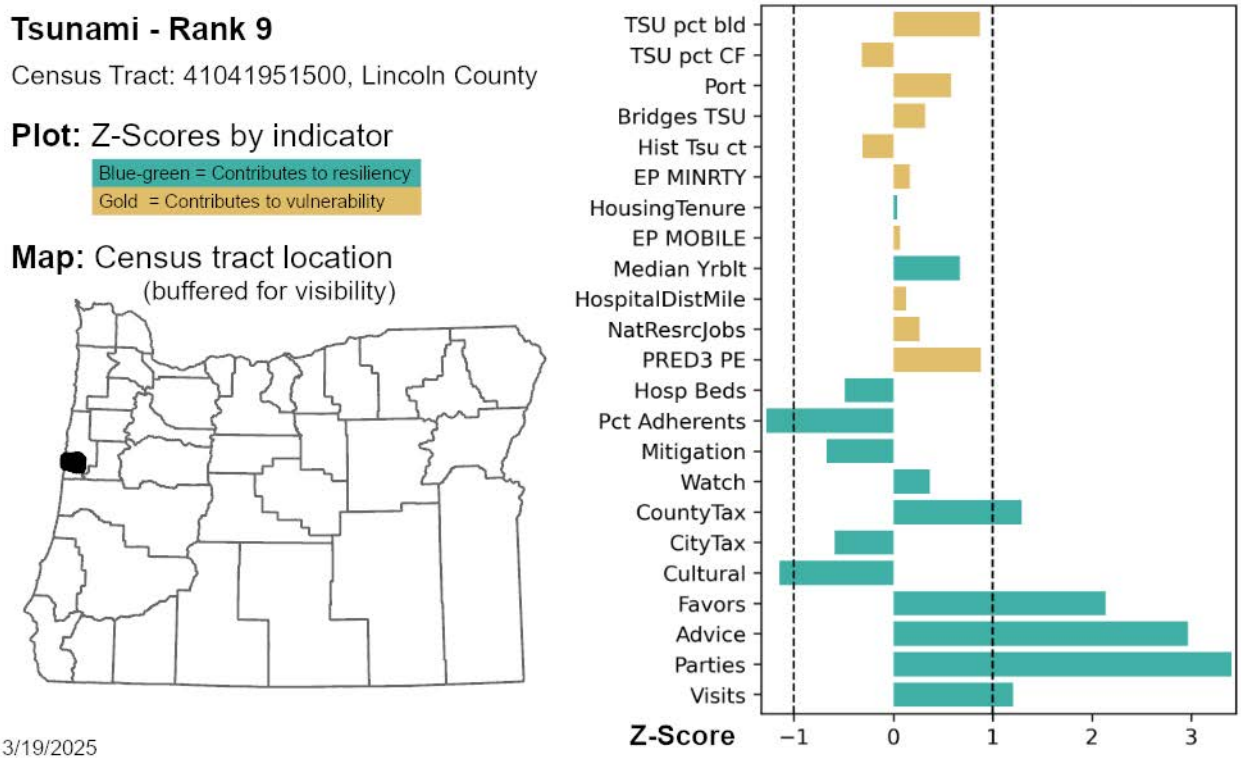


Table 9.3.3-11: State-owned Buildings in Tsunami XXL Zone

	Building Name 41041951500	Value	Source
State-owned	Brian Booth State Park	unknown	DOGAMI/DAS

No critical facilities identified in the Tsunami XXL zone

Tsunami Rank 10 – Coos County in the vicinity of Coquille 41011000902

Tsunami risks in this census tract are dominated by a larger than average estimated percentage of BIPOC populations and a higher-than-average percentage of workers in natural resource jobs. The reasons for the risk assessment showing a higher that average proportion of critical facilities is not clear (Table xx). The NRI estimates that 185 residents, or 5 percent of the census tract population is exposed to tsunami risk. The census tract hosts the large Bullards Beach State Park Campground, which is serviced with electrical hook-ups, yurts, and a meeting room. This park attracts a large number of visitors who would be exposed to tsunami risk in addition to census tract residents. No Tribal census areas.

Figure 9.3.3-11: Tenth ranked census tract for tsunami hazard

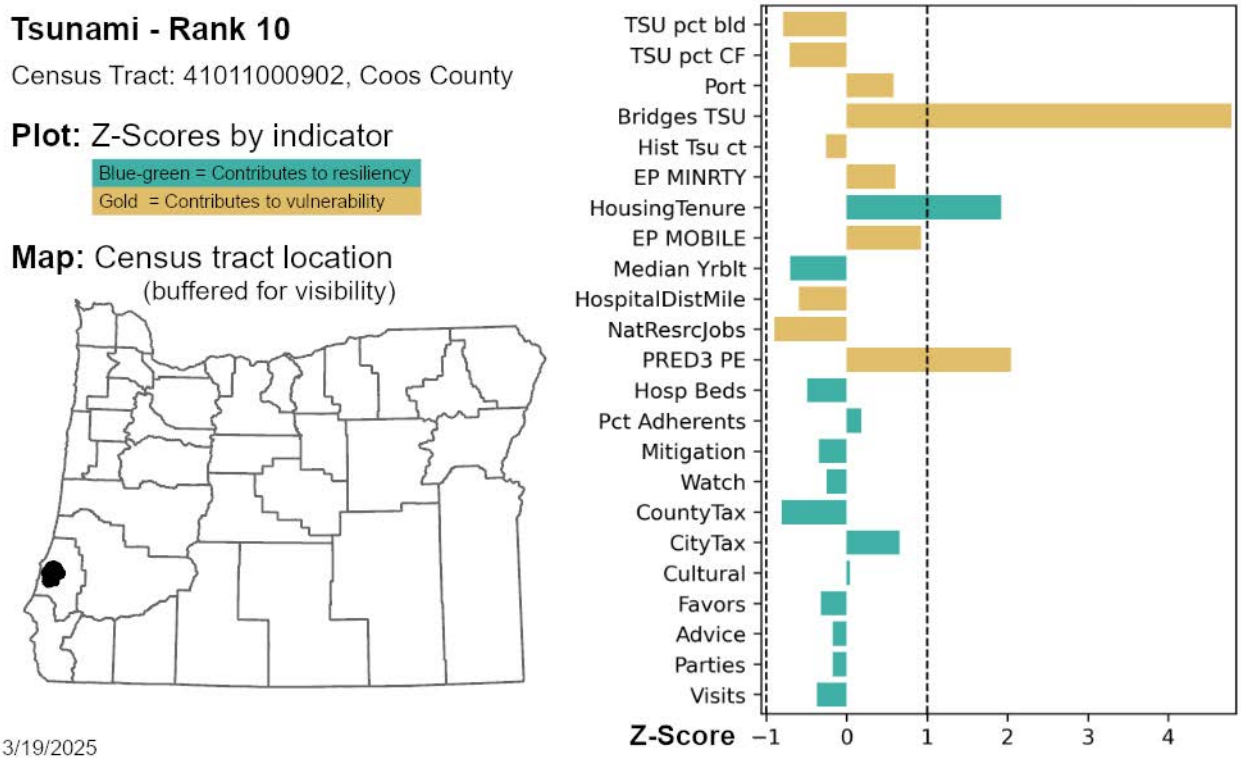


Table 9.3.3-12: State-owned Buildings or Critical Facilities in Tsunami XXL Zone

	Building Name 41011000902	Value ($)	Flood Losses
State-owned	Unknown structures off Beach Loop Road	898857	DOGAMI/DAS
State-owned	Site Systems - Four Mile M/W Operating Grounds	44635	DOGAMI/DAS
State-owned	Four Mile M/W Building	53018	DOGAMI/DAS
State-owned	Coquille River Lighthouse	2935688	DOGAMI/DAS
State-owned	Bullards Beach State Park Campground	4473338	DOGAMI/DAS

	Building Name 41011000902	Value ($)	Flood Losses
Critical facility	Communication Structure	750000	DOGAMI/DAS

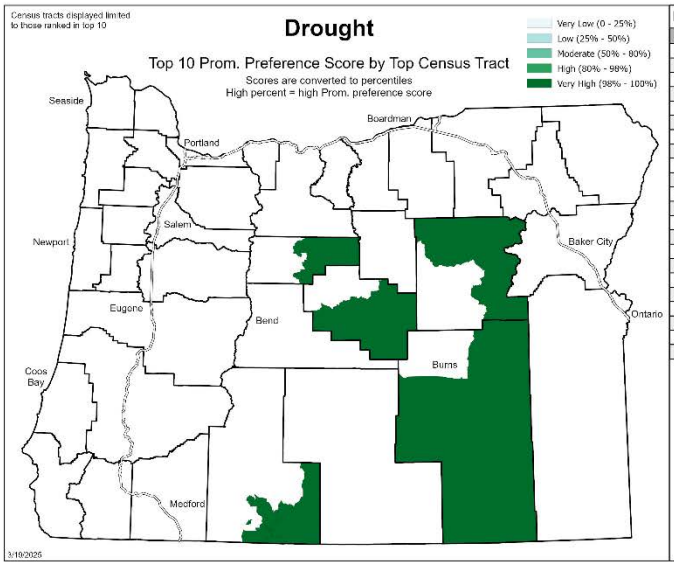
9.3.4 Drought

9.3.4.1 Hazard Scenario

Drought risk was evaluated using the number of drought events and annualized drought frequency as reported in the National Risk Index. According to NRI documentation, drought **annualized frequency** value represents the average number of recorded drought hazard occurrences (event-days) per year over the period of record (21.8 years).

9.3.4.2 Top Ranked Drought Risk Areas

Figure 9.3.4-1: Top Ranked Risk Areas in Drought Risk Areas



Indicators used for the hazard Hazard indicators are worth 35% of the total weight.

Hazard	Indicator Name	Direction	Weight	Short Description
Drought	Drght_NRI_rate	1	0.07	Drought rate from the NRI.
Drought	Drght_Events	1	0.07	Number of drought events from the NRI.
Drought	Drght_AL_AG	1	0.07	Annualized loss for agriculture from NRI.
Drought	Over90th	1	0.07	Mean days that are above the historic 90th percentile temp
Drought	Over90F	1	0.07	Mean days above 90 degrees Fahrenheit
General	EP_MINRTY	1	0.05	Percentage of Black, Indigenous, and People of Color (2020 Census).
General	HousingTenure	-1	0.05	Housing tenure from the US Census.
General	EP_MOBILE	1	0.05	Percentage of people that live in mobile homes
General	Median_Yrblt	-1	0.05	Median year built of general building stock based on HAZUS default.
General	HospitalDistMile	1	0.05	Distance from tract centroid to nearest hospital.
General	NatResrcJobs	1	0.05	Rate of natural resource jobs.
General	PRED3_PE	1	0.05	Community Resilience Estimate
General	Hosp_Beds	-1	0.05	Estimated number of hospital beds based on square footage .
General	Pct_Adherents	-1	0.05	Percentage of members to a religious group
General	Watch	-1	0.05	Neighborliness: Will watch neighbor's house
General	CountyTax	-1	0.05	County tax rate
General	CityTax	-1	0.05	City tax rate
General	Cultural	-1	0.01	Number of cultural-related buildings
General	Favors	-1	0.01	Neighborliness: Willing to do favors for neighbor
General	Advice	-1	0.01	Neighborliness: Seeks advice from neighbor
General	Parties	-1	0.01	Neighborliness: Attended parties that occur in neighborhood
General	Visits	-1	0.01	Neighborliness: Has visited neighbor's house

Table 9.3.4-1: NRI Risk Ranking

Oregon Rank	Census Tract	County	National Risk Index Hazard Rating
1	41025960200	Harney	Relatively moderate
2	41035970700	Klamath	Relatively moderate
3	41035970600	Klamath	Relatively moderate
4	41013950402	Crook	Relatively low
5	41035970400	Klamath	Relatively moderate
6	41035971500	Klamath	Very low
7	41035971200	Klamath	Very low
8	41031960100	Jefferson	Relatively low
9	41023960100	Grant	Relatively low
10	41035970500	Klamath	Relatively low

*Compared to census tracts nationwide

Table 9.3.4-2: Top 10 Census Tract Demographics

Census Tract	Drought Risk Rank	2020 Population[1]	2023 Population[2]	% Change in Population	2016 SVI[3]	2022 SVI[4]	Change in SVI
41025960200	1	2165	2261	4%	0.50	0.71	0.21
41035970700	2	2069	2361	14%	0.72	0.57	-0.16
41035970600	3	1472	1624	10%	0.88	0.87	-0.01
41013950402	4	2397	2739	14%	#N/A	0.51	#N/A
41035970400	5	1474	1679	14%	0.69	0.50	-0.19
41035971500	6	4309	4725	10%	0.95	0.94	-0.01
41035971200	7	2547	2156	-15%	0.88	0.91	0.03
41031960100	8	2482	2163	-13%	0.38	0.50	0.13
41023960100	9	2050	2214	8%	0.62	0.65	0.03
41035970500	10	1608	1663	3%	0.60	0.54	-0.06

[1] 2020 Decennial Census Census Tract Level Population Data HC2020.P1 - 2020 data was used rather than 2018 due to changes in census tract boundaries in 2020

[2] 2023 ACS 5-Year Estimates Census Tract Level Age and Sex Data S0101

[3] 2016 US CDC Social Vulnerability Index - "#N/A" cells represent census tracts that did not exist before changes to census tract boundaries in 2020

[4] 2022 US CDC Social Vulnerability Index

Drought Risk Rank 1—Harney County 41025960200

This census tract encompasses much of Harney County in Oregon's Outback of Southeastern Oregon. The NRI reports relatively moderate drought risk for this area, with a score of 94.6. The NRI does not estimate population at risk for this hazard. In this rural county, distances to hospitals and occurrence of drought events drive risk.

Figure 9.3.4-2: First ranked census tract for drought hazard

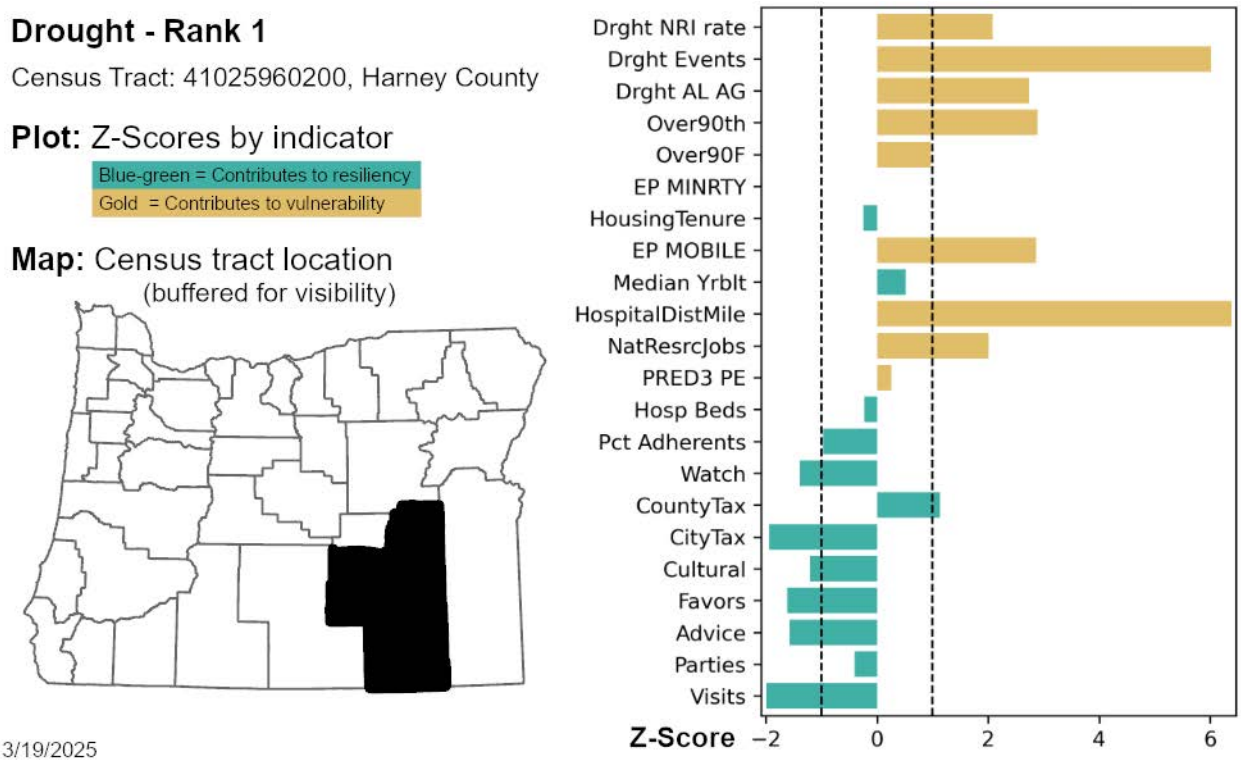


Table 9.3.4-3: State-owned facilities

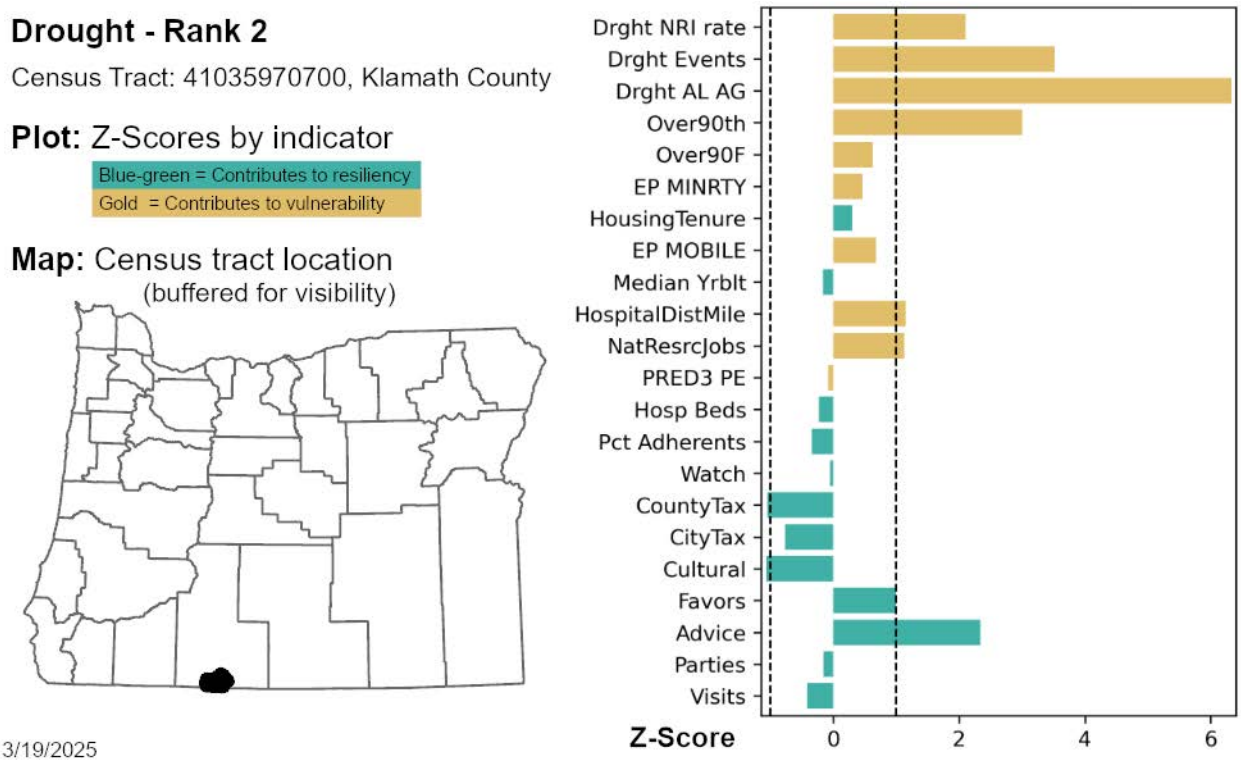
	Building Name	Value	Source
State-owned	Brown Reservoir (Dept. State Lands)	unknown	OWRD

No critical facilities are identified for the drought hazard.

Drought Risk Rank 2 – Klamath County 41035970700

This census tract is located near Klamath Falls, Oregon, in southern Oregon. The NRI reports a relatively moderate drought risk for this area. The NRI does not estimate population at risk for this hazard. A higher-than-average number of hot days, a higher-than-average drought rate, coupled with higher-than-average drought events, drives risk in this analysis.

Figure 9.3.4-3: Second ranked census tract for drought hazard

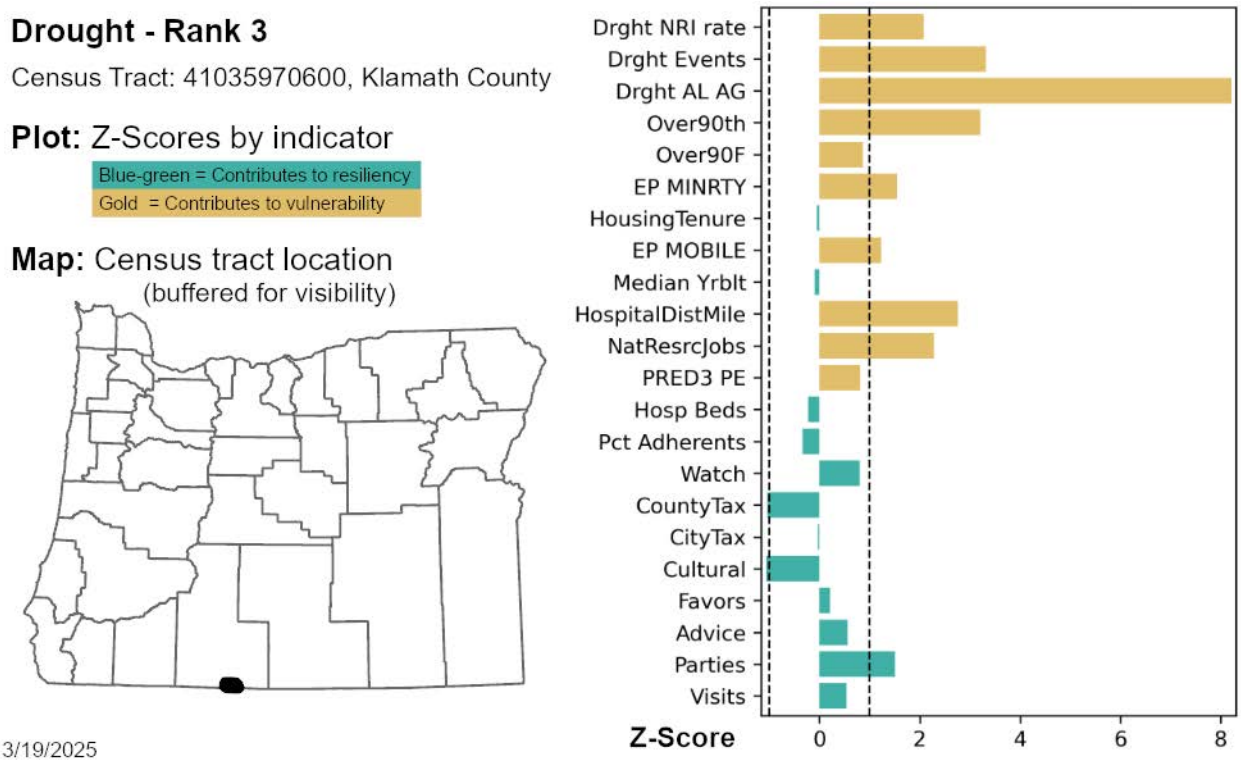


No state-owned buildings or critical facilities are identified for the drought hazard.

Drought Risk Rank 3 – Klamath County 41035970600

This census tract is located east of Klamath Falls, Oregon, in southern Oregon. The NRI reports a relatively moderate drought risk for this area. The NRI does not estimate population at risk for this hazard. High estimated social cohesion supports community resilience, but higher than average drought and heat occurrences drive risk in this area.

Figure 9.3.4-4: Third ranked census tract for drought hazard

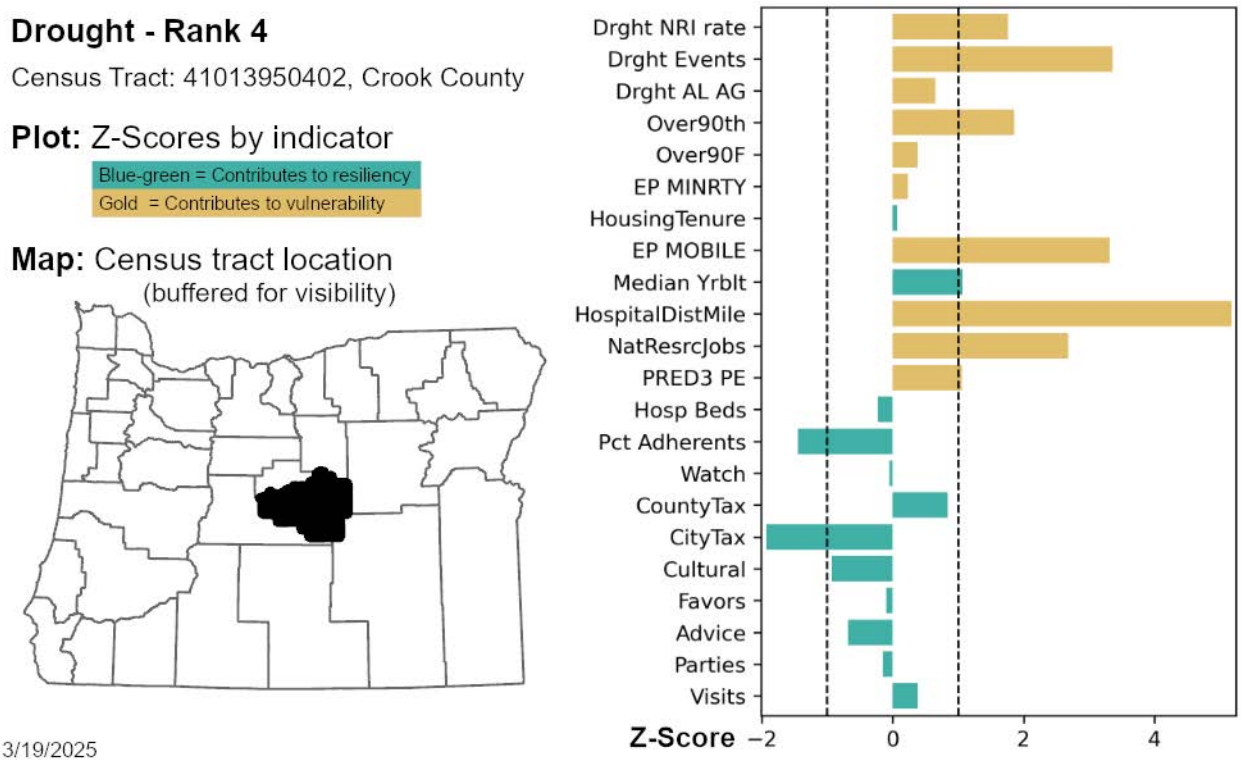


No state-owned buildings or critical facilities are identified for the drought hazard.

Drought Risk Rank 4 – Crook County 41013950402

This census tract is located east of Bend, Oregon, in central Oregon. The NRI reports a relatively low drought risk for this area, with a score of 83.1. The NRI does not estimate population at risk of this hazard. In this analysis, reliance on natural resource jobs, higher-than-average distances to hospitals, higher-than-average manufactured homes, and higher drought occurrences drive risk.

Figure 9.3.4-5: Fourth ranked census tract for drought hazard

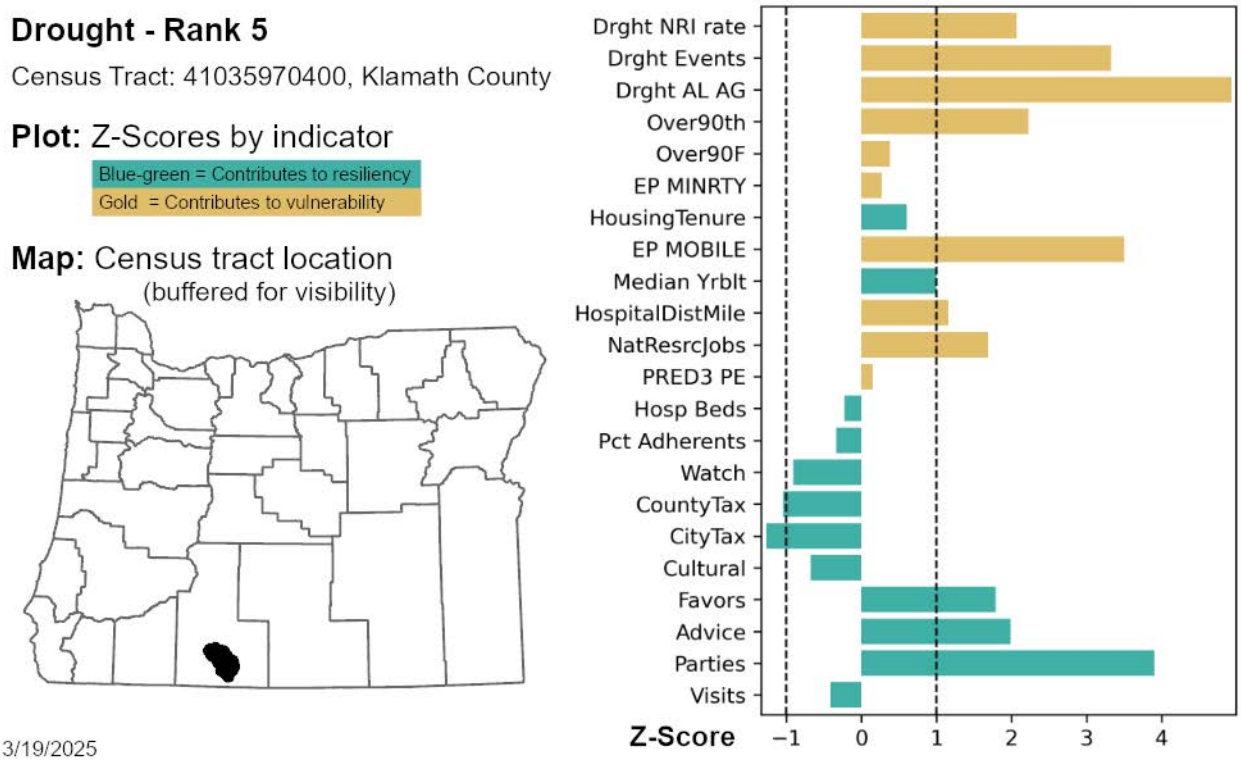


No state-owned buildings or critical facilities are identified for the drought hazard.

Drought Risk Rank 5 – Klamath County 41035970400

This census tract is located east of Klamath Falls, Oregon, in southern Oregon. The NRI reports a relatively moderate drought risk for this area. The NRI does not estimate population at risk for this hazard. In this analysis, higher than average drought occurrences drive risk in this area.

Figure 9.3.4-6: Fifth ranked census tract for drought hazard

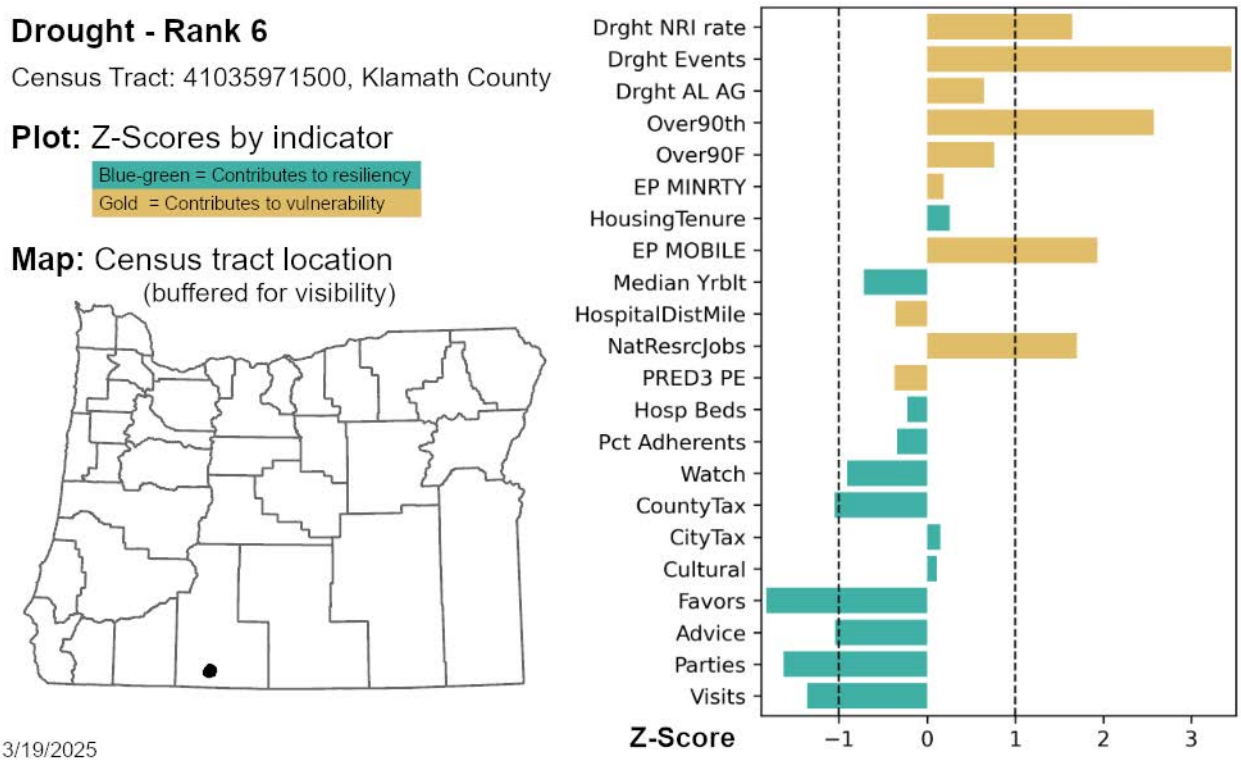


No state-owned buildings or critical facilities are identified for the drought hazard.

Drought Risk Rank 6-- Klamath County 41035971500

This census tract is located between Klamath Falls and Altamont, Oregon, in Southern Oregon. The NRI reports a relatively moderate drought risk for this area. The NRI does not estimate population at risk for this hazard. Droughts that affect agriculture, and a higher-than-average prevalence of drought events drive risk in this analysis.

Figure 9.3.4-7: Sixth ranked census tract for drought hazard

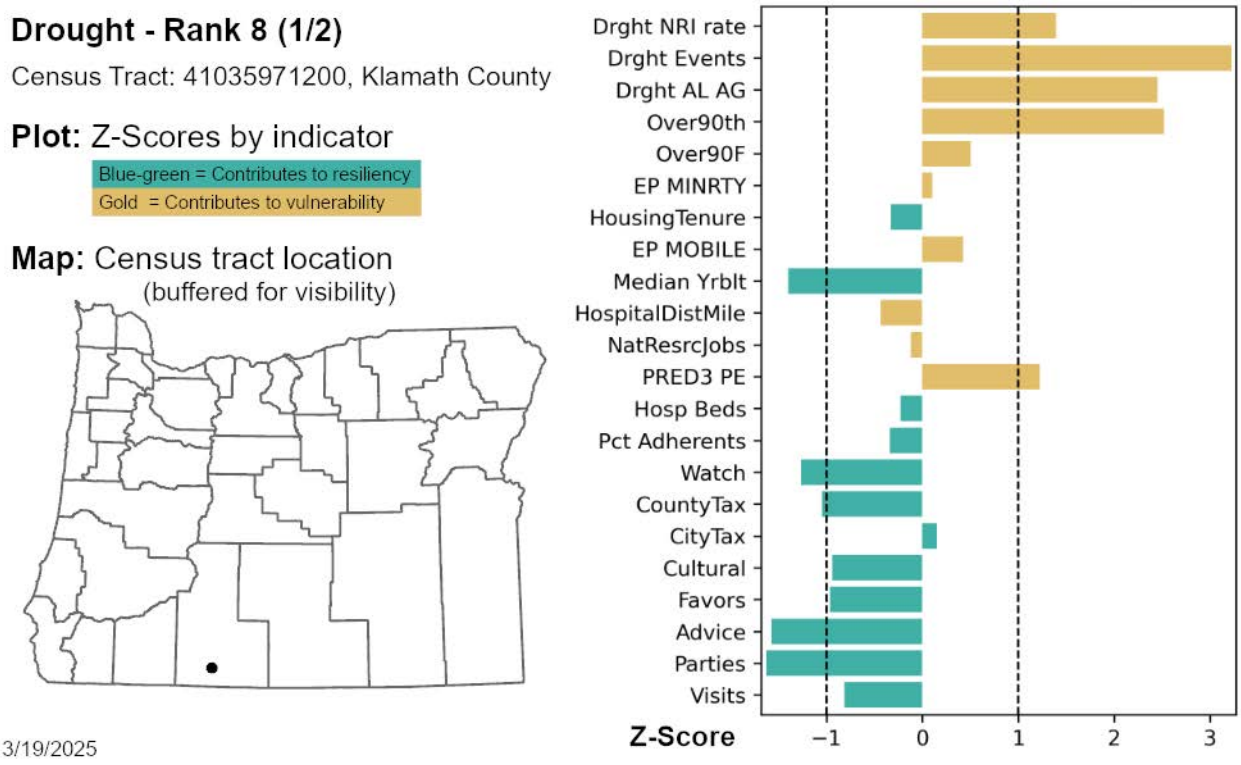


No state-owned buildings or critical facilities are identified for the drought hazard.

Drought Risk Rank 7 – Klamath County 41035971200

This census tract is located south of Klamath Falls, in southern Oregon. The NRI reports a relatively very low drought risk for this area. The NRI does not estimate population at risk for this hazard. Droughts that affect agriculture drive risk in this analysis.

Figure 9.3.4-8: Eighth ranked census tract for drought hazard

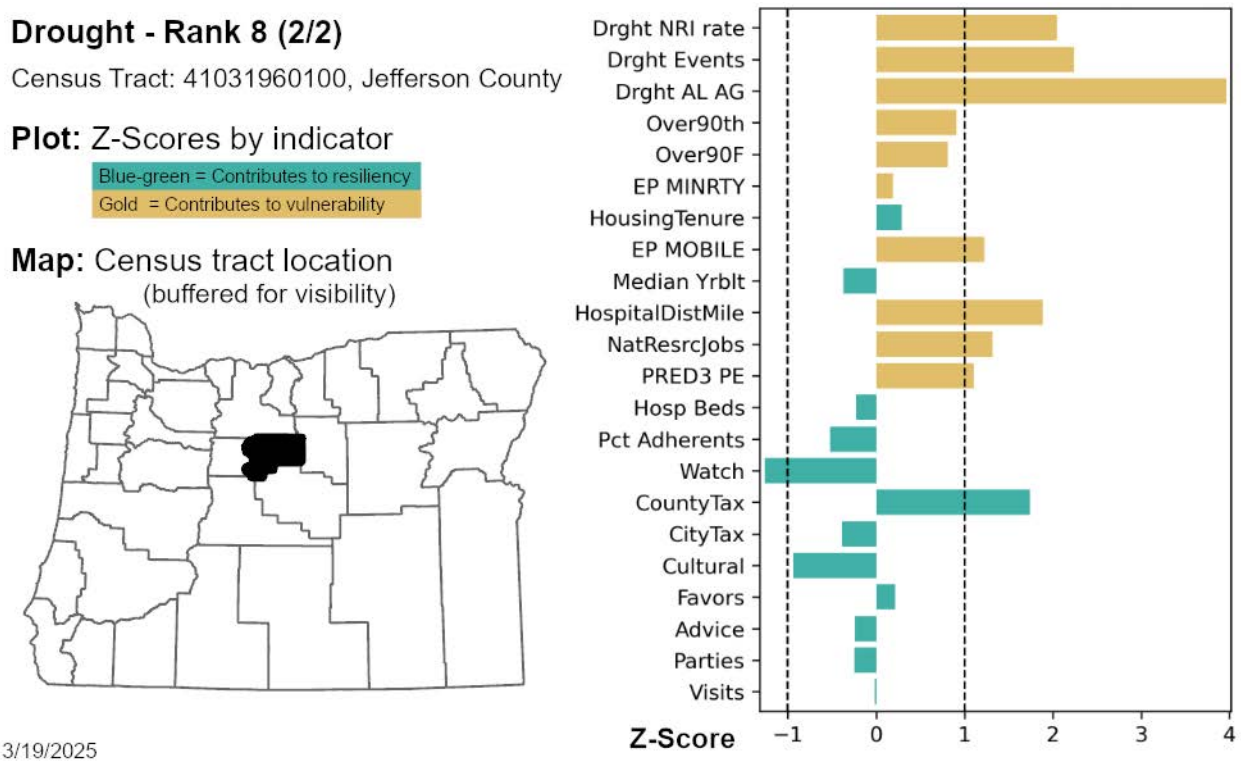


No state-owned buildings or critical facilities are identified for the drought hazard.

Drought Risk Rank 8—Jefferson County 41031960100

This census tract in Jefferson County is rural and remote. Drought affects agricultural activities, and natural resource jobs.

Figure 9.3.4-9: Eighth ranked census tract for drought hazard



No state-owned buildings or critical facilities are identified for the drought hazard.

Drought Risk Rank 9 – Grant County 41031960100

This census tract is located west of Baker City, in eastern Oregon. The NRI reports a relatively low drought risk for this area, with a score of 82.1. The NRI does not estimate population at risk of this hazard. In this analysis, local tax capacity and low social cohesion and community resilience negatively influence drought risk. Additionally, a reliance on natural resource jobs, and higher than average distance to hospitals drive risk in this area.

Figure 9.3.4-10: Ninth ranked census tract for drought hazard

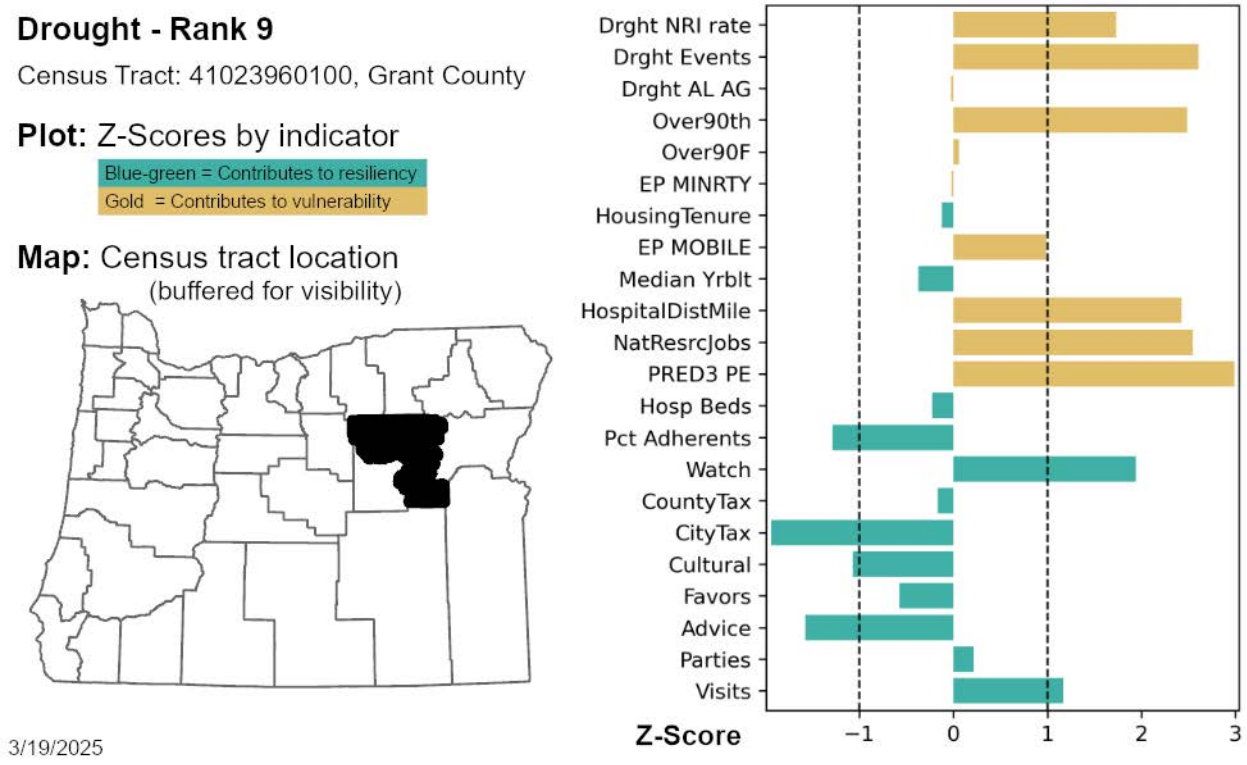


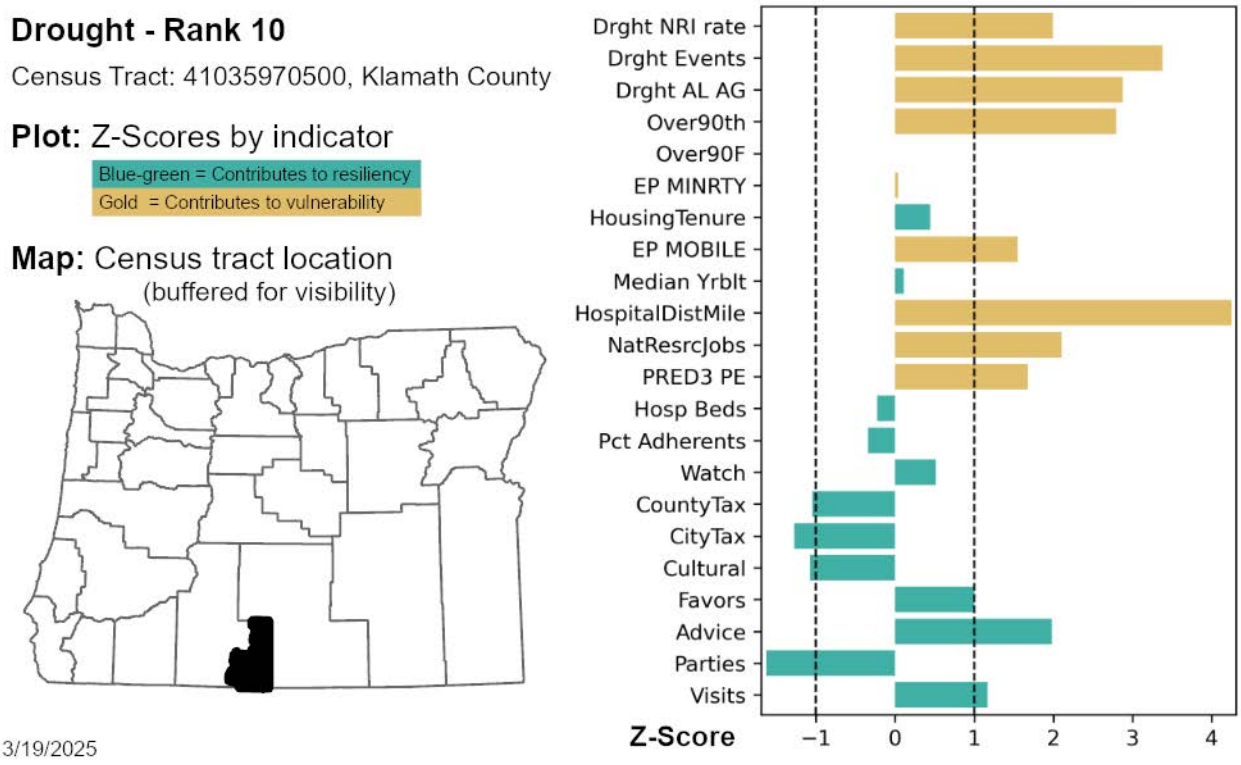
Table 9.3.4-4: State-owned buildings or critical facilities

	Building Name	Value ($)	Source
State-owned	Bull Prairie Reservoir (ODFW), Canyon Creek Meadows Dame (ODFW)	unknown	OWRD
State-owned	Bates Reservoir (OSP)	unknown	OWRD

Drought Risk Rank 10 – Klamath County 41035970500

This census tract is located east of the city of Klamath Falls, Oregon, in southern Oregon. The NRI reports a relatively low drought risk for this area. The NRI does not estimate population at risk for this hazard. In this analysis a high number of drought events coupled with low community resilience drive risk.

Figure 9.3.4-11: Tenth ranked census tract for drought hazard



No state-owned buildings or critical facilities are identified for the drought hazard.

9.3.5 Extreme Heat

9.3.5.1 Hazard Scenario

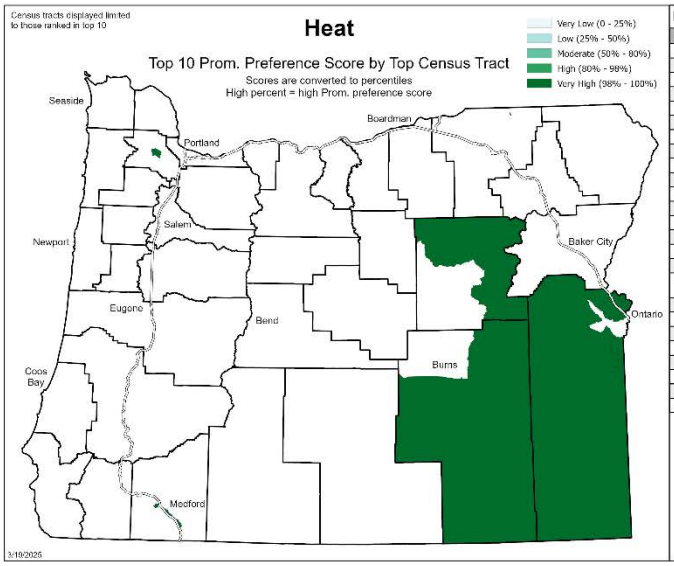
Mean number of days that are above the historic 90th percentile temp.

Mean number of days above 90 degrees Fahrenheit.

Ranking did not account for acclimatization or heat island effects.

9.3.5.2 Top Ranked Extreme Heat Risk Areas

Figure 9.3.5-1: Top Ranked Risk Areas in Heat Risk Areas



Indicators used for the hazard Hazard indicators are worth 35% of the total weight.

Hazard	Indicator Name	Direction	Weight	Short Description
Heat	Over90th	1	0.05	Mean days that are above the historic 90th percentile temp
Heat	Over90F	1	0.05	Mean days above 90 degrees Fahrenheit
Heat	Heat_Events	1	0.05	Number of heat events.
Heat	Heat_ALAG	1	0.05	Annualized loss to agriculture from heat.
Heat	Heat_ALPOP	1	0.05	Annualized loss to population from heat.
Heat	OutdoorJobs	1	0.05	Rate of jobs that occur outside.
Heat	TreeCan_avg	-1	0.05	Tree canopy density
General	EP_MINRTY	1	0.046	Percentage of Black, Indigenous, and People of Color (2020 Census).
General	HousingTenure	-1	0.046	Housing tenure from the US Census.
General	EP_MOBILE	1	0.046	Percentage of people that live in mobile homes
General	Median_Yrblt	-1	0.046	Median year built of general building stock based on HAZUS default.
General	HospitalDistMile	1	0.046	Distance from tract centroid to nearest hospital.
General	NatResrcJobs	1	0.046	Rate of natural resource jobs.
General	PRED3_PE	1	0.046	Community Resilience Estimate
General	Hosp_Beds	-1	0.046	Estimated number of hospital beds based on square footage .
General	Pct_Adherents	-1	0.046	Percentage of members to a religious group
General	Mitigation	-1	0.046	Number of migitation projects (grouped by zip code and evenly distributed to overlaying tracts)
General	Watch	-1	0.046	Neighborliness: Will watch neighbor's house
General	CountyTax	-1	0.046	County tax rate
General	CityTax	-1	0.046	City tax rate
General	Cultural	-1	0.009	Number of cultural-related buildings
General	Favors	-1	0.009	Neighborliness: Willing to do favors for neighbor
General	Advice	-1	0.009	Neighborliness: Seeks advice from neighbor
General	Parties	-1	0.009	Neighborliness: Attended parties that occur in neighborhood
General	Visits	-1	0.009	Neighborliness: Has visited neighbor's house

Table 9.3.5-1: Oregon Natural Hazard Risk Assessment Rank Compared to the National Risk Index

Oregon Rank	Census Tract	County	National Risk Index Hazard Rating	Exposed Population According to NRI
1	41029000100	Jackson	Relatively low	5860
2	41025960200	Harney	Relatively low	2145
3	41045970700	Malheur	Relatively moderate	1740
4	41045970900	Malheur	Relatively high	5653
5	41059950201	Umatilla	Relatively high	4171
6	41045970200	Malheur	Relatively high	4979

Oregon Rank	Census Tract	County	National Risk Index Hazard Rating	Exposed Population According to NRI
7	41029000800	Jackson	Relatively moderate	7284
8	41067032800	Washington	Relatively low	1309
9	41029002400	Jackson	Relatively low	2134
10	41023960100	Grant	Relatively low	1446

*Compared to census tracts nationwide

Table 9.3.5-2: Top 10 Census Tract Demographics

Census Tract	Heat Risk Rank	2020 Population[1]	2023 Population[2]	% Change in Population	2016 SVI[3]	2022 SVI[4]	Change in SVI
41029000100	1	2063	2390	16%	1.00	0.99	-0.01
41025960200	2	2165	2261	4%	0.50	0.71	0.41
41045970700	3	1740	1975	14%	0.54	0.52	-0.04
41045970900	4	5670	6202	9%	0.69	0.70	0.01
41059950201	5	4171	3639	-13%	#N/A	0.97	#N/A
41045970200	6	4979	4621	-7%	0.97	0.86	-0.11
41029000800	7	7284	7075	-3%	0.90	0.85	-0.05
41067032800	8	1309	1290	-1%	0.22	0.17	-0.20
41029002400	9	2134	2397	12%	0.41	0.66	0.63
41023960100	10	2050	2214	8%	0.62	0.65	0.05

[1] 2020 Decennial Census Census Tract Level Population Data HC2020.P1 - 2020 data was used rather than 2018 due to changes in census tract boundaries in 2020

[2] 2023 ACS 5-Year Estimates Census Tract Level Age and Sex Data S0101

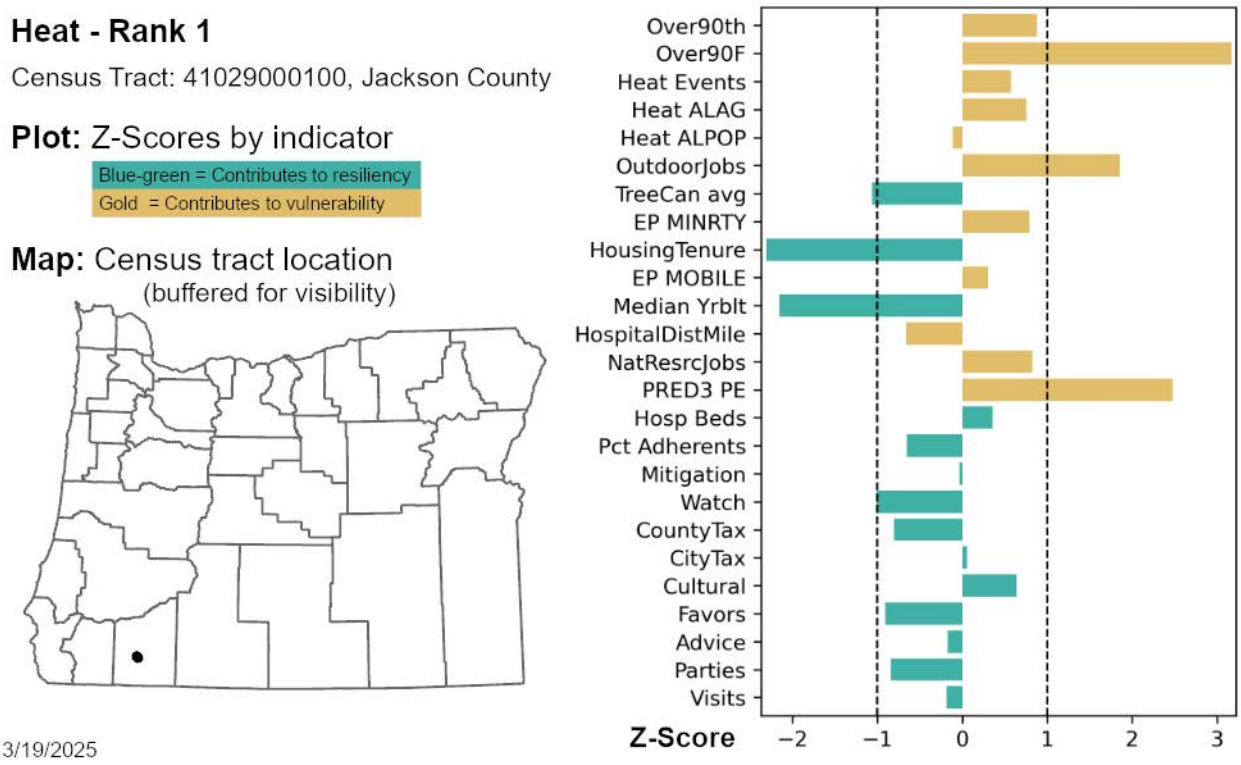
[3] 2016 US CDC Social Vulnerability Index - "#N/A" cells represent census tracts that did not exist before changes to census tract boundaries in 2020

[4] 2022 US CDC Social Vulnerability Index

Extreme Heat Risk Rank 1 – Jackson County 41029000100

This census tract encompasses the city of Medford, Oregon, in southern Oregon. The NRI reports a relatively low heat risk in this area, with a score of 46.8. The NRI estimates the entire population (100%) of this census tract as at-risk of extreme heat. In this analysis, a higher prevalence of heat events, low community resilience, and an older housing stock drives risk.

Figure 9.3.5-2: First ranked census tract for heat hazard



No state-owned buildings or critical facilities identified.

Extreme Heat Risk Rank 2 – Harney County: 41025960200

This rural census tract encompasses much of Harney County. The NRI reports a relatively low heat risk in this area, with a score of 42.8. The NRI estimates the entire population (100%) of this census tract as at-risk of extreme heat. In this analysis, a higher-than-average reliance on outdoor jobs, natural resource jobs, low social cohesion, and higher than average distance to hospitals are the primary drivers of risk.

Figure 9.3.5-3: Second ranked census tract for heat hazard

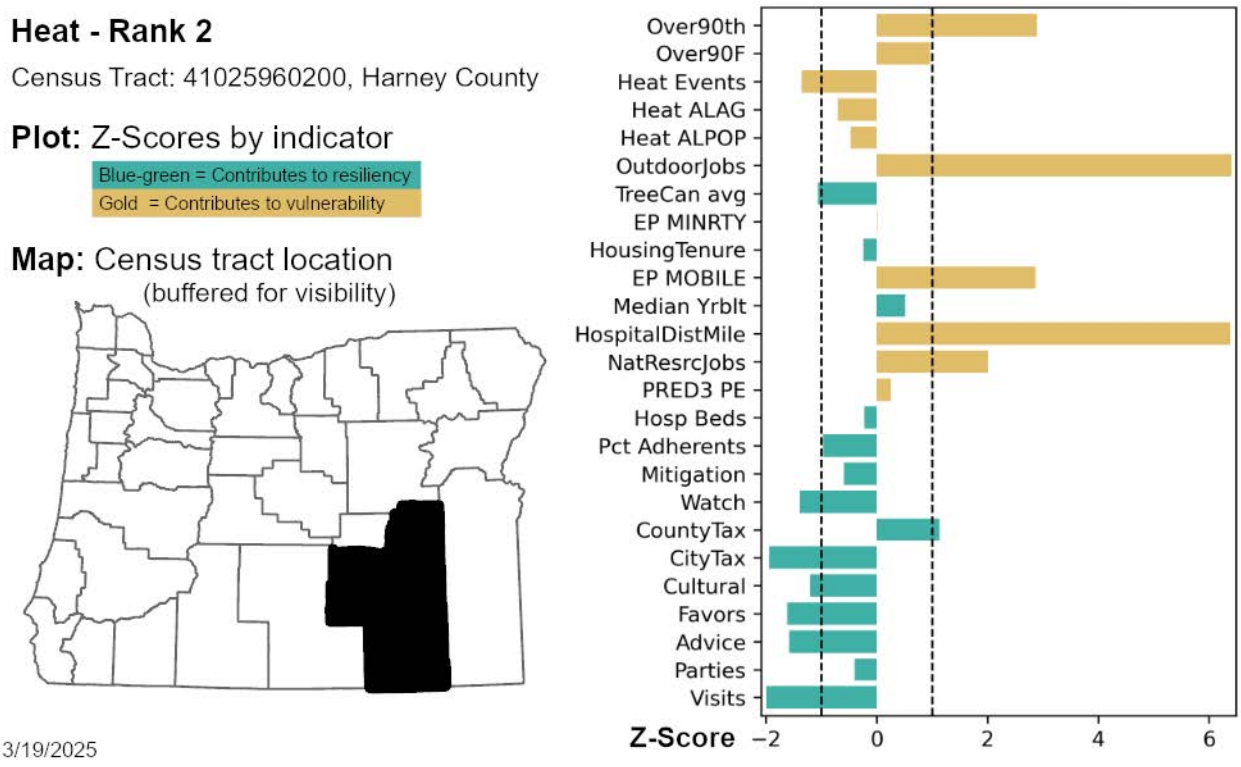


Table 9.3.5-3: State-owned buildings

	Building Name	Value ($)	Source
State-owned	Stinkingwater Mountain Sand Shed	431817	DOGAMI/DAS
State-owned	Pete French Round Barn	509322	DOGAMI/DAS
State-owned	Sagehen Hill RA Grounds	835829	DOGAMI/DAS
State-owned	Stinking Water Scoop Shed	82741	DOGAMI/DAS
State-owned	Sagehen Hill RA Grounds	486577	DOGAMI/DAS
State-owned	Frenchglen Hotel	690192	DOGAMI/DAS
State-owned	Frenchglen Hotel	175447	DOGAMI/DAS

	Building Name	Value ($)	Source
State-owned	Buchanan Springs RA Shelter	106513	DOGAMI/DAS
State-owned	Site Systems – Steens Radio Operating Exp Grounds	31564	DOGAMI/DAS
State-owned	Steens Radio Building	76217	DOGAMI/DAS
State-owned	Site Systems – King Mountain M/W Grounds	31564	DOGAMI/DAS
State-owned	King Mountain M/W Building	60474	DOGAMI/DAS
State-owned	King Mountain M/W Battery Building	60474	DOGAMI/DAS
State-owned	Alkali Lake MS Deicer Building	156455	DOGAMI/DAS
State-owned	Alkali Lake MS Residence Garage	104851	DOGAMI/DAS
State-owned	Alkali Lake MS Residence Garage	104851	DOGAMI/DAS
State-owned	Alkali Lake MS Mobile Home 17	274408	DOGAMI/DAS
Critical facility	DREWSEY ELEMENTARY SCHOOL	190960	DOGAMI/DAS
Critical facility	CRANE ELEMENTARY SCHOOL	1070893	DOGAMI/DAS
Critical facility	CRANE UNION HIGH SCHOOL	1581720	DOGAMI/DAS
Critical facility	CRANE UNION HIGH SCHOOL	92838	DOGAMI/DAS
Critical facility	CRANE UNION HIGH SCHOOL	202202	DOGAMI/DAS
Critical facility	CRANE UNION HIGH SCHOOL	68603	DOGAMI/DAS
Critical facility	CRANE UNION HIGH SCHOOL	165974	DOGAMI/DAS
Critical facility	CRANE UNION HIGH SCHOOL	165974	DOGAMI/DAS
Critical facility	CRANE ELEMENTARY SCHOOL	98478	DOGAMI/DAS
Critical facility	FIELDS ELEMENTARY SCHOOL	1111350	DOGAMI/DAS
Critical facility	FIELDS ELEMENTARY SCHOOL	421350	DOGAMI/DAS
Critical facility	DIAMOND ELEMENTARY SCHOOL	39964	DOGAMI/DAS
Critical facility	CRANE UNION HIGH SCHOOL	783727	DOGAMI/DAS
Critical facility	CRANE UNION HIGH SCHOOL	88801	DOGAMI/DAS
Critical facility	CRANE ELEMENTARY SCHOOL	6311	DOGAMI/DAS

	Building Name	Value ($)	Source
Critical facility	DIAMOND ELEMENTARY SCHOOL	39964	DOGAMI/DAS
Critical facility	Double O Elementary School	323300	DOGAMI/DAS
Critical facility	Frenchglen Elementary School	288690	DOGAMI/DAS
Critical facility	Communication Structure	750000	DOGAMI/DAS
Critical facility	Communication Structure	33750	DOGAMI/DAS
Critical facility	Communication Structure	750000	DOGAMI/DAS
Critical facility	Communication Structure	750000	DOGAMI/DAS
Critical facility	Communication Structure	750000	DOGAMI/DAS
Critical facility	BUREAU OF LAND MANAGEMENT – BURNS FIELD OFFICE	2016150	DOGAMI/DAS
Critical facility	Burns Municipal Airport	2654381	DOGAMI/DAS
Critical facility	Roaring Springs Ranch Airport	402150	DOGAMI/DAS
Critical facility	El Rancho Airport	85950	DOGAMI/DAS
Critical facility	Wildhorse Valley Airport	750000	DOGAMI/DAS
Critical facility	Barton Lake Ranch	377700	DOGAMI/DAS
Critical facility	Wagontire	270450	DOGAMI/DAS
Critical facility	Arnold Airstrip	750000	DOGAMI/DAS
Critical facility	Whitehorse Ranch Airport	750000	DOGAMI/DAS

Extreme Heat Risk Rank 3– Malheur County 41045970700

This census tract is in eastern Oregon, on the border with Idaho. The NRI reports a relatively moderate heat risk in this area, with a score of 71.9. The NRI estimates the entire population (100%) of this census tract as at-risk of extreme heat. Extreme high and low temperatures, and a higher-than-average annualized loss to population due to heat drives risk in this area. Additionally, variable social cohesion and slightly lower community resilience affects extreme heat risks in this area.

Figure 9.3.5-4: Third ranked census tract for heat hazard

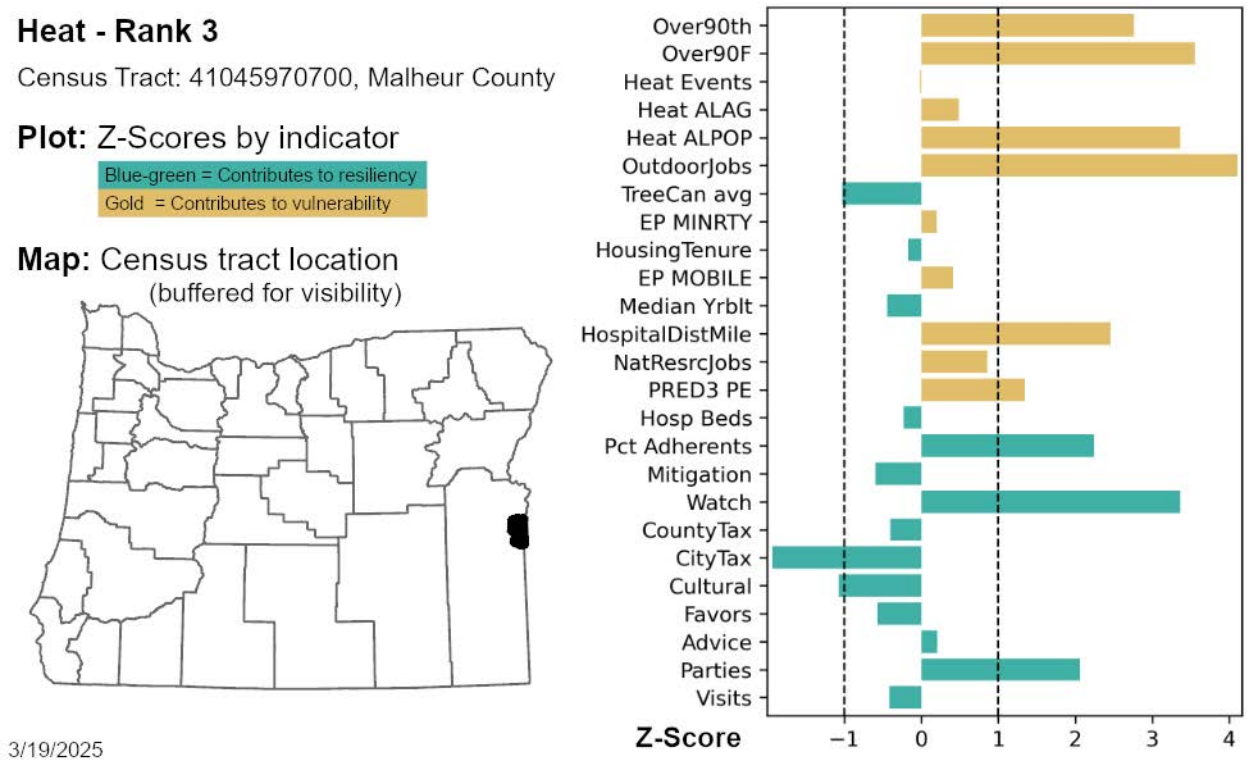


Table 9.3.5-4: State owned buildings and Critical Facilities 41045970700

	Name	Value	Source
State-owned	Vault Single – CXT (Indian Creek-ADA)	38472	DOGAMI/DAS
State-owned	Vault Single – CXT (Indian Creek Boat Ramp-ADA)	20675	DOGAMI/DAS
Critical Facility	ADRIAN HIGH SCHOOL	2844900	DOGAMI/DAS
Critical Facility	ADRIAN HIGH SCHOOL	3365100	DOGAMI/DAS
Critical Facility	ADRIAN HIGH SCHOOL	3127050	DOGAMI/DAS
Critical Facility	ADRIAN HIGH SCHOOL	431400	DOGAMI/DAS

	Name	Value	Source
Critical Facility	ADRIAN HIGH SCHOOL	1031550	DOGAMI/DAS
Critical Facility	ADRIAN HIGH SCHOOL	533850	DOGAMI/DAS
Critical Facility	ADRIAN HIGH SCHOOL	139950	DOGAMI/DAS
Critical Facility	ADRIAN HIGH SCHOOL	764400	DOGAMI/DAS

Extreme Heat Risk Rank 4 – Malheur County 41045970900

This census tract encompasses much of Malheur County. The NRI reports a relatively high heat risk in this area, with a score of 89.9. According to the NRI, almost all (99.7) of the population is at risk to this hazard. In this analysis, higher than average distance to hospitals and higher than average annualized loss to the population due to heat events drives risk.

Figure 9.3.5-5: Fourth ranked census tract for heat hazard

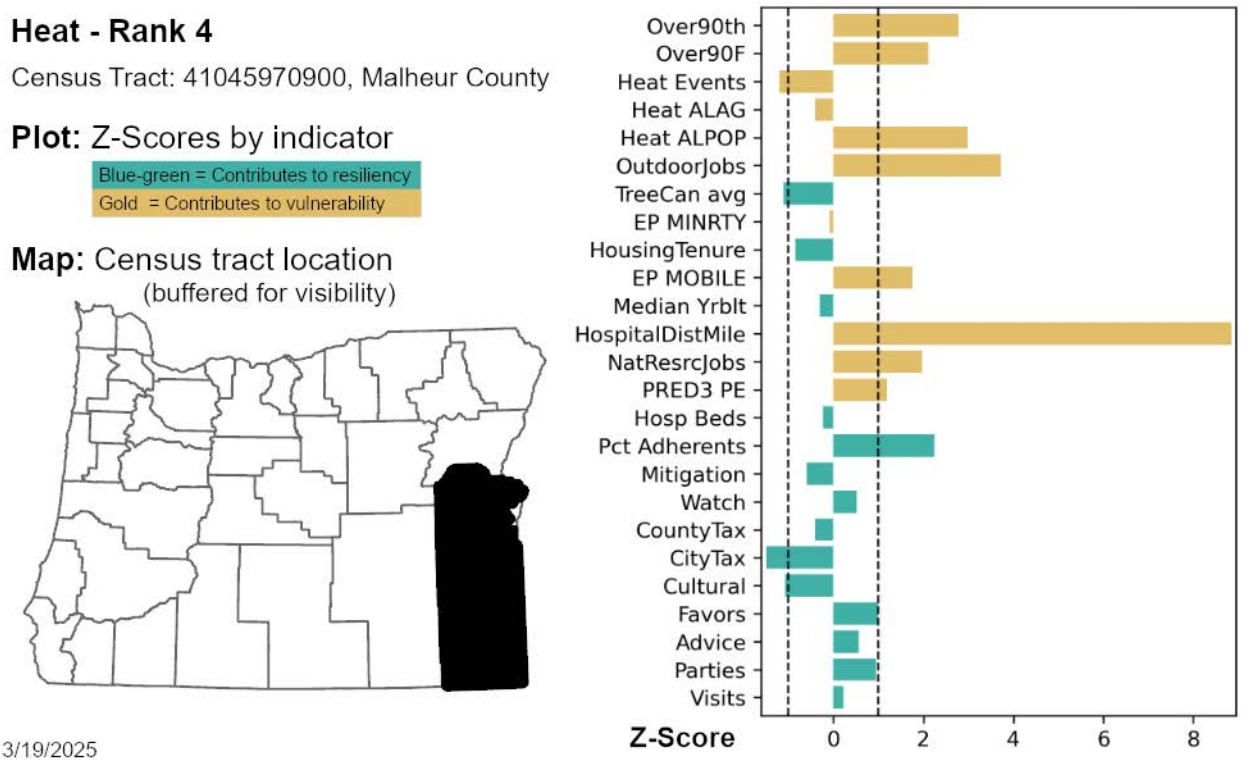


Table 9.3.5-5: State-owned buildings or critical facilities

No state-owned building or critical facilities identified.

Extreme Heat Risk Rank 5 – Umatilla County 41059950201

This census tract is located in Milton-Freewater, in the northeast corner of Oregon. The NRI reports a relatively high heat risk in this area, with a score of 82.2. The NRI estimates the entire population (100%) of this census tract as at-risk of extreme heat. In this analysis, higher than average distances to hospitals, somewhat low social cohesion, and higher prevalence of heat events and loss to the population as a result of these heat events, drives heat risk in this area.

Figure 9.3.5-6: Fifth ranked census tract for heat hazard

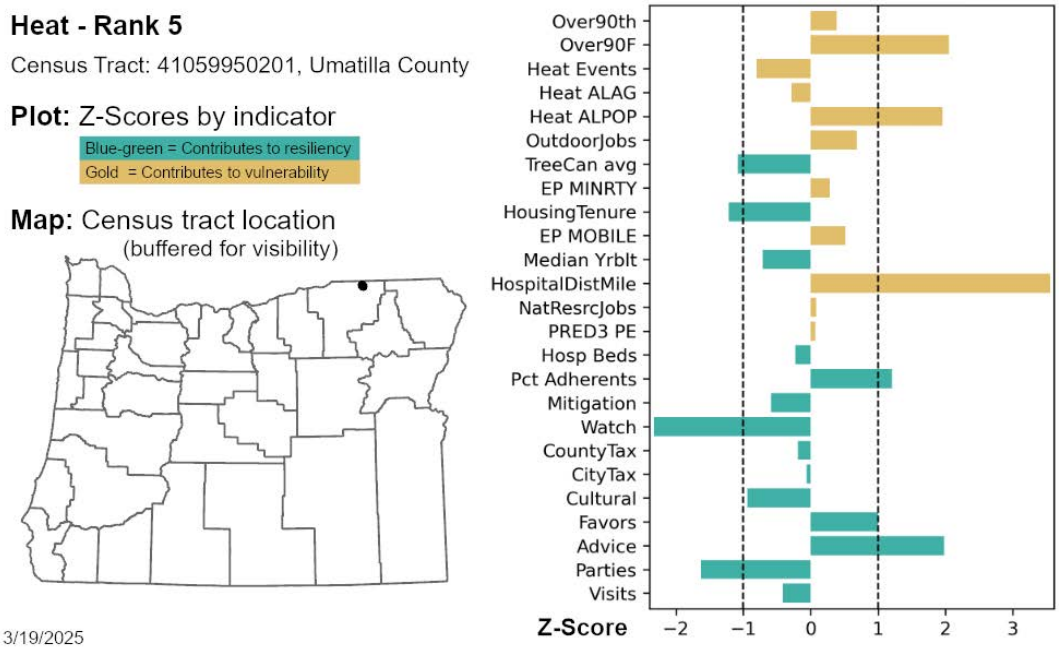


Table 9.3.5-6: Critical Facilities 41059950201

	Building Name	Value	Source	
Critical Facility	Ferndale Elementary School	unknown	RAPT	
Critical Facility	Mcloughlin High School	unknown	RAPT	
Critical Facility	Gib Olinger Elementary School	unknown	RAPT	
Critical Facility	Cascade Valley Assisted Living	unknown	RAPT	
Critical Facility	Evergreen Oregon Rehabilitation	unknown	RAPT	

No state-owned building identified.

Extreme Heat Risk Rank 6 – Malheur County 4105970200

This census tract encompasses the northeast corner of Malheur County in eastern Oregon. The NRI reports a relatively high heat risk in this area, with a score of 91.5. The NRI estimates the entire population (100%) of this census tract as at-risk of extreme heat. In this analysis, high heat events and higher-than-average annualized loss to the population drives heat risk. Additionally, a reliance on natural resource jobs and outdoor jobs influences heat risk.

Figure 9.3.5-7: Sixth ranked census tract for heat hazard

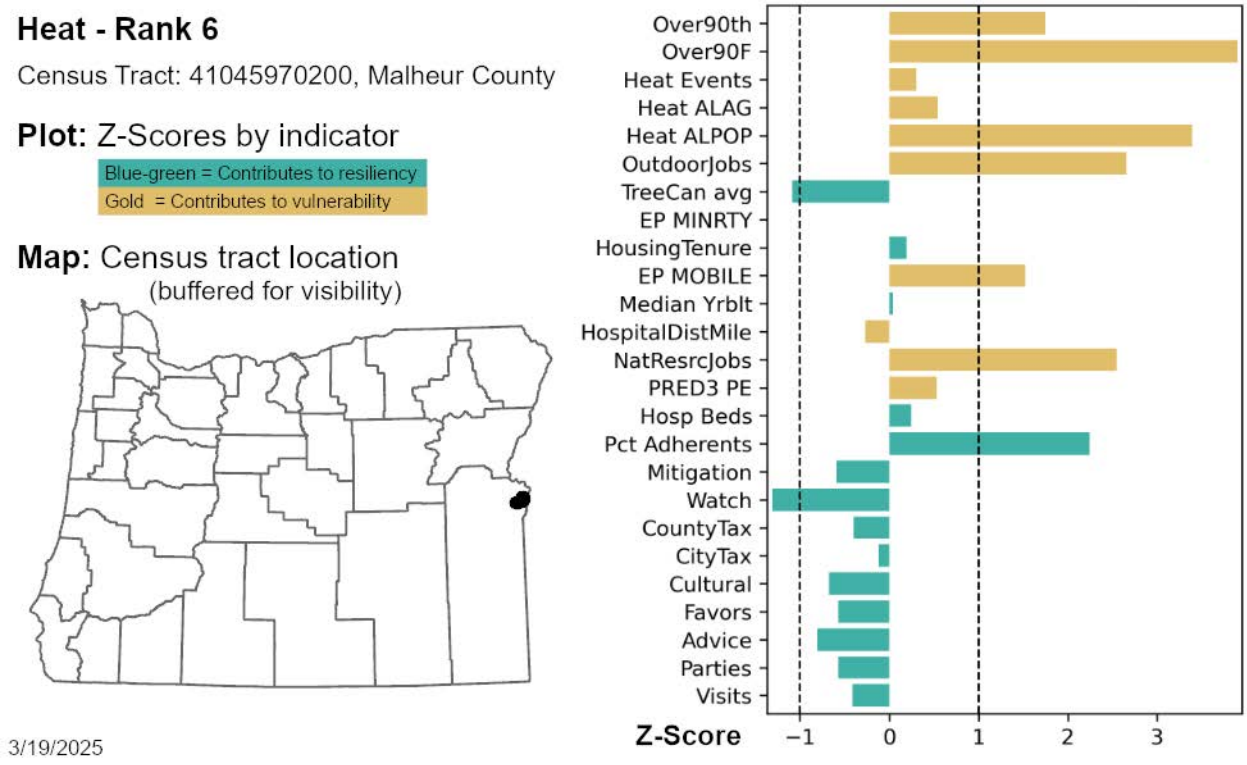


Table 9.3.5-7: Critical facilities 41045970200

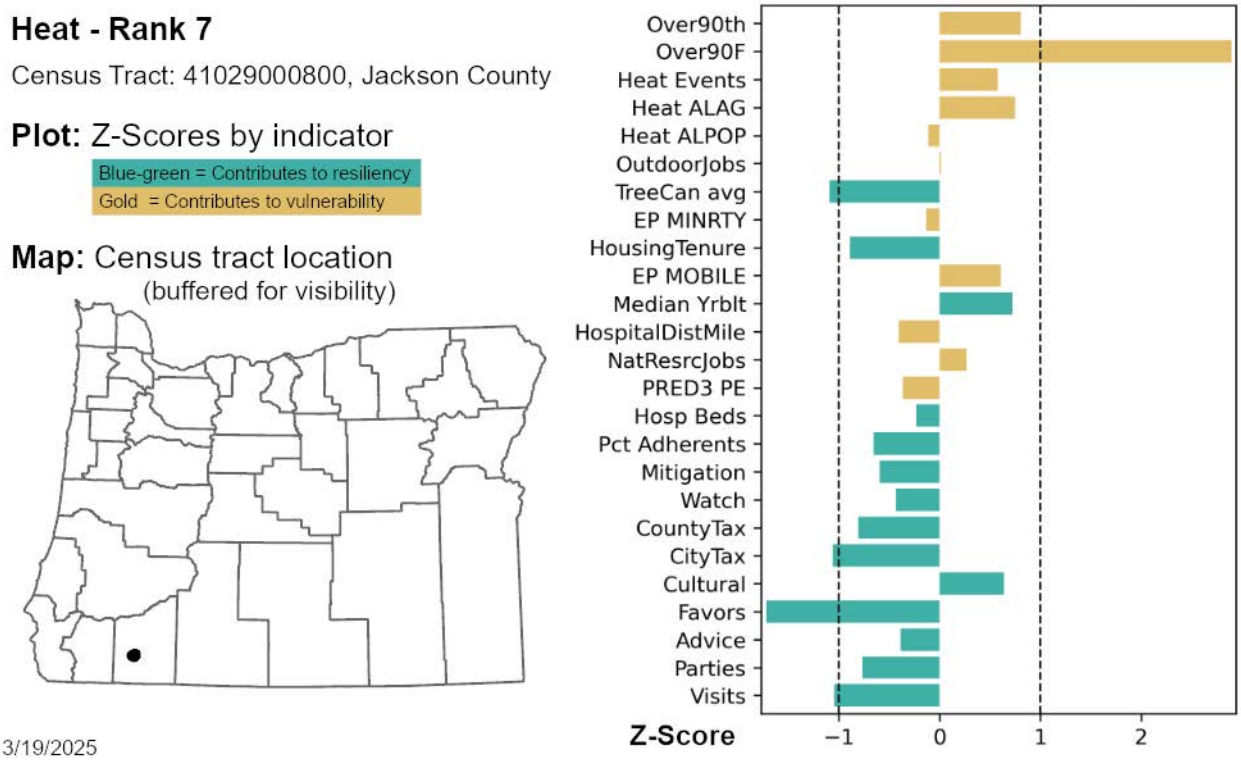
	Building Name	Value	Source
Critical Facility	FOUR RIVERS COMMUNITY SCHOOL	1599450	DOGAMI/DAS
Critical Facility	TREASURE VALLEY CHRISTIAN SCHOOL	1092000	DOGAMI/DAS
Critical Facility	AIKEN ELEMENTARY SCHOOL	5991000	DOGAMI/DAS
Critical Facility	Communication Structure	91050	DOGAMI/DAS
Critical Facility	MALHEUR RIVER CLINIC	2459400	DOGAMI/DAS
Critical Facility	Ontario Municipal Airport	1442850	DOGAMI/DAS

	Building Name	Value	Source
Critical Facility	ONTARIO, CITY OF	178500	DOGAMI/DAS

No state-owned buildings identified.

Extreme Heat Risk Rank 7 – Jackson County 41029000800

Figure 9.3.5-8: Seventh ranked census tract for heat hazard



No state-owned buildings or critical facilities identified.

Extreme Heat Risk Rank 8 – Washington County 41067032800

This census tract is located northwest of Hillsboro, Oregon, in northwest Oregon. The NRI reports a relatively low heat risk in this area, with a score of 41. The NRI estimates the entire population (100%) of this census tract as at-risk of extreme heat. Low social cohesion, and a reliance on outdoor jobs and natural resource jobs, drives risk in this analysis.

Figure 9.3.5-9: Eighth ranked census tract for heat hazard

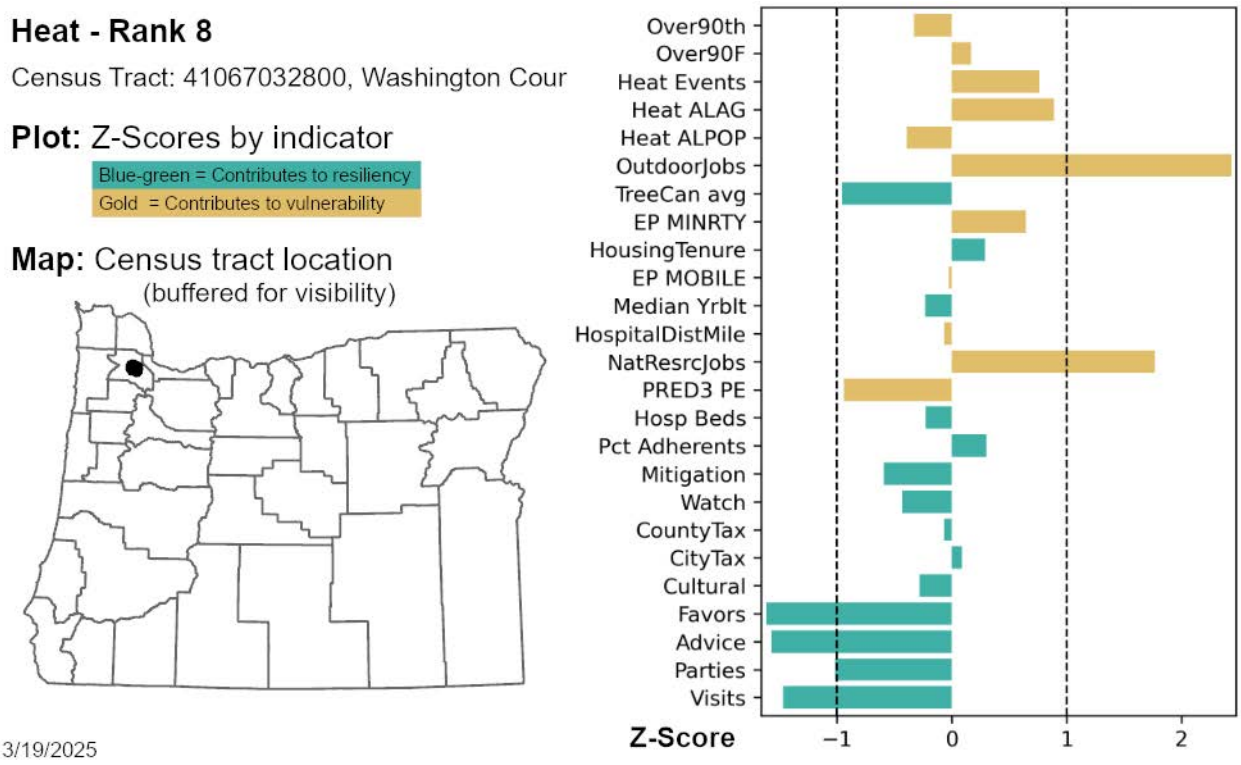


Table 9.3.5-8: State-owned buildings and Critical Facilities 41067032800

	Building Name	Value	Source
State-owned	North Plains Scale House	69027	DOGAMI/DAS
State-owned	Site Systems - North Plains Scale House Grounds	69027	DOGAMI/DAS
Critical Facility	ST FRANCIS OF ASSISI SCHOOL	1490400	DOGAMI/DAS
Critical Facility	VISITATION CATHOLIC SCHOOL	1708050	DOGAMI/DAS
Critical Facility	School Building	345450	DOGAMI/DAS
Critical Facility	Communication Structure	81000	DOGAMI/DAS

	Building Name	Value	Source
Critical Facility	Olinger Airpark	861750	DOGAMI/DAS
Critical Facility	Sunset Air Strip	750000	DOGAMI/DAS
Critical Facility	Skyport	750000	DOGAMI/DAS
Critical Facility	Rieben	750000	DOGAMI/DAS

Extreme Heat Risk Rank 9 – Jackson County 41029002400

This rural census tract is east of Grant's Pass, Oregon, in southern Oregon. The NRI reports a relatively moderate heat risk in this area, with a score of 54.8. The NRI estimates the entire population of this census tract as at-risk of extreme heat. According to the NRI, nearly all (99.7%) of the population is at risk of extreme heat. In this analysis, low estimated social cohesion, coupled with a higher prevalence of high heat days, drives risk.

Figure 9.3.5-10: Ninth ranked census tract for heat hazard

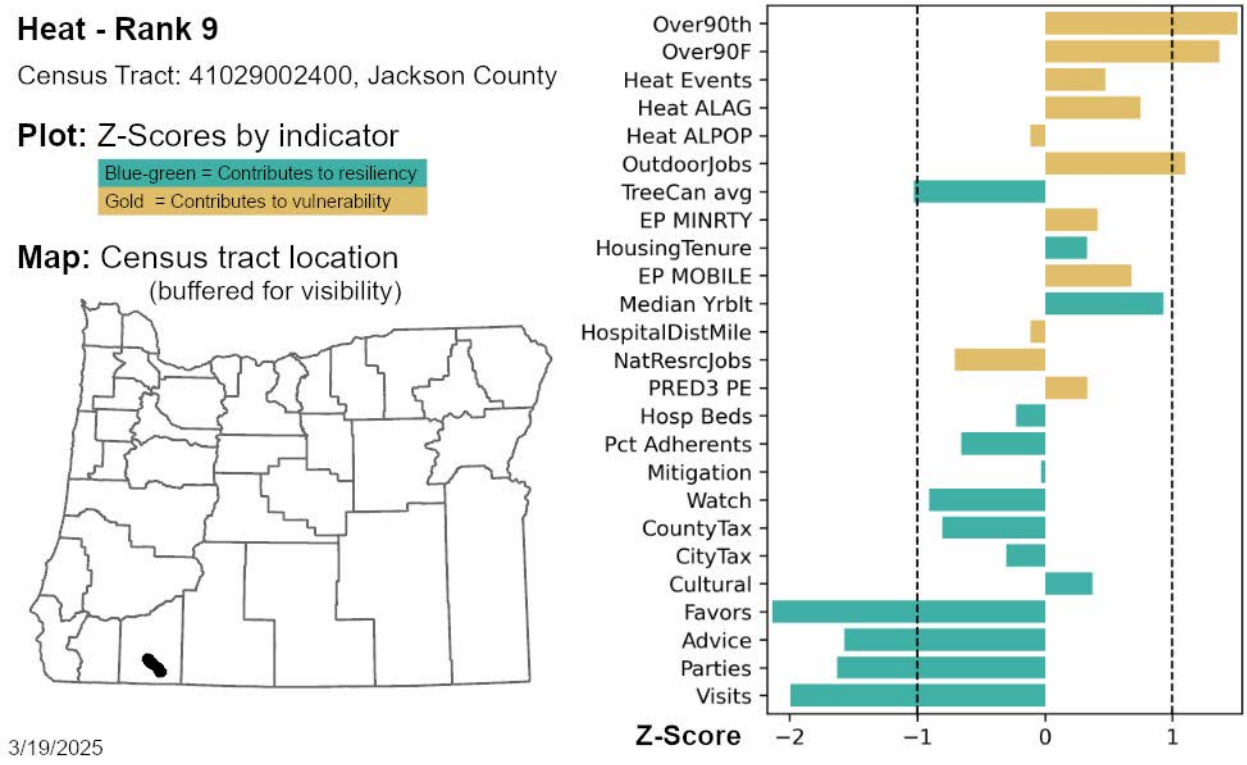


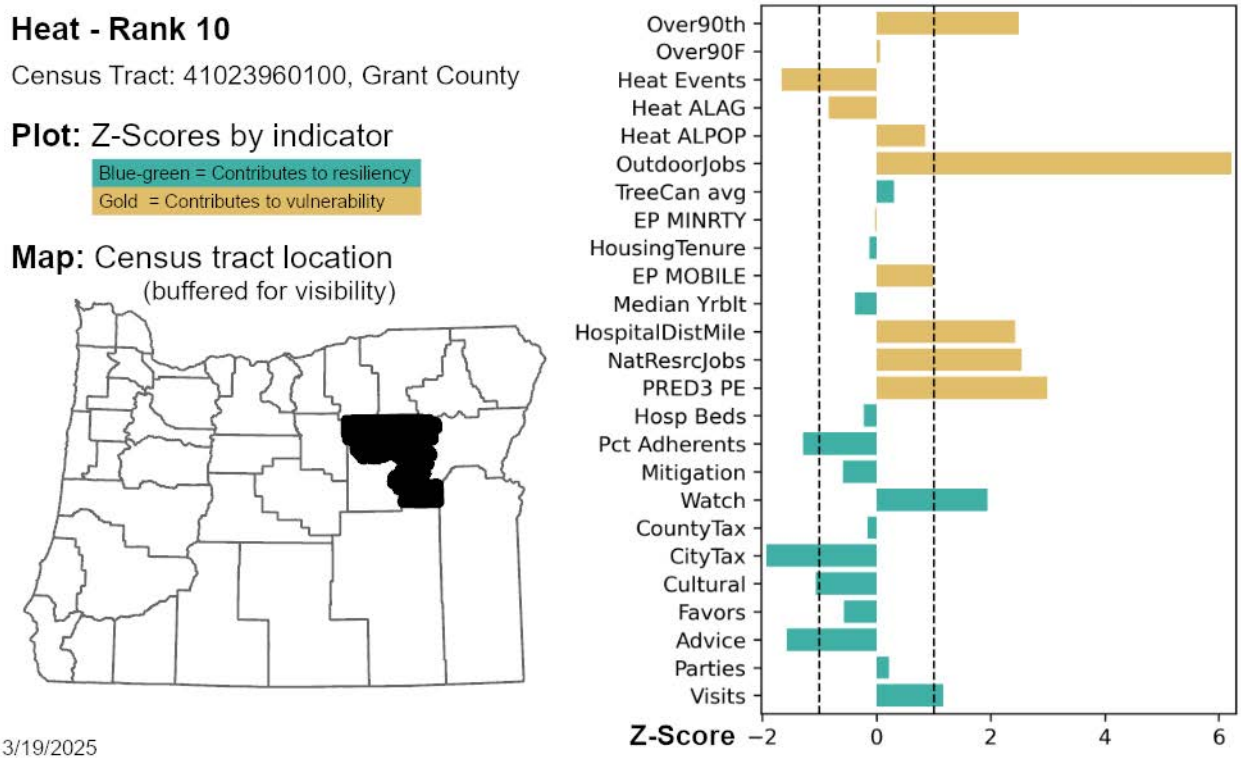
Table 9.3.5-9: State-owned buildings and critical facilities

	Building Name	Value	Source
State-owned	Unknown	93457	DOGAMI/DAS
Critical Facility	SAMS VALLEY ELEMENTARY SCHOOL	8069100	DOGAMI/DAS
Critical Facility	SAMS VALLEY ELEMENTARY SCHOOL	64950	DOGAMI/DAS
Critical Facility	PATRICK ELEMENTARY SCHOOL	357450	DOGAMI/DAS
Critical Facility	HANBY MIDDLE SCHOOL	5433450	DOGAMI/DAS
Critical Facility	PATRICK ELEMENTARY SCHOOL	7696500	DOGAMI/DAS

	Building Name	Value	Source
Critical Facility	Communication Structure	750000	DOGAMI/DAS
Critical Facility	Communication Structure	750000	DOGAMI/DAS
Critical Facility	Communication Structure	32100	DOGAMI/DAS
Critical Facility	Communication Structure	750000	DOGAMI/DAS
Critical Facility	Jackson County Fire District 3 - Sams Valley	774750	DOGAMI/DAS
Critical Facility	Sutton on Rogue Airport	750000	DOGAMI/DAS
Critical Facility	Firefly Ranch Airfield	234750	DOGAMI/DAS
Critical Facility	Snider Creek Airport	750000	DOGAMI/DAS
Critical Facility	East Oregon Cattle Co	750000	DOGAMI/DAS
Critical Facility	GOLD HILL STP	155400	DOGAMI/DAS

Extreme Heat Risk Rank 10 –Grant County 41023960100

Figure 9.3.5-11: Tenth ranked census tract for heat hazard



No state-owned buildings or critical facilities identified.

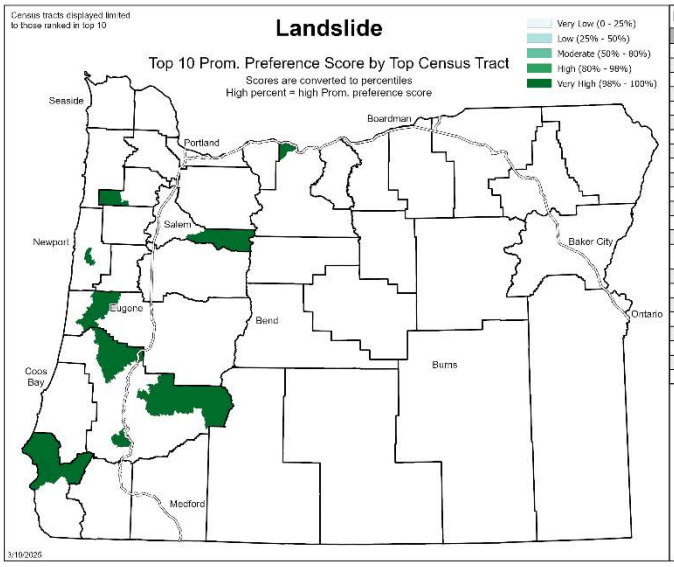
9.3.6 Landslide

9.3.6.1 Hazard Scenario

Landslide Susceptibility from the Statewide Landslide Information Database.

9.3.6.2 Top Ranked Risk Areas

Figure 9.3.6-1: Top Ranked Risk Areas in Landslide Risk Areas



Indicators used for the hazard Hazard indicators are worth 35% of the total weight.

Hazard	Indicator Name	Direction	Weight	Short Description
Landslide	LSS_pct_bld	1	0.07	Percentage of SBFO buildings exposed to existing landslide deposit.
Landslide	LSS_pct_CF	1	0.07	Percentage of critical facilities exposed to existing landslide deposit.
Landslide	Hwy_LSS_pct	1	0.07	Major roadway miles that are exposed to existing landslide deposits.
Landslide	Hist_LSS_ct	1	0.07	Percentage of historic buildings exposed to existing landslide deposit.
Landslide	LSS_Haz_Area	1	0.07	Area of tract in high or very high landslide hazard.
General	EP_MINRTY	1	0.046	Percentage of Black, Indigenous, and People of Color (2020 Census).
General	HousingTenure	-1	0.046	Housing tenure from the US Census.
General	EP_MOBILE	1	0.046	Percentage of people that live in mobile homes
General	Median_Yrblt	-1	0.046	Median year built of general building stock based on HAZUS default.
General	HospitalDistMile	1	0.046	Distance from tract centroid to nearest hospital.
General	NatResrcJobs	1	0.046	Rate of natural resource jobs.
General	PRED3_PE	1	0.046	Community Resilience Estimate
General	Hosp_Beds	-1	0.046	Estimated number of hospital beds based on square footage .
General	Pct_Adherents	-1	0.046	Percentage of members to a religious group
General	Mitigation	-1	0.046	Number of migitation projects (grouped by zip code and evenly distributed to overlaying tracts)
General	Watch	-1	0.046	Neighborliness: Will watch neighbor's house
General	CountyTax	-1	0.046	County tax rate
General	CityTax	-1	0.046	City tax rate
General	Cultural	-1	0.009	Number of cultural-related buildings
General	Favors	-1	0.009	Neighborliness: Willing to do favors for neighbor
General	Advice	-1	0.009	Neighborliness: Seeks advice from neighbor
General	Parties	-1	0.009	Neighborliness: Attended parties that occur in neighborhood
General	Visits	-1	0.009	Neighborliness: Has visited neighbor's house

Table 9.3.6-1: Oregon Natural Hazard Risk Assessment Rank Compared to the National Risk Index

Oregon Rank	Census Tract	County	National Risk Index Hazard Rating	Exposed Population According to NRI
1	41019100000	Douglas	Very high	2392
2	41047010600	Marion	Very high	1995
3	41039000500	Lane	Very high	2159
4	41015950202	Curry	Very high	1246
5	41015950100	Curry	Relatively high	2187
6	41065970600	Wasco	Very high	1361
7	41041951400	Lincoln	Very high	2864
8	41019030000	Douglas	Very high	2791

Oregon Rank	Census Tract	County	National Risk Index Hazard Rating	Exposed Population According to NRI
9	41019200000	Douglas	Relatively high	4232
10	41071030502	Yamhill	Very high	2526

*Compared to census tracts nationwide

Table 9.3.6-2: Top 10 Census Tract Demographics

Census Tract	Landslide Risk Rank	2020 Population[1]	2023 Population[2]	% Change in Population	2016 SVI[3]	2022 SVI[4]	Change in SVI
41019100000	1	3103	3283	6%	0.56	0.56	0.00
41047010600	2	2661	2126	-20%	0.30	0.43	0.13
41039000500	3	2244	2148	-4%	0.53	0.56	0.02
41015950202	4	1923	2074	8%	#N/A	0.34	#N/A
41015950100	5	3296	3226	-2%	0.66	0.56	-0.10
41065970600	6	3007	2965	-1%	0.88	0.67	-0.21
41041951400	7	3044	3003	-1%	0.48	0.77	0.28
41019030000	8	4047	4107	1%	0.39	0.35	-0.04
41019200000	9	4902	4912	0%	0.87	0.91	0.04
41071030502	10	5205	4697	-10%	0.84	0.65	-0.18

[1] 2020 Decennial Census Census Tract Level Population Data HC2020.P1 - 2020 data was used rather than 2018 due to changes in census tract boundaries in 2020

[2] 2023 ACS 5-Year Estimates Census Tract Level Age and Sex Data S0101

[3] 2016 US CDC Social Vulnerability Index - "#N/A" cells represent census tracts that did not exist before changes to census tract boundaries in 2020

[4] 2022 US CDC Social Vulnerability Index

Landslide Susceptibility Rank 1 – Douglas County 41019100000

This census tract is located east of Roseburg, Oregon, in Southern Oregon. The NRI reports a very high landslide susceptibility in this area, with a perfect score of 100. The NRI estimates 77% of this census tract's population are susceptible to landslides. Low social cohesion, large distances to hospitals, and widespread landslide susceptibility are the primary drivers of susceptibility. A higher than statewide average number of buildings are exposed to potential landslides.

Figure 9.3.6-2: First ranked census tract for landslide hazard

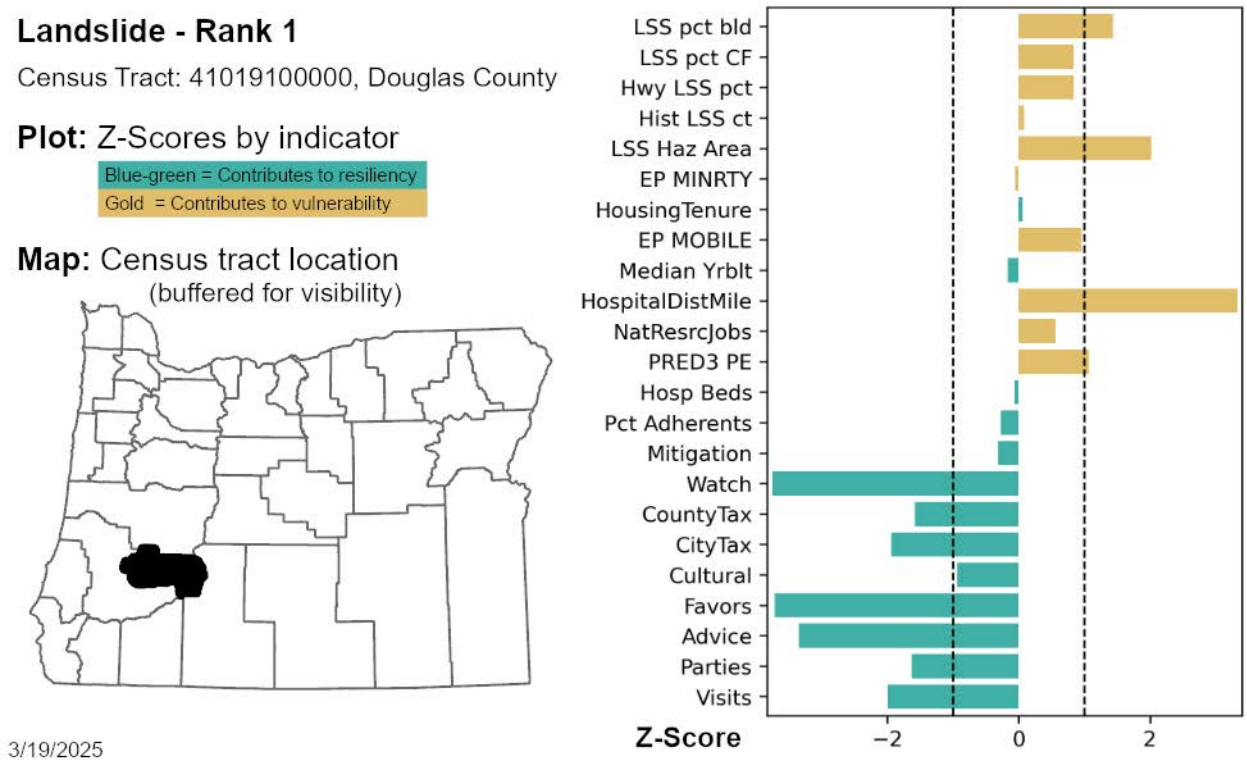


Table 9.3.6-3: State-owned buildings or critical facilities 41019100000

	Building Name	Value	Source
State-owned	Rock Creek Hatchery	259,624	DOGAMI/DAS
State-owned	Unknown	252,905	DOGAMI/DAS
Critical facility	Toketee Elementary School	516,450	DOGAMI/DAS
Critical facility	Steamboat Maintenance Station	127,168	DOGAMI/DAS

Landslide Susceptibility Rank 2 – Marion County 41047010600

This census tract is located east of Salem, Oregon, in the Willamette Valley. The NRI reports a very high landslide susceptibility in this area, with a perfect score of 100. The NRI estimates 75% of this census tract's population are susceptible to landslide hazard events. Low social cohesion, large distances to hospitals, widespread landslide susceptibility across the area of the census tract, and critical facilities located with landslide susceptibility areas, drive susceptibility in this analysis.

Figure 9.3.6-3: Second ranked census tract for landslide hazard

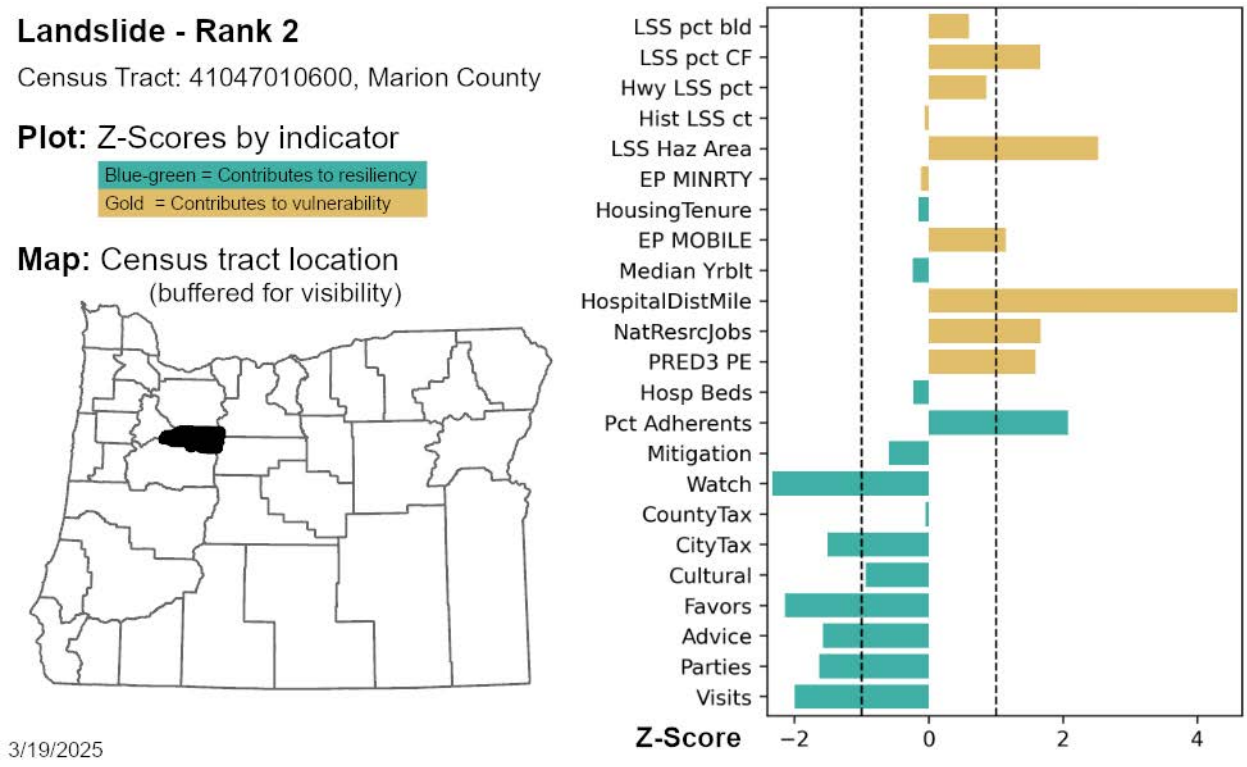


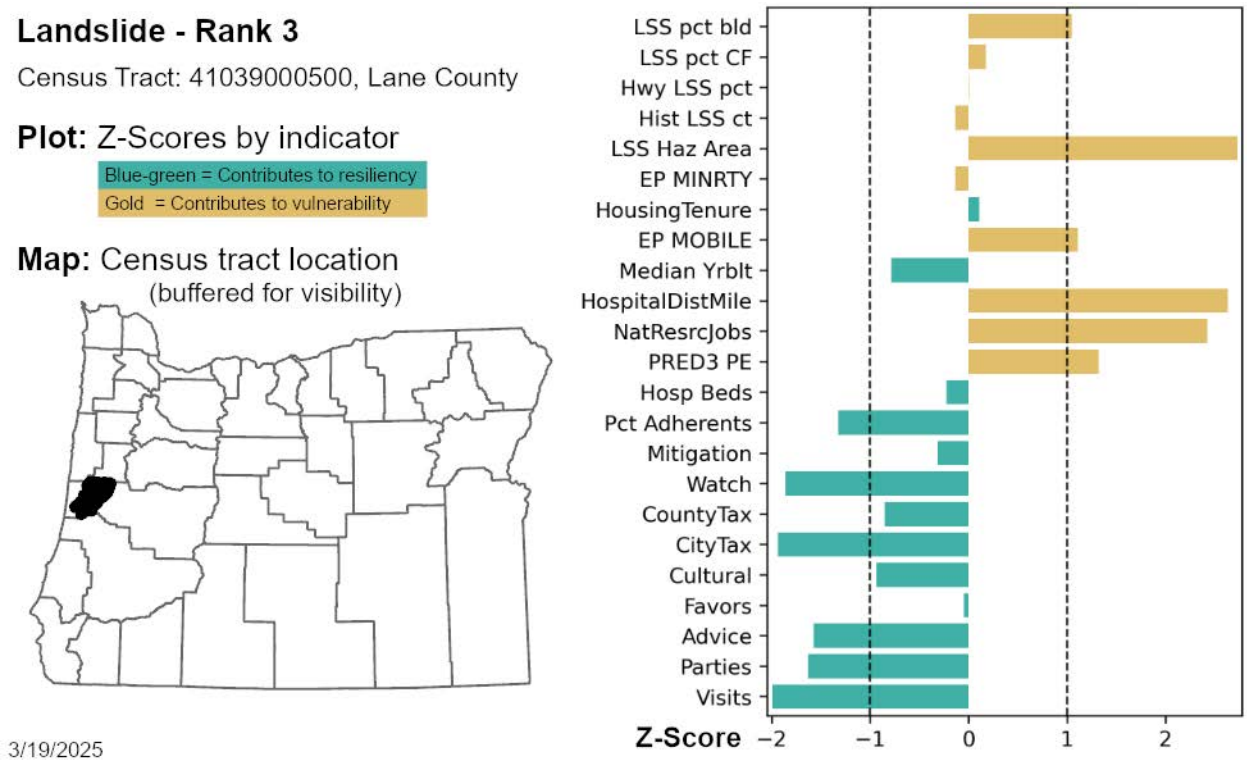
Table 9.3.6-4: State-owned buildings or critical facilities 41047010600

	Building Name	Value	Source
State-owned	Unknown	127,555	DOGAMI/DAS
State-owned	Unknown	91,448	DOGAMI/DAS
State-owned	Unknown	251,538	DOGAMI/DAS
Critical facility	Communications Structure	67,950	DOGAMI/DAS
Critical facility	Stayton RFPD	230,400	DOGAMI/DAS

Landslide Susceptibility Rank 3 – Lane County 41039000500

This rural census tract is located northeast of the coastal town of Florence, Oregon. The NRI reports a very high landslide susceptibility in this area, with a score of 100. The NRI estimates 96% of this census tract's population is susceptible to a landslide. In this analysis, widespread landslide susceptibility, coupled with low social cohesion and community resilience, and large distances to hospitals, drive overall susceptibility to harm in a landslide event.

Figure 9.3.6-4: Third ranked census tract for landslide hazard



No State-owned buildings or critical facilities in landslide susceptibility area. 41039000500

Landslide Susceptibility Rank 4 – Curry County 41015950202

This rural census tract is located north of Gold Beach, Oregon, on the southern Oregon coast. The NRI reports a very high landslide risk in this area, with a score of 99.7. The NRI estimates 64% of this census tract's population are susceptible to landslides. In this analysis, low taxing capacity, coupled with higher-than-average landslide susceptibility in areas with highways and buildings are the primary drivers of susceptibility to landslides, potentially due to a lower capacity to issue bonds or other tax mechanisms to adapt or respond in the event of a landslide. Additionally, low community resilience as estimated by the Census' Community Resilience Estimates (CRE) and large distances to hospitals drive susceptibility in this area.

Figure 9.3.6-5: Fourth ranked census tract for landslide hazard

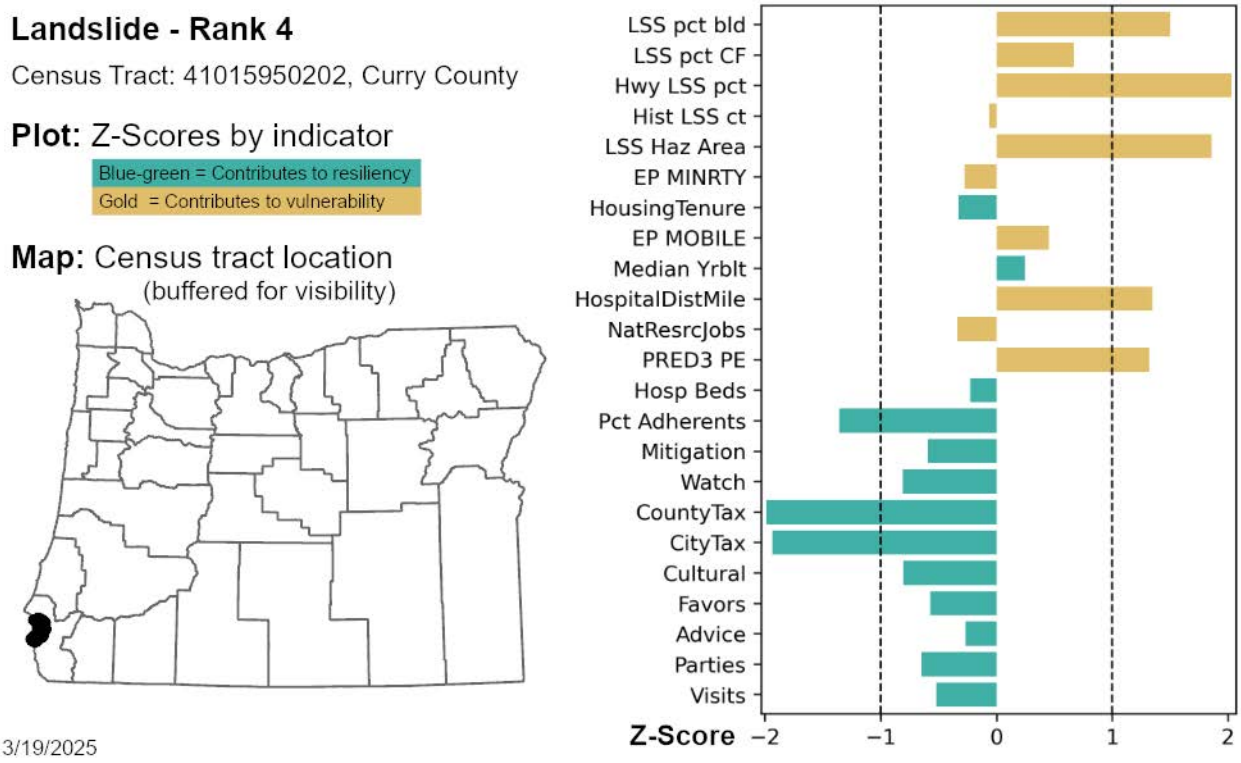


Table 9.3.6-5: State-owned buildings 41047010600

	Building Name	Value	Source
State-owned	Unknown	1,005,735	DOGAMI/DAS
State-owned	Unknown	929,953	DOGAMI/DAS

No critical facilities identified.

Landslide Susceptibility Rank 5 – Curry County 41015950100

This rural coastal census tract encompasses Port Orford, Oregon, on Oregon's southern coast. The NRI reports a relatively high landslide susceptibility in this area, with a score of 99.1. The NRI estimates that two-thirds (66.3%) of this census tract's population are susceptible to a landslide. Low social cohesion and high landslide susceptibility area are the primary drivers in this analysis.

Figure 9.3.6-6: Fifth ranked census tract for landslide hazard

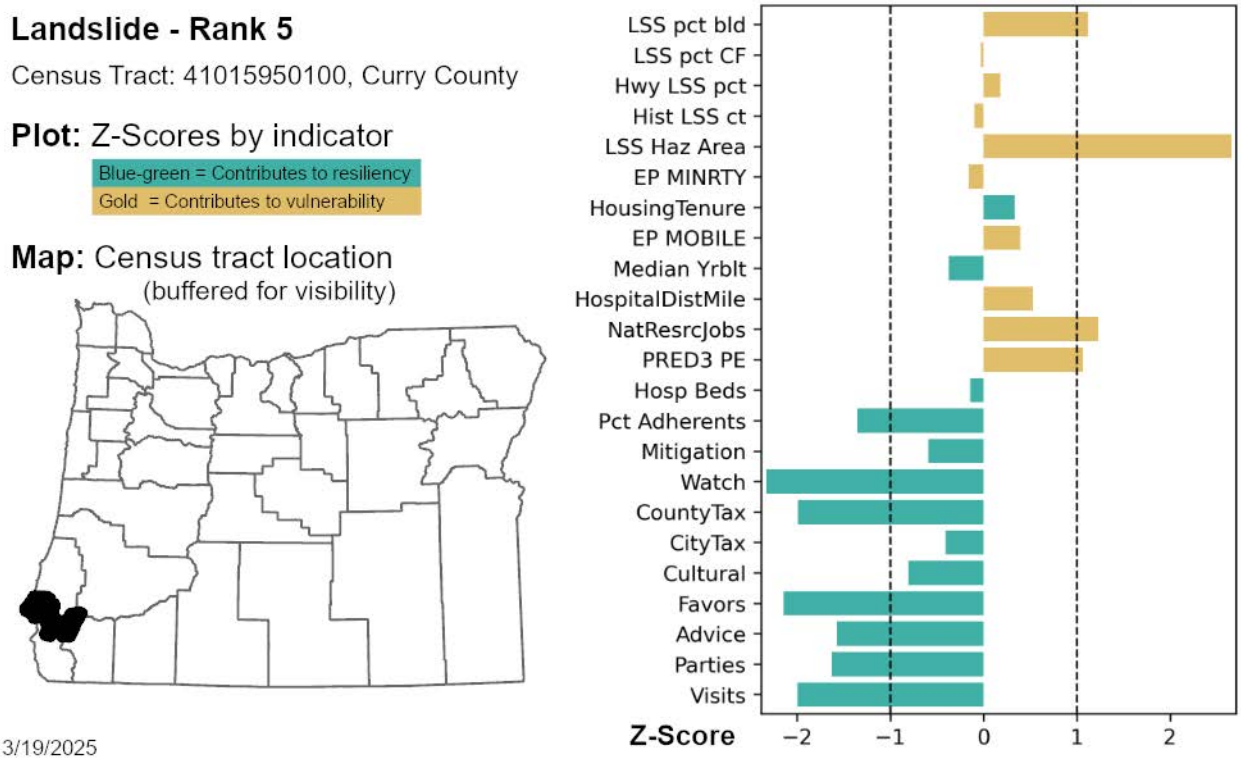


Table 9.3.6-6: Critical facilities 41047010600

	Building Name	Value	Source
Critical facility	Communication Structure	268,050	DOGAMI/DAS
Critical facility	Unknown	142,009	DOGAMI/DAS

No state-owned buildings identified.

Landslide Susceptibility Rank 6 – Wasco County 41065970600

This census tract encompasses Mosier and The Dalles, Oregon, in the Columbia River Gorge. The NRI reports a very high landslide susceptibility in this area, with a score of 99.5. The NRI estimates nearly half (45.2%) of this census tract's population are susceptible to a landslide. In this analysis, critical facilities and historic buildings within the landslide susceptibility area are the primary drivers of this susceptibility ranking.

Figure 9.3.6-7: Sixth ranked census tract for landslide hazard

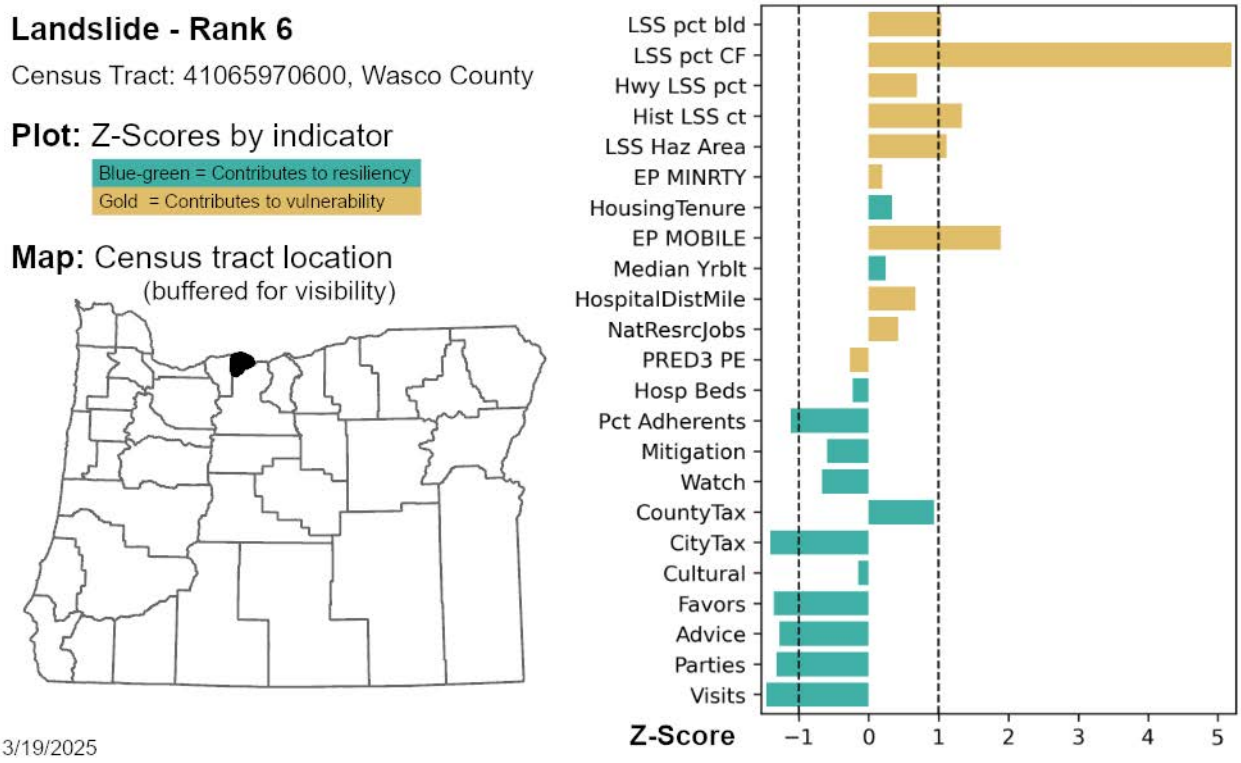


Table 9.3.6-7: State-owned buildings or critical facilities 41047010600

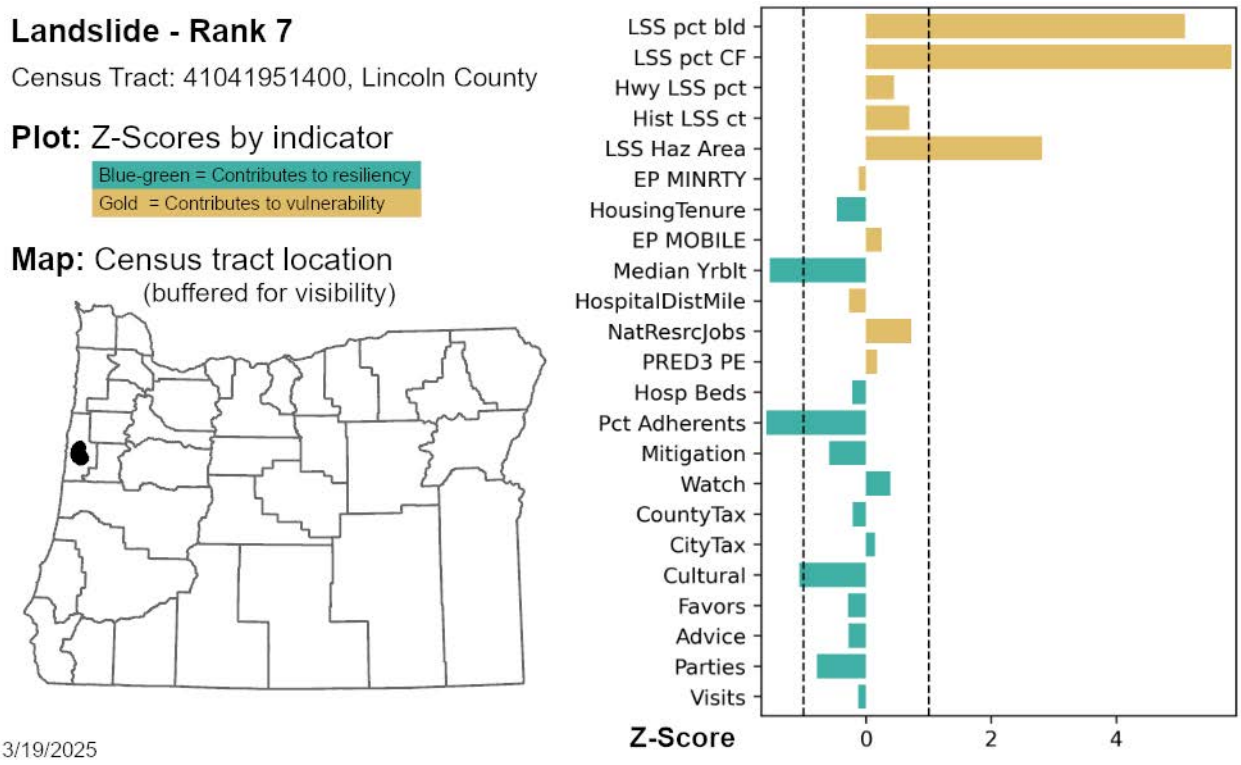
	Building Name	Value	Source
State-owned	Unknown AGR	345,336	DOGAMI/DAS
State-owned	Unknown AGR	475,424	DOGAMI/DAS
Critical facility	Mosier Fire Department	unknown	RAPT
Critical facility	Mosier Community School	unknown	RAPT
Critical facility	Mosier STP	unknown	RAPT

Landslide Susceptibility Rank 7 – Lincoln County 41041950400

This census tract is located east of the coastal city of Newport, Oregon. The NRI reports a very high landslide susceptibility in this area, with a score of 99.5. The NRI estimates 94% of this census tract's population are susceptible to a landslide. In this analysis, widespread landslide susceptibility and exposed buildings in landslide areas are the primary drivers of this susceptibility ranking.

may be susceptible to landslide damage when compared to other census tracts in the state.

Figure 9.3.6-8: Seventh ranked census tract for landslide hazard

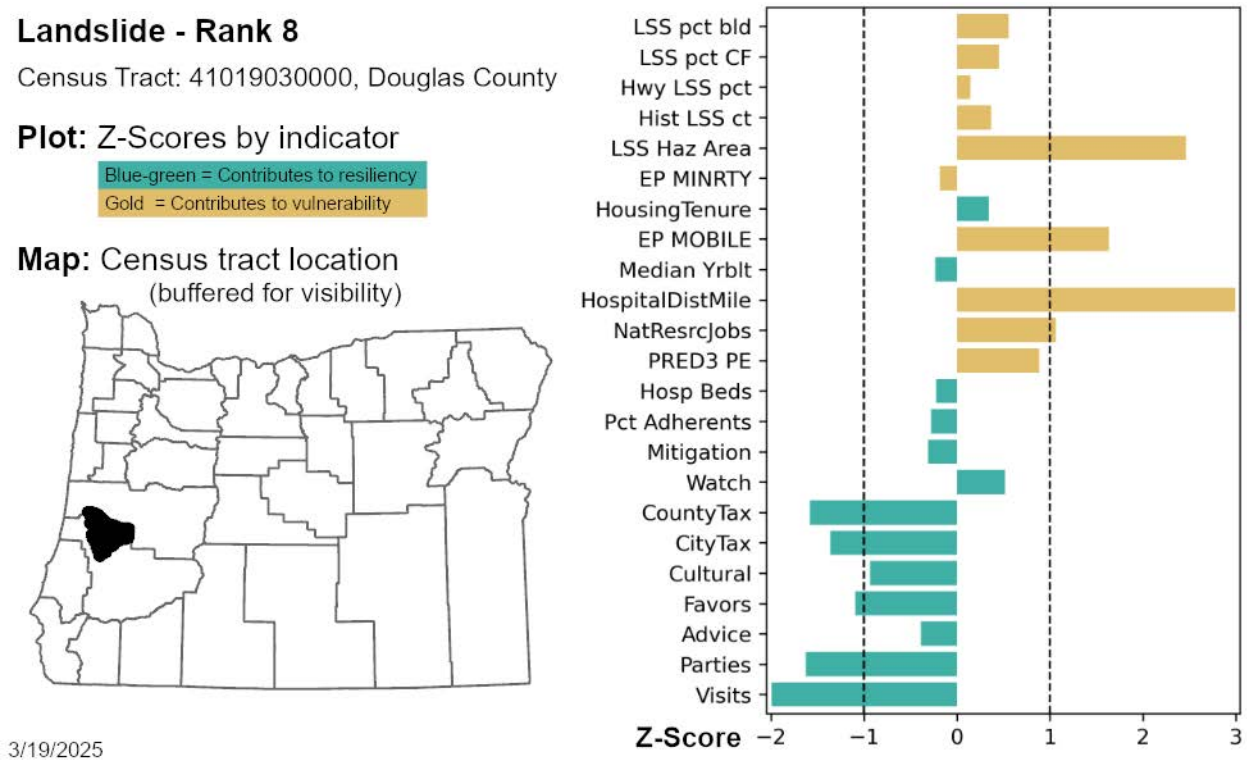


No State-owned buildings or critical facilities in landslide susceptibility area. 41041950100

Landslide Susceptibility Rank 8 — Douglas County 41019030000

This rural census tract is located northwest of Roseburg, Oregon, in southern Oregon. The NRI reports a very high landslide susceptibility in this area, with a score of 100. The NRI estimates around two-thirds (69%) of this census tract's population are susceptible to landslide. In this analysis, low social cohesion, large distances to hospitals, and widespread landslide susceptibility hazard areas are the primary drivers of this susceptibility ranking.

Figure 9.3.6-9: Eighth ranked census tract for landslide hazard

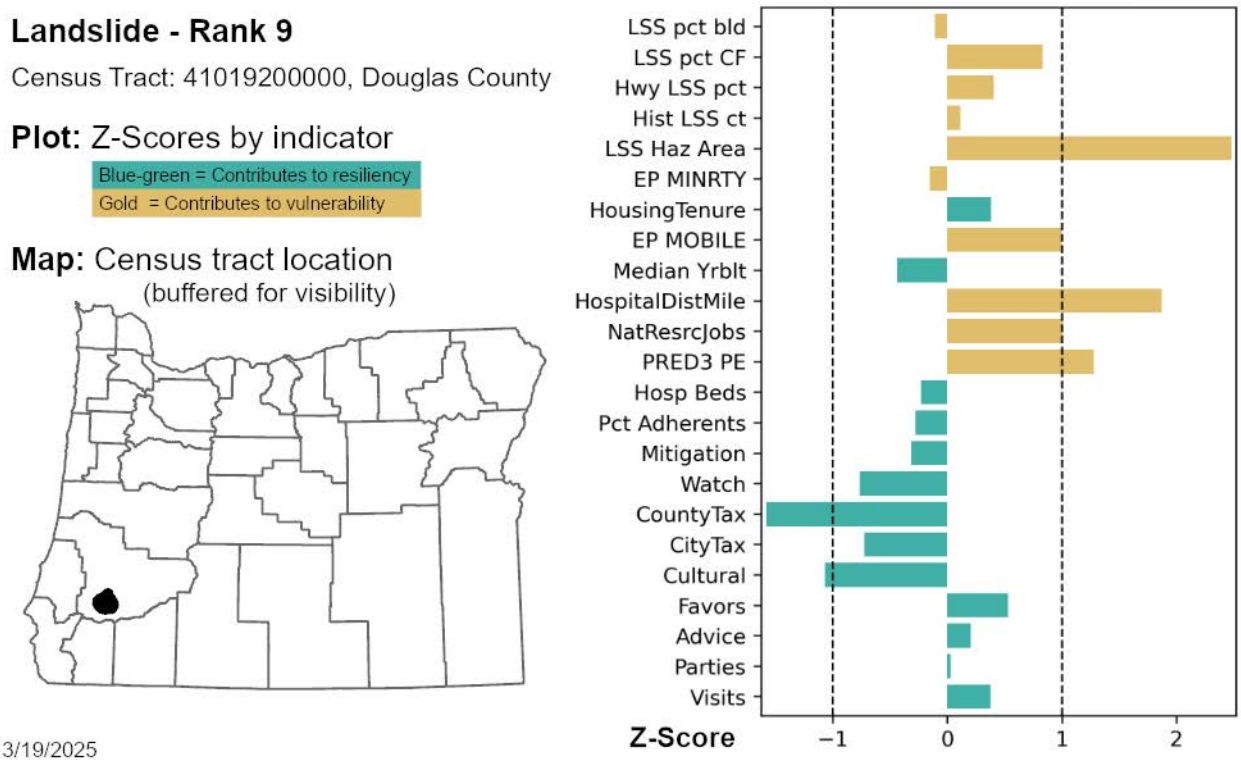


No State-owned buildings or critical facilities in landslide susceptibility area.

Landslide Susceptibility Rank 9 – Douglas County 410192200000

This rural census tract is located north of the coastal city of Newport, Oregon. The NRI reports a very high landslide susceptibility in this area, with a score of 99.9. The NRI estimates around half (56%) of this census tract's population are susceptible to a landslide. In this analysis, lower social cohesion coupled with higher exposure of buildings and critical facilities in the landslide hazard area drive this susceptibility ranking.

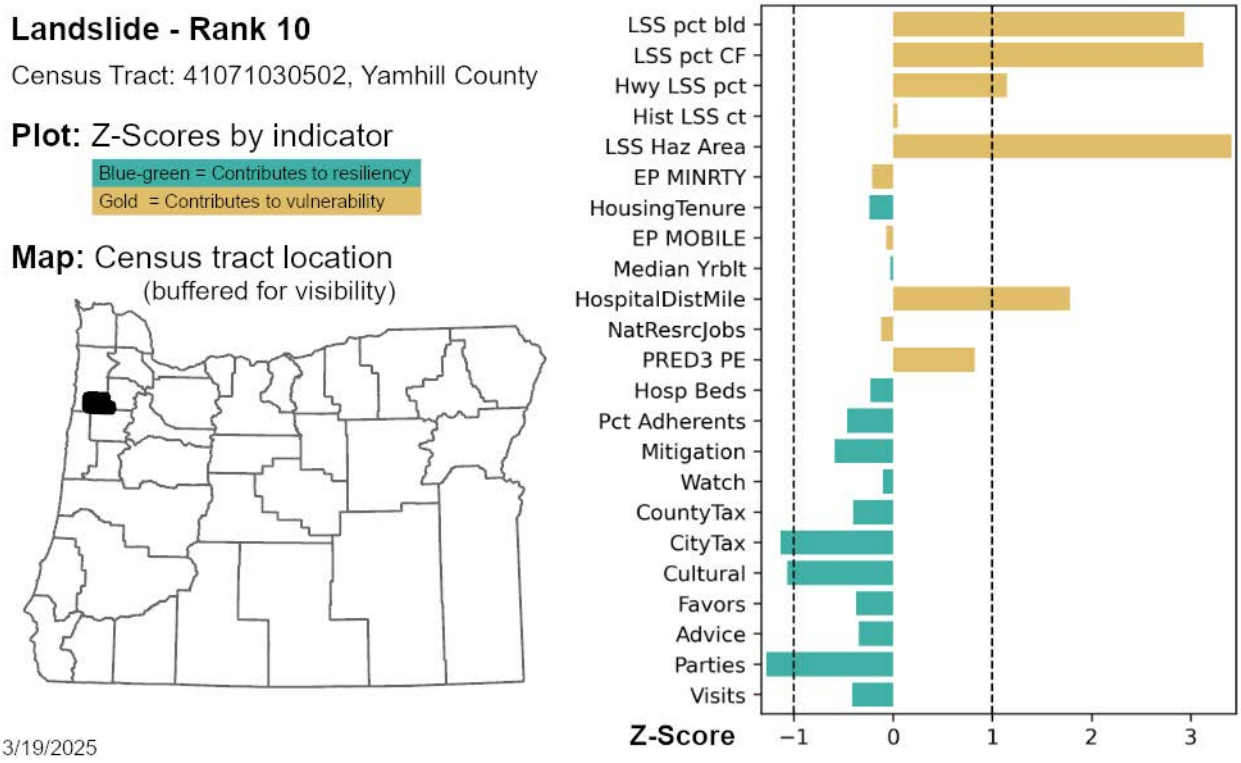
Figure 9.3.6-10: Ninth ranked census tract for landslide hazard



No State-owned buildings or critical facilities in landslide susceptibility area.

Landslide Susceptibility Rank 10 – Yamhill County 41071030502

Figure 9.3.6-11: Tenth ranked census tract for landslide hazard



No State-owned buildings or critical facilities in the landslide susceptibility area.

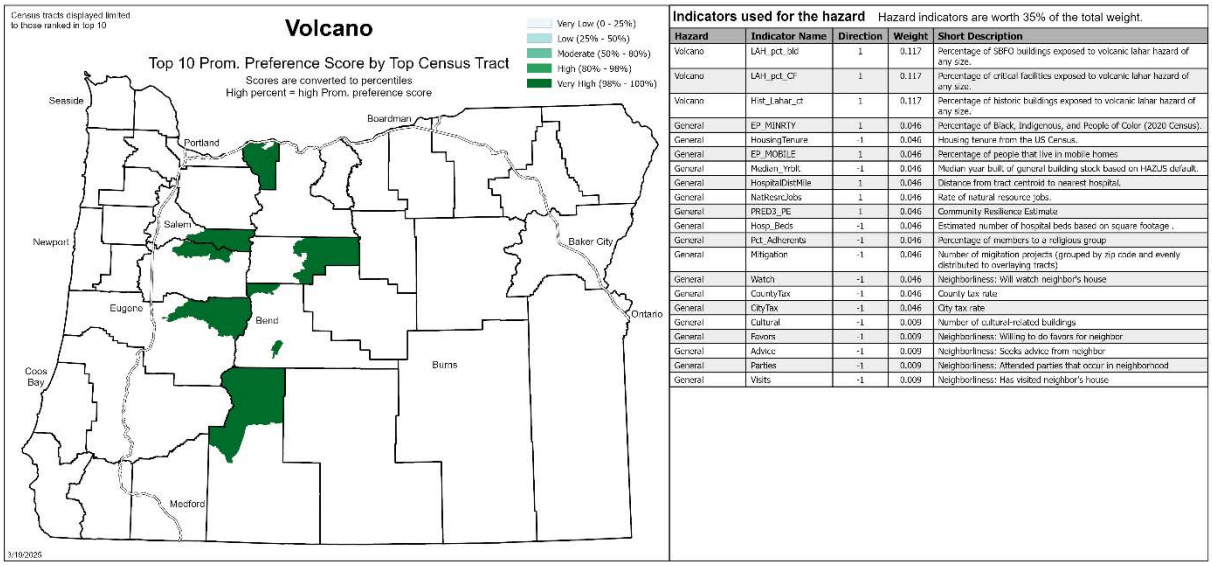
9.3.7 Volcano

9.3.7.1 Hazard Scenario

Lahar inundation zones	USGS (Mt. Jefferson, Sisters, Crater Lake)
Lahar inundation zones	Mt. Hood – DOGAMI (Burns and others, 2011)

9.3.7.2 Top Ranked Volcano Risk Areas

Figure 9.3.7-1: Top Ranked Risk Areas in Volcano Risk Areas



Indicators used for the hazard Hazard indicators are worth 35% of the total weight.

Hazard	Indicator Name	Direction	Weight	Short Description
Volcano	LAH_pct_bld	1	0.117	Percentage of SBFO buildings exposed to volcanic lahar hazard of any size.
Volcano	LAH_pct_CF	1	0.117	Percentage of critical facilities exposed to volcanic lahar hazard of any size.
Volcano	Hist_Lahar_ct	1	0.117	Percentage of historic buildings exposed to volcanic lahar hazard of any size.
General	EP_MINRTY	1	0.046	Percentage of Black, Indigenous, and People of Color (2020 Census).
General	HousingTenure	-1	0.046	Housing tenure from the US Census.
General	EP_MOBILE	1	0.046	Percentage of people that live in mobile homes
General	Median_Yrblt	-1	0.046	Median year built of general building stock based on HAZUS default.
General	HospitalDistMile	1	0.046	Distance from tract centroid to nearest hospital.
General	NatResrcJobs	1	0.046	Rate of natural resource jobs.
General	PRED3_PE	1	0.046	Community Resilience Estimate
General	Hosp_Beds	-1	0.046	Estimated number of hospital beds based on square footage .
General	Pct_Adherents	-1	0.046	Percentage of members to a religious group
General	Mitigation	-1	0.046	Number of migitation projects (grouped by zip code and evenly distributed to overlaying tracts)
General	Watch	-1	0.046	Neighborliness: Will watch neighbor's house
General	CountyTax	-1	0.046	County tax rate
General	CityTax	-1	0.046	City tax rate
General	Cultural	-1	0.009	Number of cultural-related buildings
General	Favors	-1	0.009	Neighborliness: Willing to do favors for neighbor
General	Advice	-1	0.009	Neighborliness: Seeks advice from neighbor
General	Parties	-1	0.009	Neighborliness: Attended parties that occur in neighborhood
General	Visits	-1	0.009	Neighborliness: Has visited neighbor's house

Table 9.3.7-1: Oregon Natural Hazard Risk Assessment Rank Compared to the National Risk Index

Oregon Rank	Census Tract	County	National Risk Index Hazard Rating *	Exposed Population According to NRI
1	41019030000	Marion	Very low	na
2	41035970100	Klamath	No rating	na
3	41017000501	Deschutes	Not applicable	na
5	41027950400	Hood River	Very high	5508
4	41017000301	Deschutes	Not applicable	na
6	41027950100	Hood River	Very high	4446
7	41039000100	Lane	Not applicable	na

Oregon Rank	Census Tract	County	National Risk Index Hazard Rating *	Exposed Population According to NRI
8	41031960100	Jefferson	Relatively low	2123
9	41043030201	Linn	Relatively low	2551
10	41039001804	Lane	Not applicable	na

*Compared to census tracts nationwide

Table 9.3.7-2: Top 10 Census Tract Demographics

Census Tract	Volcano Risk Rank	2020 Population[1]	2023 Population[2]	% Change in Population	2016 SVI[3]	2022 SVI[4]	Change in SVI
41019030000	1	4047	4107	1%	0.39	0.35	-0.11
41035970100	2	3301	3546	7%	0.76	0.57	-0.25
41017000501	3	3057	3013	-1%	#N/A	0.05	#N/A
41027950400	4	5519	5455	-1%	0.81	0.82	0.01
41017000301	5	4679	4024	-14%	#N/A	0.11	#N/A
41027950100	6	4449	4873	10%	0.64	0.74	0.16
41039000100	7	5232	4838	-8%	0.16	0.25	0.59
41031960100	8	2482	2163	-13%	0.38	0.50	0.33
41043030201	9	3501	3216	-8%	#N/A	0.50	#N/A
41039001804	10	3687	4312	17%	0.20	0.17	-0.14

[1] 2020 Decennial Census Census Tract Level Population Data HC2020.P1 - 2020 data was used rather than 2018 due to changes in census tract boundaries in 2020

[2] 2023 ACS 5-Year Estimates Census Tract Level Age and Sex Data S0101

[3] 2016 US CDC Social Vulnerability Index - "#N/A" cells represent census tracts that did not exist before changes to census tract boundaries in 2020

[4] 2022 US CDC Social Vulnerability Index

Volcano Risk Rank 1 – Marion County 41047010600

This census tract is located east of Salem and encompasses the towns of Lyons and Mill City. The NRI reports a very low volcanic risk in this area, with a score of 40.4. The NRI estimates nearly all (98.9%) of the population in this census tract to be at risk of volcanic hazards. In this analysis, buildings and critical facilities exposed to lahar flows and higher than average distance to hospitals drives risk.

Figure 9.3.7-2: First ranked census tract for volcano hazard

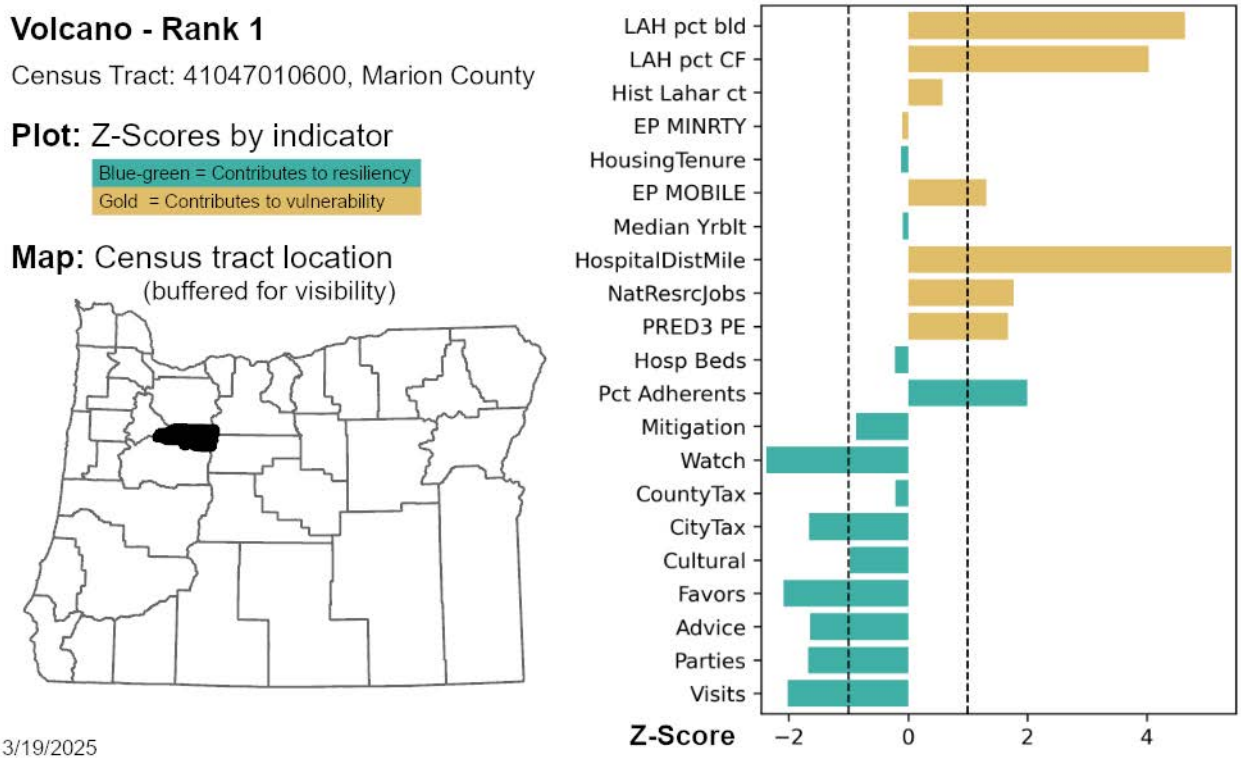


Table 9.3.7-3: State-owned buildings 41047010600

	Building Name	Value	Source
State-owned	Storage	123725	DOGAMI/DAS
State-owned	Detroit Maintenance Station Grounds	1859548	DOGAMI/DAS
State-owned	Detroit Maintenance Station Grounds	1005053	DOGAMI/DAS
State-owned	Unknown	291080	DOGAMI/DAS
State-owned	North Santiam Boat Ramp Restroom	153767	DOGAMI/DAS
State-owned	ODOT Maintenance Station	161240	DOGAMI/DAS
State-owned	Ranger station garage	694500	DOGAMI/DAS

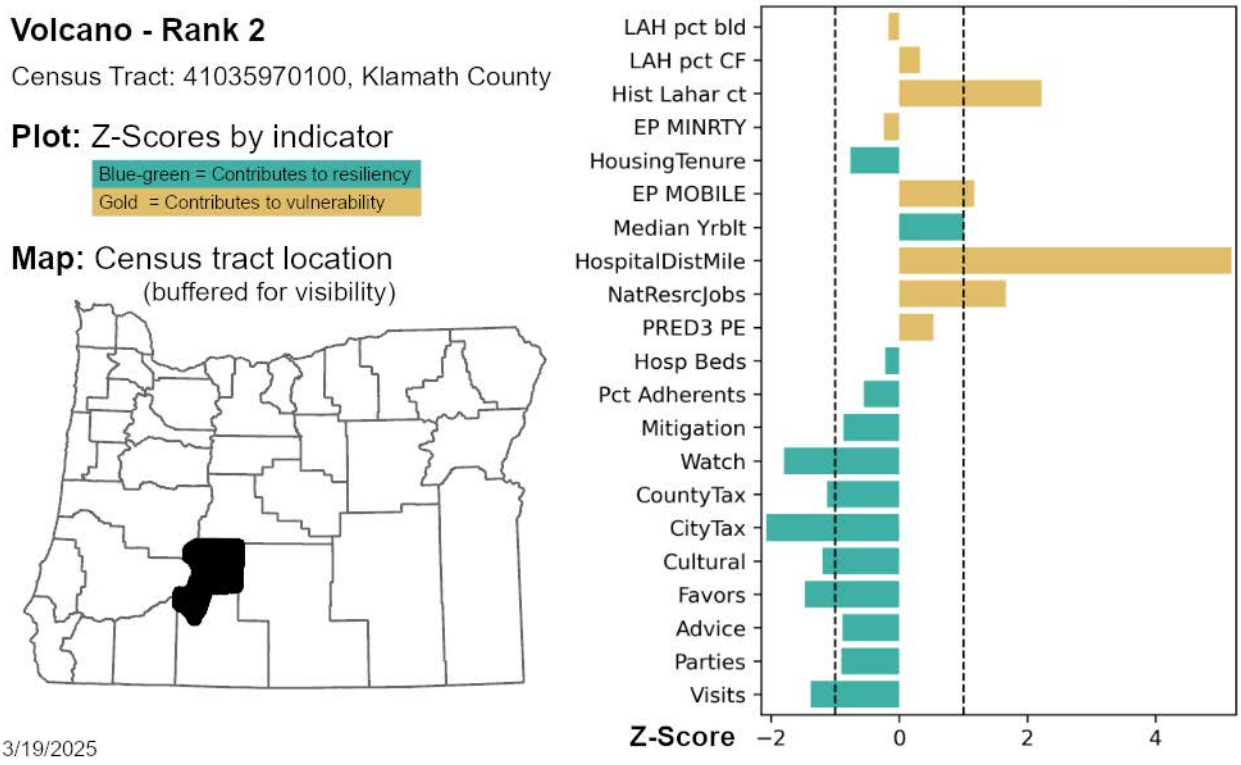
	Building Name	Value	Source
State-owned	Storage	462550	DOGAMI/DAS
State-owned	Restroom	174780	DOGAMI/DAS
State-owned	Site Systems - Minto Creek Stockpile Grounds	86142	DOGAMI/DAS
State-owned	Minto Creek Scoop Shed	215659	DOGAMI/DAS
State-owned	The Maples RA Pumphouse/ Storage	117943	DOGAMI/DAS
State-owned	Site Systems - The Maples RA Grounds	86142	DOGAMI/DAS
State-owned	The Maples RA New Restroom	430171	DOGAMI/DAS

No critical facilities identified.

Volcano Risk Rank 2 – Klamath County 41035970100

Klamath County 41035970100NRI does not report a volcanic risk in this area and does not provide a score for this hazard in this area. The NRI does not estimate people at risk for this hazard. Risk is primarily driven by historic lahar flows and greater distance to hospitals.

Figure 9.3.7-3: Second ranked census tract for volcano hazard



No state-owned buildings or critical facilities identified.

Volcano Risk Rank 3 – Deschutes County 41017000501

This census tract is located northwest of Bend, Oregon, in central Oregon. The NRI does not report a volcanic risk in this area and does not provide a score for this hazard in this area. The NRI does not estimate people at risk for this hazard. Historic lahar flows and exposures of critical facilities and buildings, in addition to large distances to hospitals, drive risk.

Figure 9.3.7-4: Third ranked census tract for volcano hazard

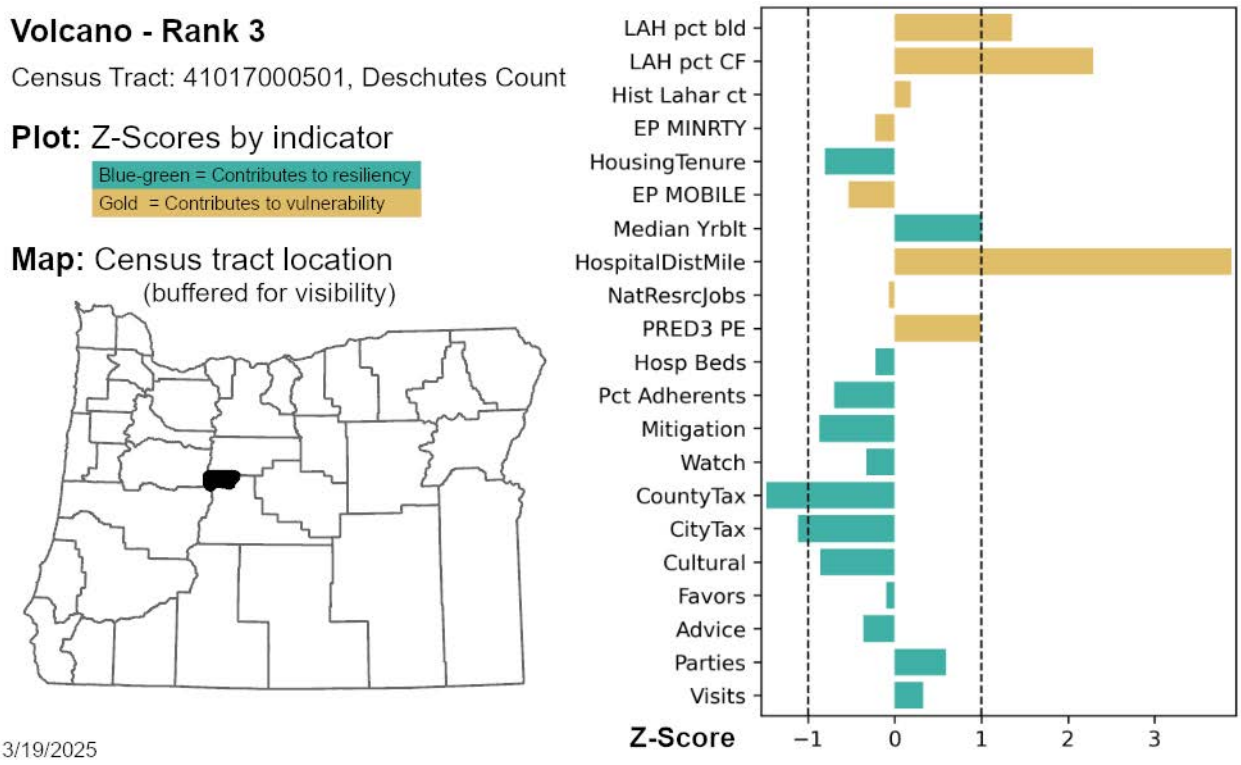


Table 9.3.7-4: State-owned buildings 41017000501

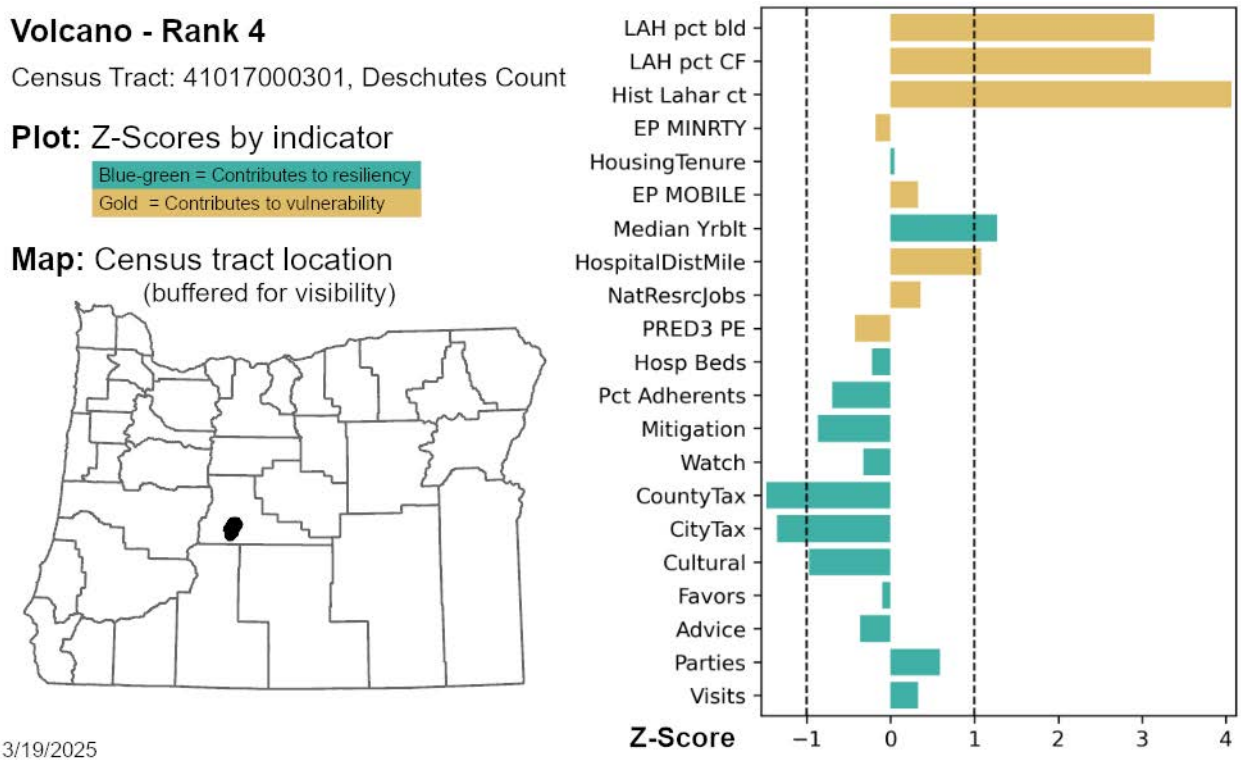
	State-owned Buildings	Value	Source
State-owned	Sisters Sub-Unit	1899604	DOGAMI/DAS
State-owned	Sisters Sub-Unit	94103	DOGAMI/DAS

No critical facilities identified.

Volcano Risk Rank 4 – Deschutes County 41017000301

This census tract is located south of Bend and Sunriver, Oregon, in central Oregon. The NRI does not report a volcanic risk in this area and does not provide a score for this hazard in this area. The NRI does not estimate people at risk for this hazard. Historic lahar flows primarily drive risk.

Figure 9.3.7-5: Fourth ranked census tract for volcano hazard



No state-owned buildings or critical facilities identified in volcano hazard zone

Volcano Risk Rank 5 – Hood River County 41027950400

This census tract is located adjacent to Hood River, Oregon in the Columbia River Gorge. The NRI reports a very high volcanic risk in this area, with a score of 99.3. The NRI estimates nearly all (99.7%) of the population in this census tract to be at risk of this hazard. Reliance on natural resource jobs and historic lahar flows primarily drive risk in this analysis.

Figure 9.3.7-6: Fifth ranked census tract for volcano hazard

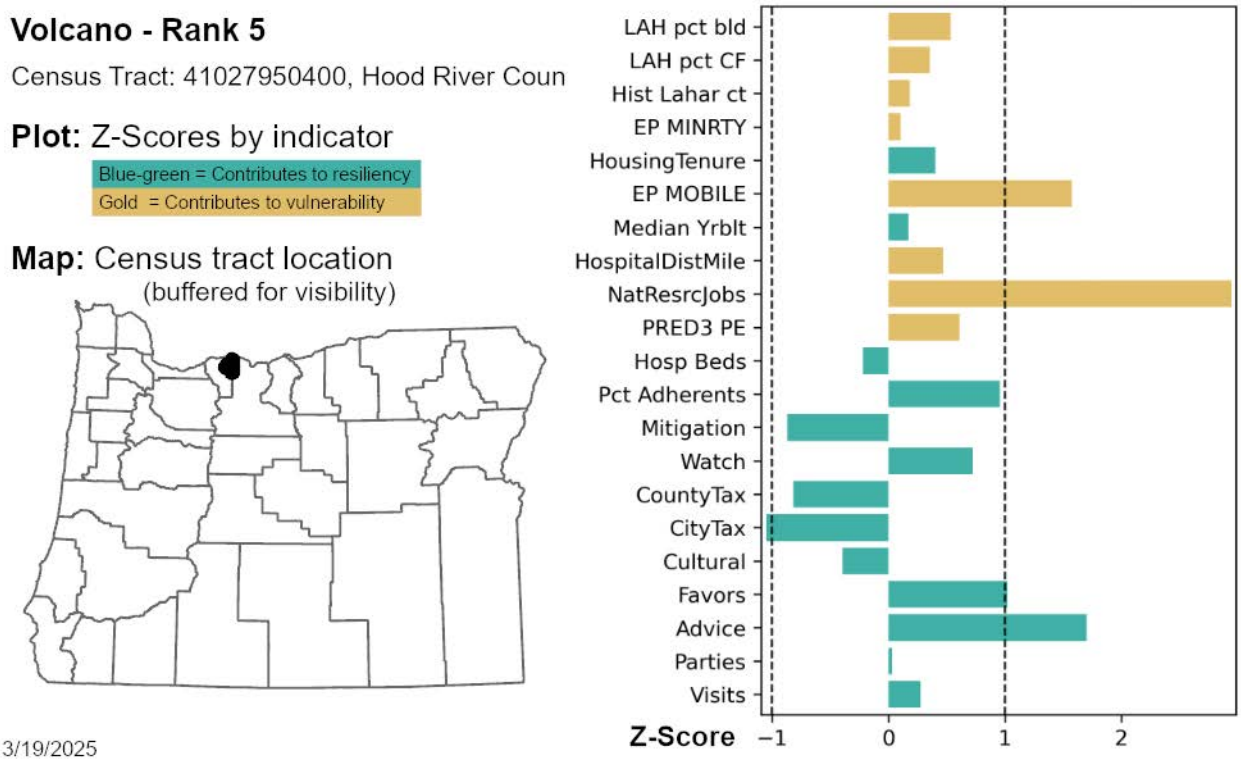


Table 9.3.7-5: State-owned buildings 41027950400

	Building Name 41027950400	Value	Source
State-owned	Unknown	424668	DOGAMI/DAS

No critical facilities identified.

Volcano Risk Rank 6 – Hood River County:

This census tract encompasses much of Hood River County, in the Columbia River Gorge. The NRI reports a very high volcanic risk in this area, with a score of 98.6. The NRI estimates nearly all (99.9%) of the population in this census tract to be at risk for this hazard. Historic lahar flows, and exposure of state-owned buildings and critical facilities to lahar flows, drives risk in this analysis.

Figure 9.3.7-7: Sixth ranked census tract for volcano hazard

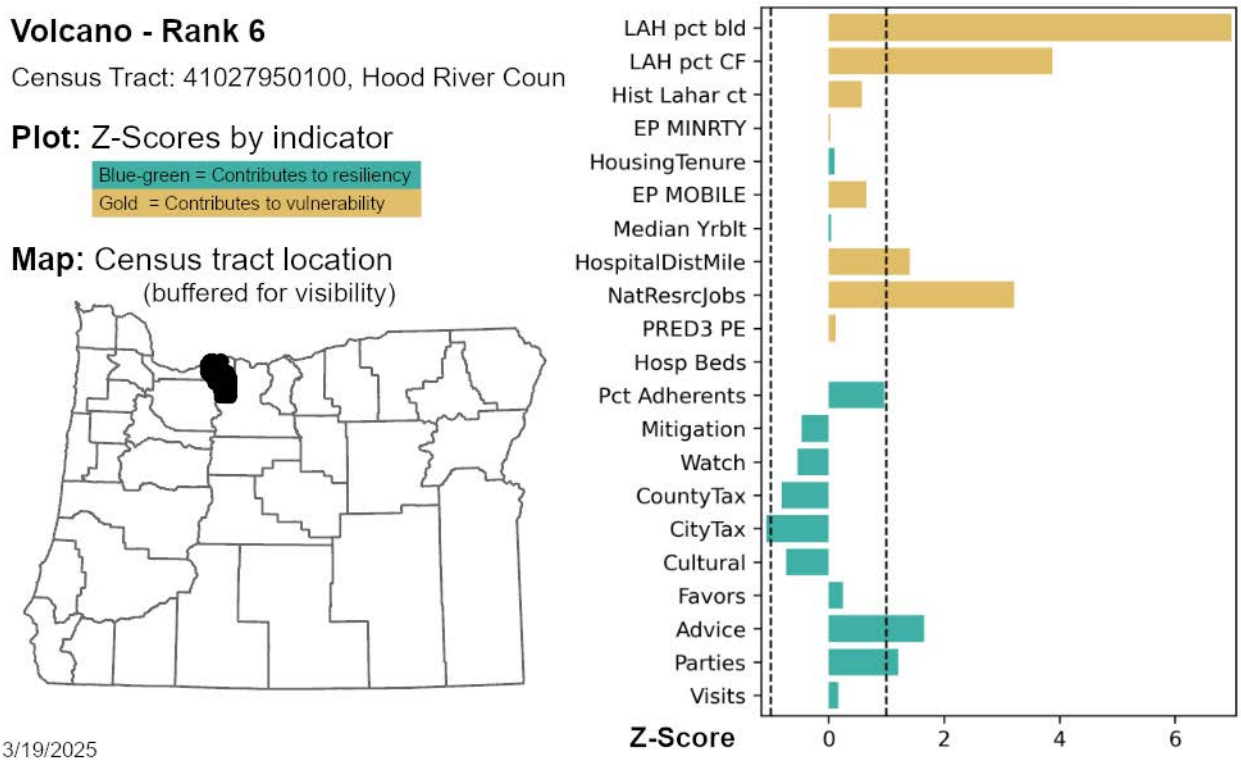


Table 9.3.7-6: State-owned buildings 41027950100

	Building Name	Value	Source
State-owned	Parkdale Maintenance Station New Grounds	2026059	DOGAMI
State-owned	Parkdale Maintenance Station New Grounds	421722	DOGAMI
State-owned	Parkdale Maintenance Station New Grounds	1757869	DOGAMI
State-owned	Fire Guard Station, maintenance building	344838	DOGAMI
State-owned	Unknown	1485289	DOGAMI
State-owned	Dept of Forestry, house	321233	DOGAMI

No critical facilities identified.

Volcano Risk Rank 7 – Lane County 41039000100

This census tract is east of Eugene and Springfield, Oregon, in the Willamette Valley. The NRI does not report a volcanic risk in this area and does not score this hazard. The NRI does not estimate people at risk for this hazard. Exposure of buildings and critical facilities to potential lahars and historic lahar flows are the primary drivers of risk. Additionally, higher than average distances to hospitals drive risk.

Figure 9.3.7-8: Seventh ranked census tract for volcano hazard

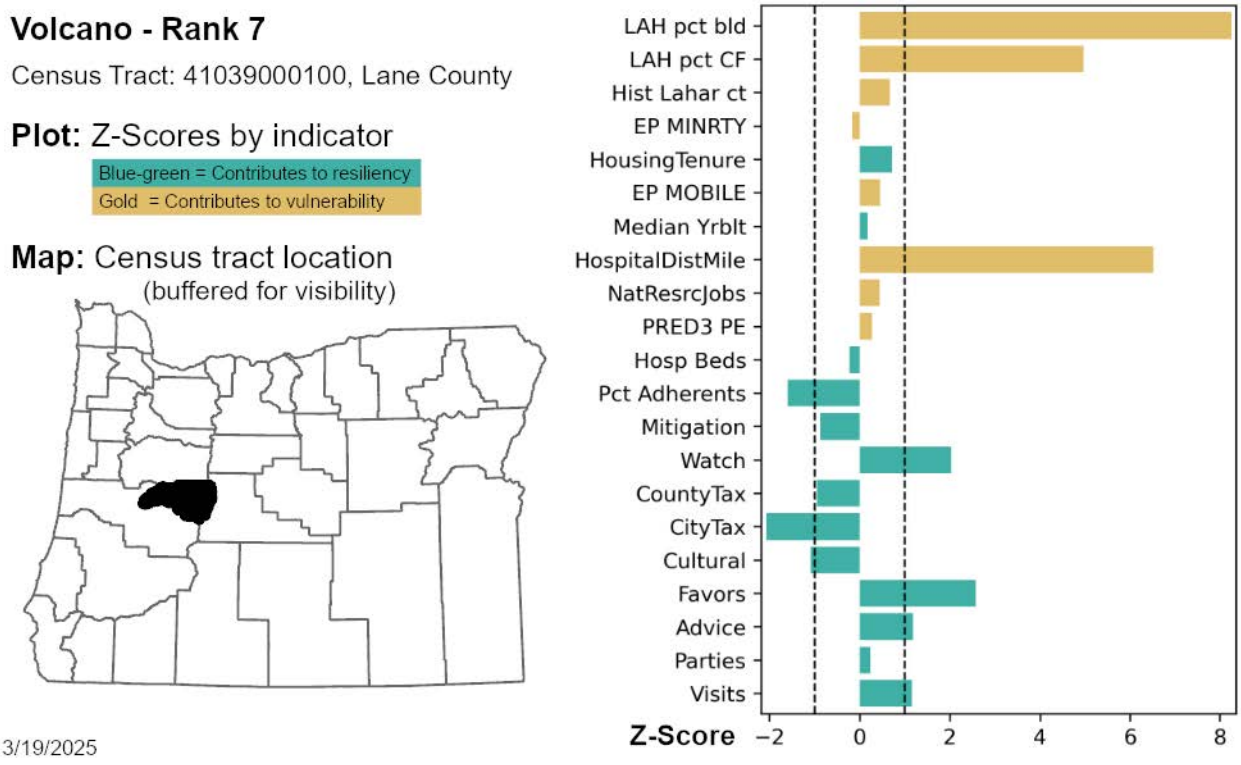


Table 9.3.7-7: State-owned buildings 41039000100

	Building Name 41039000100	Value	Source
State-owned	Unknown	1112233	DOGAMI/DAS
State-owned	McKenzie River Ranger Station	846509	DOGAMI/DAS
State-owned	Holman Guard Station	1026117	DOGAMI/DAS
State-owned	ODOT McKenzie Bridge Maintenance Station	1161757	DOGAMI/DAS
State-owned	McKenzie River Ranger Station	708786	DOGAMI/DAS
State-owned	McKenzie River Ranger Station	690311	DOGAMI/DAS
State-owned	Unknown	681544	DOGAMI/DAS

	Building Name 41039000100	Value	Source
State-owned	ODOT McKenzie Maintenance Station	1040027	DOGAMI/DAS
State-owned	McKenzie Hatchery	4366318	DOGAMI/DAS
State-owned	McKenzie River Ranger Station	850963	DOGAMI/DAS
State-owned	Unknown	1004841	DOGAMI/DAS
State-owned	Unknown	769060	DOGAMI/DAS
State-owned	Unknown	1063182	DOGAMI/DAS
State-owned	McKenzie River Ranger Station	680673	DOGAMI/DAS
State-owned	McKenzie Bridge Maintenance Station Grounds	2159576	DOGAMI/DAS
State-owned	McKenzie Bridge State Airport (00S)	667242	DOGAMI/DAS
State-owned	McKenzie Bridge Deicer Building	934370	DOGAMI/DAS
State-owned	Site Systems - McKenzie Bridge MS Grounds	667242	DOGAMI/DAS
State-owned	Offices, Fire House, & Equipment Storage	1026117	DOGAMI/DAS
State-owned	Leaburg Hatchery Residence Duplex	667242	DOGAMI/DAS
State-owned	Leaburg Hatchery Garage	667242	DOGAMI/DAS
State-owned	Leaburg Hatchery Residence Duplex	667242	DOGAMI/DAS
State-owned	Leaburg Hatchery Spawning House	667242	DOGAMI/DAS
State-owned	Leaburg Hatchery Offices/Garage/Shop/River Building	667242	DOGAMI/DAS
State-owned	Leaburg Hatchery Residence Duplex	667242	DOGAMI/DAS
State-owned	Leaburg Hatchery Garage/Truck Shop/Paint	667242	DOGAMI/DAS
State-owned	Leaburg Hatchery Residence and Garage Utility	667242	DOGAMI/DAS
State-owned	Leaburg Hatchery Garage	667242	DOGAMI/DAS
State-owned	Site Systems - Walterville Scale House Grounds	667242	DOGAMI/DAS
State-owned	Walterville Scale House	719280	DOGAMI/DAS

No critical facilities identified.

Volcano Risk Rank 8 – Jefferson County:

This census tract is located to the northeast of Bend, Oregon, in central Oregon. The NRI reports a relatively low volcanic risk in this area, with a score of 58.2. The NRI estimates 85% of the population of the census tract to be at risk of this hazard. Higher than average distances to hospitals, and slightly lower than average social cohesion drives risk in this area.

Figure 9.3.7-9: Eighth ranked census tract for volcano hazard

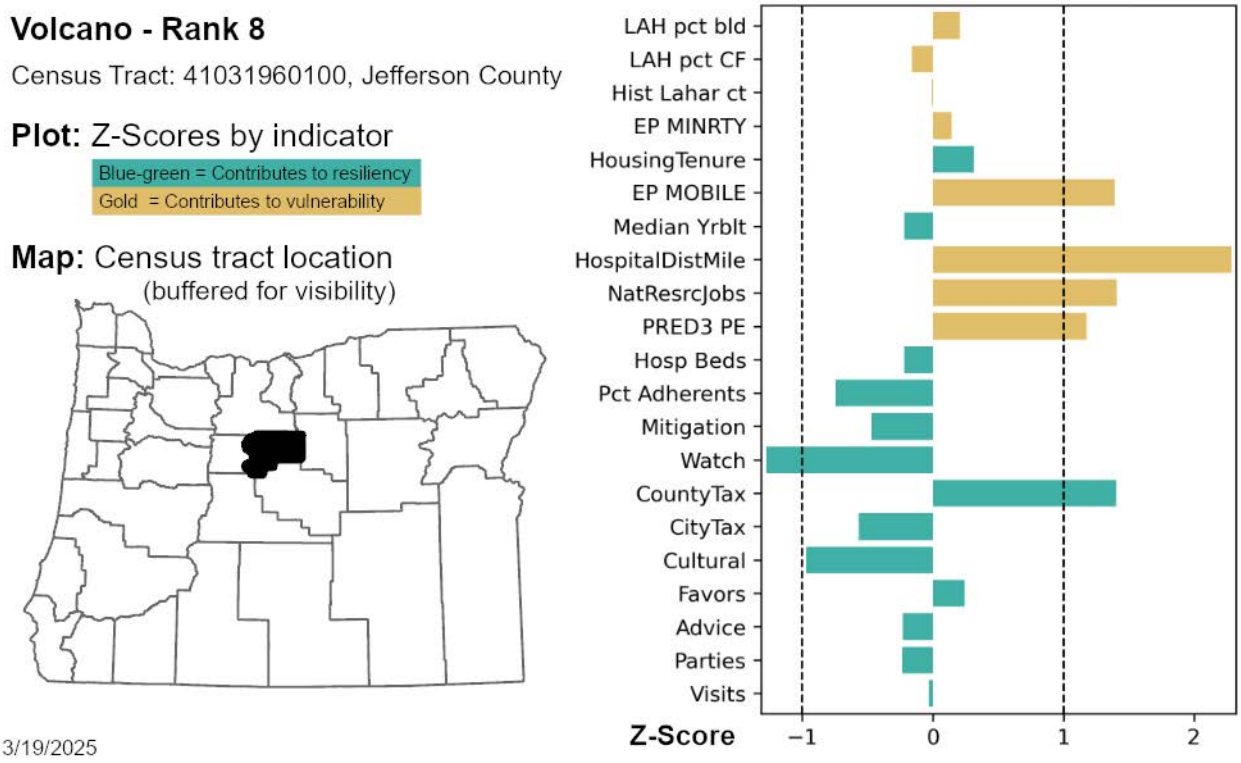


Table 9.3.7-8: State-owned buildings 41031960100

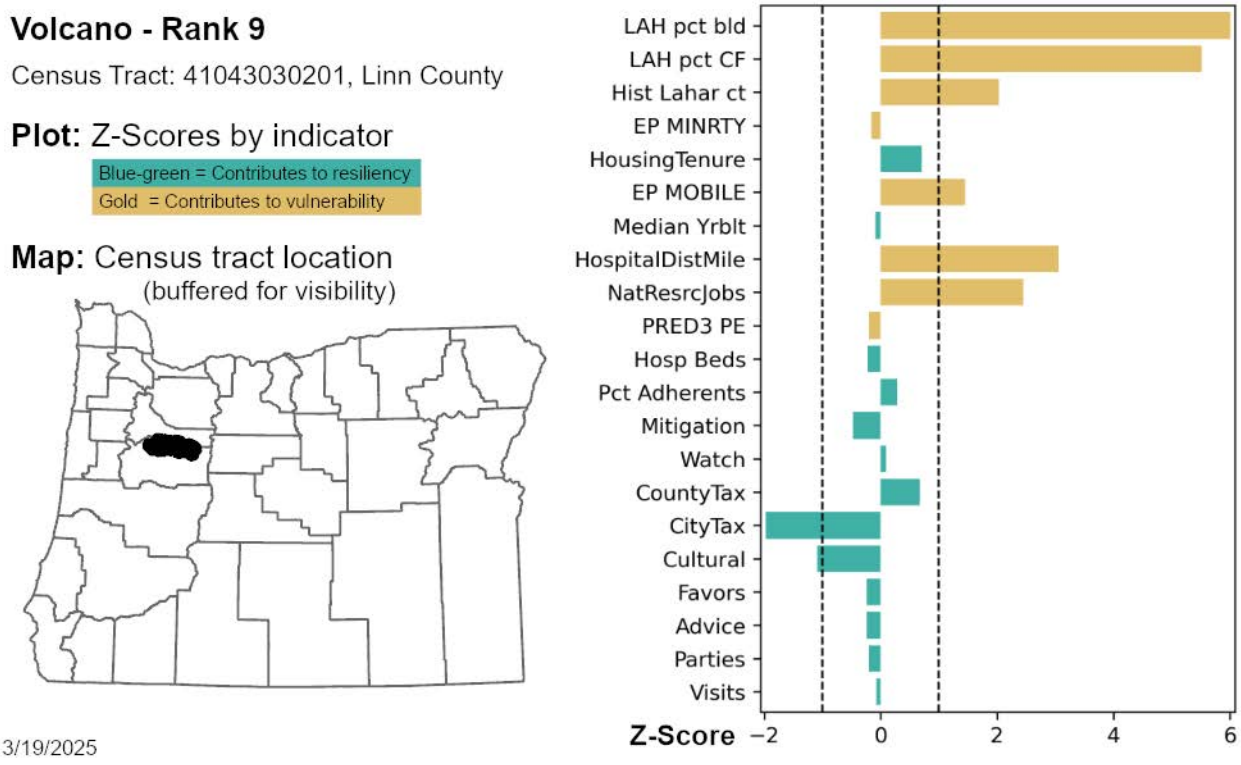
	Building Name	Value	Source
State-owned	Unknown	39065	DOGAMI/DAS

No critical facilities identified.

Volcano Risk Rank 9 – Linn County:

This census tract is located east of Albany, Oregon, in the Willamette Valley. The NRI reports a relatively low volcanic risk in this area, with a score of 78.2. The NRI estimates 72% of the population within this census tract to be at risk of volcanic hazards. Exposure of critical facilities and state-owned buildings, coupled with historic lahar flows drive risk.

Figure 9.3.7-10: Ninth ranked census tract for volcano hazard

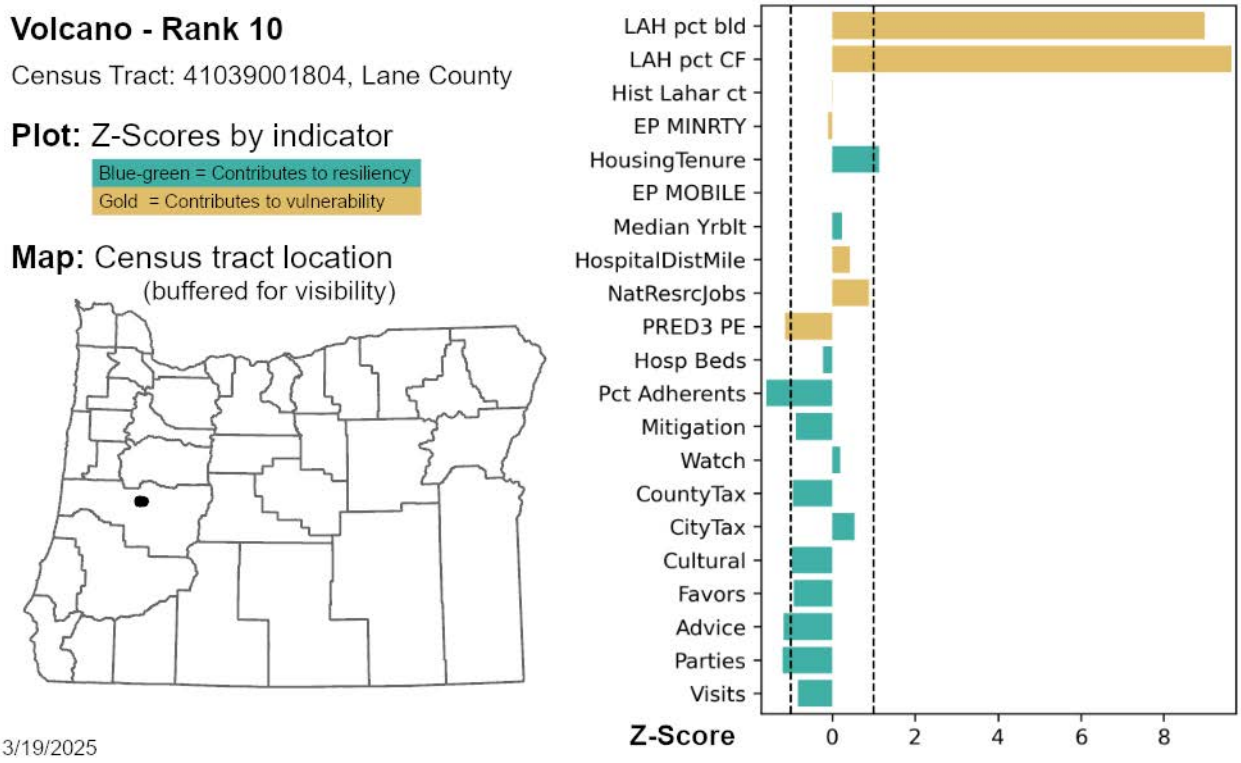


No state-owned buildings or critical facilities identified.

Volcano Risk Rank 10 – Lane County:

This census tract is located east of Eugene, Oregon, in the Willamette Valley. The NRI does not report a volcanic risk in this area and does not score this hazard. The NRI does not estimate people at risk for this hazard. Exposure of critical facilities and state-owned buildings, coupled with historic lahar flows, are the primary drivers of risk.

Figure 9.3.7-11: Tenth ranked census tract for volcano hazard



No state-owned buildings or critical facilities identified in volcano hazard zone.

9.3.8 Wildfire

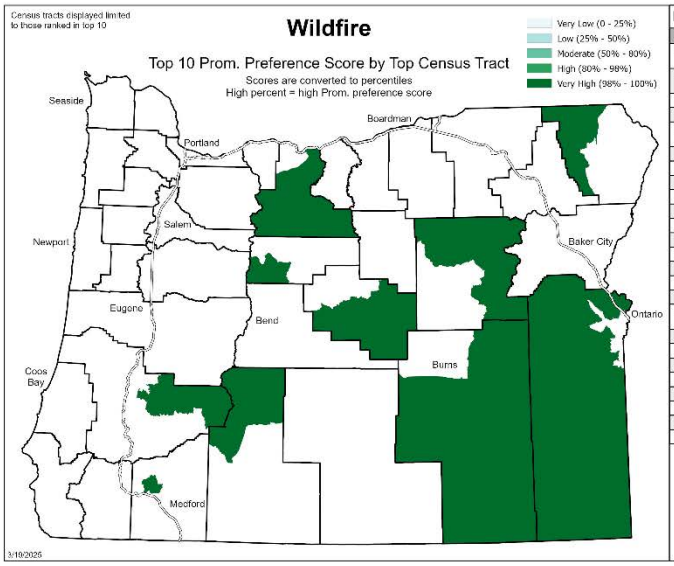
9.3.8.1 Hazard Scenario

Burn probability Oregon Dept. of Forestry (McEvoy and others, 2023)

The Pacific Northwest Quantitative Wildfire Risk Assessment (QWRA): Methods and Results (McEvoy and others, 2023) is a comprehensive report that includes a database of spatial information related to wildfire hazard developed by the United States Forest Service (USFS) for the states of Oregon and Washington. For this project, DOGAMI used the burn probability dataset from the QWRA to measure exposure to wildfire risk. While this risk assessment uses some of the same underlying data as the statewide wildfire hazard map developed by ODF and Oregon State University, this risk assessment and related maps are not intended for regulatory purposes. Rather, they will be used to identify state-owned buildings and critical facilities for possible mitigation actions. To learn more about the statewide wildfire hazard map, visit https://www.oregon.gov/odf/fire/pages/wildfire-hazard.aspx.

9.3.8.2 Top Ranked Wildfire Risk Areas

Figure 9.3.8-1: Top Ranked Risk Areas in Wildfire Risk Areas



Indicators used for the hazard Hazard indicators are worth 35% of the total weight.

Hazard	Indicator Name	Direction	Weight	Short Description
Wildfire	WF_pct_bld	1	0.05	Percentage of SBFO buildings exposed to Medium and High Burn Probability.
Wildfire	WF_pct_CF	1	0.05	Percentage of critical facilities exposed to Medium and High Burn Probability .
Wildfire	BurnProb	1	0.05	Burn probability from the QPNW.
Wildfire	Hwy_WF_pct	1	0.05	Percentage of highway within High Burn Probability zones
Wildfire	Hist_WF_ct	1	0.05	Percentage of historic buildings exposed to Medium and High Burn Probability.
Wildfire	Over90th	1	0.05	Mean days above the historic 90th percentile temp
Wildfire	Over90F	1	0.05	Mean days above 90 degrees Fahrenheit
General	EP_MINRTY	1	0.046	Percentage of Black, Indigenous, and People of Color (2020 Census).
General	HousingTenure	-1	0.046	Housing tenure from the US Census.
General	EP_MOBILE	1	0.046	Percentage of people that live in mobile homes
General	Median_Yrblt	-1	0.046	Median year built of general building stock based on HAZUS default.
General	HospitalDistMile	1	0.046	Distance from tract centroid to nearest hospital.
General	NatResrcJobs	1	0.046	Rate of natural resource jobs.
General	PRED3_PE	1	0.046	Community Resilience Estimate
General	Hosp_Beds	-1	0.046	Estimated number of hospital beds based on square footage .
General	Pct_Adherents	-1	0.046	Percentage of members to a religious group
General	Mitigation	-1	0.046	Number of migitation projects (grouped by zip code and evenly distributed to overlaying tracts)
General	Watch	-1	0.046	Neighborliness: Will watch neighbor's house
General	CountyTax	-1	0.046	County tax rate
General	CityTax	-1	0.046	City tax rate
General	Cultural	-1	0.009	Number of cultural-related buildings
General	Favors	-1	0.009	Neighborliness: Willing to do favors for neighbor
General	Advice	-1	0.009	Neighborliness: Seeks advice from neighbor
General	Parties	-1	0.009	Neighborliness: Attended parties that occur in neighborhood
General	Visits	-1	0.009	Neighborliness: Has visited neighbor's house

Table 9.3.8-1: Oregon Natural Hazard Risk Assessment Rank Compared to the National Risk Index

Oregon Rank	Census Tract	County	National Risk Index Hazard Rating *	Exposed Population According to NRI
1	41025960200	Harney	Very high	1,102
2	41013950402	Crook	Relatively high	1301

Oregon Rank	Census Tract	County	National Risk Index Hazard Rating *	Exposed Population According to NRI
3	41023960100	Grant	Relatively high	891
4	41031960303	Jefferson	Relatively high	395
5	41029002800	Jackson	Relatively high	362
6	41045970900	Malheur	Relatively high	679
7	41065970800	Wasco	Very high	1949
8	41035970100	Klamath	Relatively moderate	511
9	41063960200	Wallowa	Relatively high	216
10	41019100000	Douglas	Relatively moderate	481

*Compared to census tracts nationwide
NRI accessed 03/27/2025

Table 9.3.8-2: Top 10 Census Tract Demographics

Census Tract	Wildfire Risk Rank	2020 Population[1]	2023 Population[2]	% Change in Population	2016 SVI[3]	2022 SVI[4]	Change in SVI
41025960200	1	2165	2261	4%	0.50	0.71	0.21
41031960303	2	564	678	20%	#N/A	0.36	#N/A
41029002800	3	4965	4765	-4%	0.52	0.63	0.11
41013950402	4	2397	2739	14%	#N/A	0.51	#N/A
41023960100	5	2050	2214	8%	0.62	0.65	0.03
41045970900	6	5670	6202	9%	0.69	0.70	0.01
41065970800	7	4542	4650	2%	0.71	0.73	0.03
41035970100	8	3301	3546	7%	0.76	0.57	-0.19
41063960200	9	1860	1877	1%	0.72	0.45	-0.28
41019100000	10	3103	3283	6%	0.56	0.56	0.00

[1] 2020 Decennial Census Census Tract Level Population Data HC2020.P1 - 2020 data was used rather than 2018 due to changes in census tract boundaries in 2020

[2] 2023 ACS 5-Year Estimates Census Tract Level Age and Sex Data S0101

[3] 2016 US CDC Social Vulnerability Index - "#N/A" cells represent census tracts that did not exist before changes to census tract boundaries in 2020

[4] 2022 US CDC Social Vulnerability Index

Wildfire Risk Rank 1 – Harney County 41025960200

This rural census tract encompasses much of Harney County. The NRI reports a very high risk of wildfire, with a score of 99.5 and a Risk Index Rating of Very High. According to the NRI, about half (51%) of the population in this area is at risk of this hazard. Large distances to hospitals primarily drive risk in this area. Although a rural census tract, a larger than statewide average percent of buildings, critical facilities and historic buildings could be harmed by wildfire. This is likely due to the large area covered by the census tract. A larger than statewide average number of people in the census tract live in mobile homes. Social cohesion indicators are below statewide average.

Figure 9.3.8-2: First ranked census tract for wildfire hazard

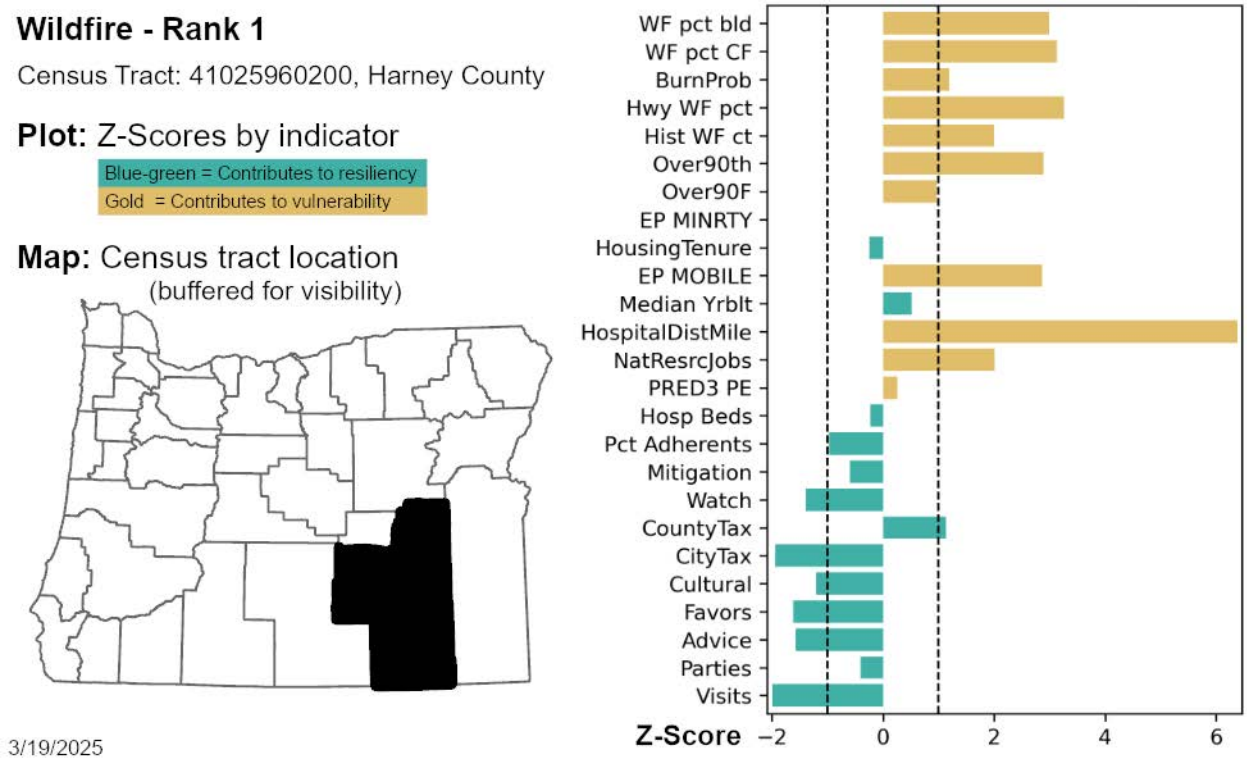


Table 9.3.8-3: State-owned buildings or critical facilities 41025960200

Type of Exposed Structure	Name	Value	Source
State-owned	Sand Shed	431817	DOGAMI/DAS
State-owned	Pete French Round Barn	509322	DOGAMI/DAS
State-owned	Sagehen Hill RA Grounds	835829	DOGAMI/DAS
State-owned	Sagehen Hill RA Grounds	486577	DOGAMI/DAS
State-owned	Frenchglen Hotel	690192	DOGAMI/DAS

Type of Exposed Structure	Name	Value	Source
State-owned	Frenchglen Hotel	175447	DOGAMI/DAS
State-owned	Buchanan Springs Rest Area	106513	DOGAMI/DAS
State-owned	Site Systems - Steens Radio Operating Exp Grounds	31564	DOGAMI/DAS
State-owned	Steens Radio Building	76217	DOGAMI/DAS
State-owned	Site Systems - King Mountain M/W Grounds	31564	DOGAMI/DAS
State-owned	King Mountain M/W Building	60474	DOGAMI/DAS
State-owned	King Mountain M/W Battery Building	60474	DOGAMI/DAS
State-owned	Alkali Lake MS Deicer Building	156455	DOGAMI/DAS
State-owned	Alkali Lake MS Residence Garage	104851	DOGAMI/DAS
State-owned	Alkali Lake MS Mobile Home 17	274408	DOGAMI/DAS
Critical Facility	DREWSEY ELEMENTARY SCHOOL	190960	DOGAMI/DAS
Critical Facility	PINE CREEK ELEMENTARY SCHOOL	330490	DOGAMI/DAS
Critical Facility	DIAMOND ELEMENTARY SCHOOL	10934	DOGAMI/DAS
Critical Facility	CRANE ELEMENTARY SCHOOL	1070893	DOGAMI/DAS
Critical Facility	CRANE UNION HIGH SCHOOL	1581720	DOGAMI/DAS
Critical Facility	CRANE UNION HIGH SCHOOL	92838	DOGAMI/DAS
Critical Facility	CRANE UNION HIGH SCHOOL	202202	DOGAMI/DAS
Critical Facility	CRANE UNION HIGH SCHOOL	68603	DOGAMI/DAS
Critical Facility	CRANE UNION HIGH SCHOOL	165974	DOGAMI/DAS
Critical Facility	CRANE UNION HIGH SCHOOL	165974	DOGAMI/DAS
Critical Facility	CRANE ELEMENTARY SCHOOL	98478	DOGAMI/DAS
Critical Facility	FIELDS ELEMENTARY SCHOOL	1111350	DOGAMI/DAS
Critical Facility	FIELDS ELEMENTARY SCHOOL	421350	DOGAMI/DAS
Critical Facility	DIAMOND ELEMENTARY SCHOOL	39964	DOGAMI/DAS
Critical Facility	CRANE UNION HIGH SCHOOL	783727	DOGAMI/DAS

Type of Exposed Structure	Name	Value	Source
Critical Facility	CRANE UNION HIGH SCHOOL	88801	DOGAMI/DAS
Critical Facility	CRANE ELEMENTARY SCHOOL	6311	DOGAMI/DAS
Critical Facility	DIAMOND ELEMENTARY SCHOOL	39964	DOGAMI/DAS
Critical Facility	Double O Elementary School	323300	DOGAMI/DAS
Critical Facility	Frenchglen Elementary School	288690	DOGAMI/DAS
Critical Facility	Communication Structure	750000	DOGAMI/DAS
Critical Facility	Communication Structure	33750	DOGAMI/DAS
Critical Facility	Communication Structure	750000	DOGAMI/DAS
Critical Facility	Communication Structure	750000	DOGAMI/DAS
Critical Facility	Communication Structure	750000	DOGAMI/DAS
Critical Facility	BUREAU OF LAND MANAGEMENT - BURNS FIELD OFFICE	2016150	DOGAMI/DAS
Critical Facility	Burns Municipal Airport	2654381	DOGAMI/DAS
Critical Facility	Roaring Springs Ranch Airport	402150	DOGAMI/DAS
Critical Facility	El Rancho Airport	85950	DOGAMI/DAS
Critical Facility	Wildhorse Valley Airport	750000	DOGAMI/DAS
Critical Facility	Barton Lake Ranch	377700	DOGAMI/DAS
Critical Facility	Wagontire	270450	DOGAMI/DAS
Critical Facility	Arnold Airstrip	750000	DOGAMI/DAS
Critical Facility	Whitehorse Ranch Airport	750000	DOGAMI/DAS

Wildfire Risk Rank 2 – Crook County 41013950402

This census tract is located east of Bend. The NRI reports a relatively high risk of wildfire, with a score of 98.3. According to the NRI, around half (54.2%) of the population in this area is at risk. Large distances to hospitals, and exposure of buildings, historic buildings, and critical facilities drive risk in this area.

Figure 9.3.8-3: Second ranked census tract for wildfire hazard

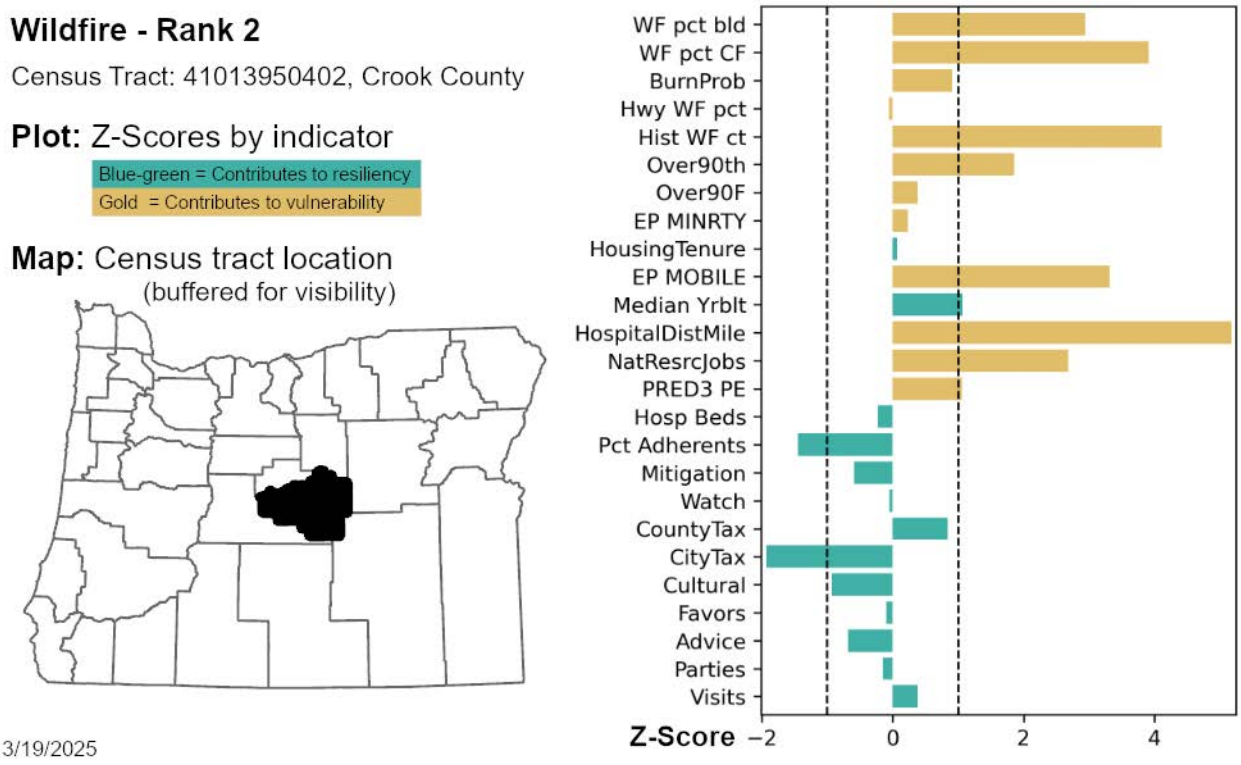


Table 9.3.8-4: State-owned buildings 41013950402

	Building Name 41013950402	Value	Source
State-owned	Prineville Reservoir State Park	8054379	DOGAMI/DAS
State-owned	Powder House Cove Boat Ramp	459018	DOGAMI/DAS
State-owned	Lookout Gerow Butte	331558	DOGAMI/DAS

No critical facilities identified.

Wildfire Risk Rank 3 – Grant County 41023960100

This rural census tract is located in Oregon's northeast corner west of Baker City. The NRI reports a relatively high risk of wildfire, with a score of 99.1. According to the NRI, around half (43.4%) of the population in this area is at risk. Low community resilience, indicated by the Community Resilience Estimate score, coupled with longer distances to hospitals and a higher prevalence of natural resource jobs, drive risk in this area. Additionally, while there is not a higher burn probability, there is a higher than stateside average of exposed structures and historic buildings exposed to potential wildfires in this area.

Figure 9.3.8-4: Third ranked census tract for wildfire hazard

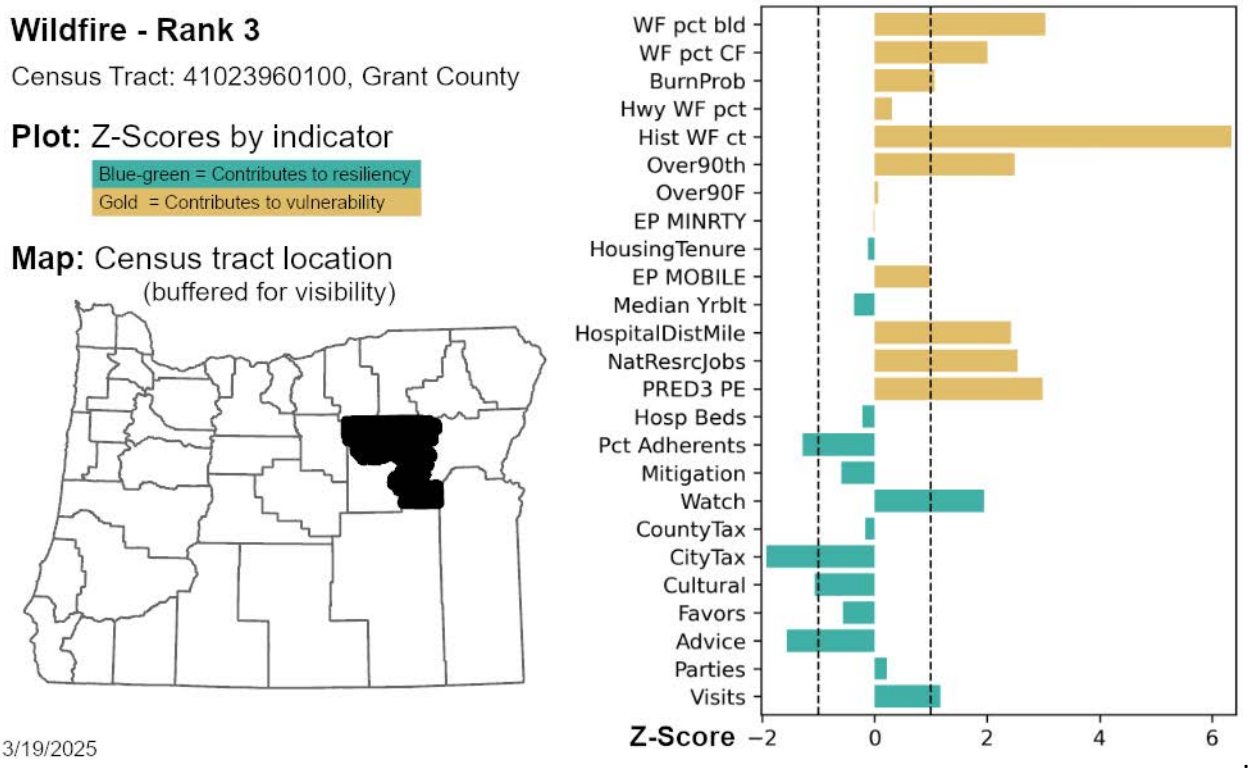


Table 9.3.8-5: State-owned buildings or critical facilities 41023960100

	Name	Total Building Value	Source
State-owned	Austin Maintenance Station	4,407,243	DOGAMI/DAS
State-owned	Bone Point M/W $ Radio Operations	66,220	DOGAMI/DAS
State-owned	Long Creek Maintenance Station	1,478,301	DOGAMI/DAS
State-owned	Tamarack M/W & Radio Operations	89,232	DOGAMI/DAS
Critical facility	Dayville School	6152537	DOGAMI/DAS
Critical facility	MALHEUR NATIONAL FOREST - SUPERVISORS OFFICE	4715000	DOGAMI/DAS
Critical facility	Grant County Road Dept	1132830	DOGAMI/DAS
Critical facility	Ponderosa Ranch Airport	754350	DOGAMI/DAS

	Name	Total Building Value	Source
Critical facility	Communication Structure	750000	DOGAMI/DAS
Critical facility	Land's Inn Ranch Airport	750000	DOGAMI/DAS
Critical facility	Cerny Airport	750000	DOGAMI/DAS
Critical facility	Communication Structure	750000	DOGAMI/DAS
Critical facility	Hi Country No 2 Airport	750000	DOGAMI/DAS
Critical facility	Inshallah International Airport	750000	DOGAMI/DAS
Critical facility	Miranda's Skyranch	750000	DOGAMI/DAS
Critical facility	Oxbow Ranch Airport	750000	DOGAMI/DAS
Critical facility	Seneca Emergency Airstrip	750000	DOGAMI/DAS
Critical facility	Wiley Creek Airport	750000	DOGAMI/DAS
Critical facility	Grant County Road Dept	748342	DOGAMI/DAS
Critical facility	Communication Structure	742950	DOGAMI/DAS
Critical facility	NATIONAL PARK SERVICE - JOHN DAY FOSSIL BEDS NATIONAL MONUMENT RANGER STATION	570450	DOGAMI/DAS
Critical facility	Communication Structure	516900	DOGAMI/DAS
Critical facility	Communication Structure	501450	DOGAMI/DAS
Critical facility	Dayville Fire Department	411853	DOGAMI/DAS
Critical facility	Communication Structure	402000	DOGAMI/DAS
Critical facility	Communication Structure	333000	DOGAMI/DAS
Critical facility	Communication Structure	265350	DOGAMI/DAS
Critical facility	Communication Structure	227250	DOGAMI/DAS
Critical facility	Communication Structure	202800	DOGAMI/DAS
Critical facility	Communication Structure	165450	DOGAMI/DAS
Critical facility	Communication Structure	114900	DOGAMI/DAS
Critical facility	Communication Structure	93900	DOGAMI/DAS
Critical facility	MT VERNON STP	88699	DOGAMI/DAS
Critical facility	CITY OF DAYVILLE	80550	DOGAMI/DAS
Critical facility	LONG CREEK STP	62850	DOGAMI/DAS
Critical facility	Communication Structure	47550	DOGAMI/DAS
Critical facility	Communication Structure	40200	DOGAMI/DAS
Critical facility	Monument Municipal Airport	38250	DOGAMI/DAS

Wildfire Risk Rank 4– Jefferson County

This rural census tract lays north of Bend and Redmond, Oregon. The NRI reports a relatively high risk of wildfire, with a score of 98.5. According to the NRI, an estimated 70% of the population in this area is at risk of wildfire. Exposures of critical facilities, historic buildings, and other buildings primarily drive risk in this census tract, despite normal overall wildfire burn probabilities. CRE scores indicate high social vulnerability in the area, although social cohesion appears to align with statewide averages. A higher than statewide average number of people live in rental housing.

Figure 9.3.8-5: Fourth ranked census tract for wildfire hazard

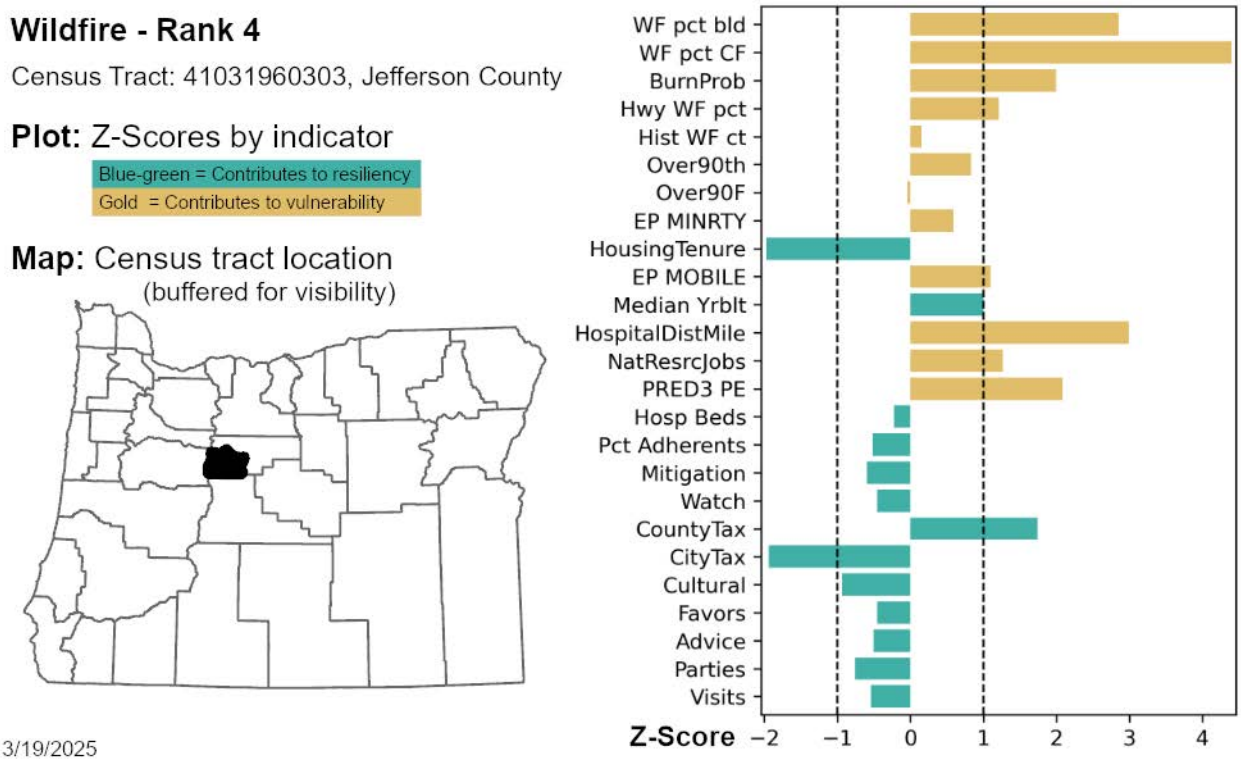


Table 9.3.8-6: State-owned buildings and critical facilities 41031960303

	Name	Total Building Value	Source
State-owned	Lake Billy Chinook State Airport	237450	DOGAMI/DAS
Critical facility	Communication Structure	6251550	DOGAMI/DAS
Critical facility	Black Butte Elementary	810900	DOGAMI/DAS
Critical facility	3 Rivers Recreation Area Airport	750000	DOGAMI/DAS
Critical facility	Bombay Farms Airport	750000	DOGAMI/DAS
Critical facility	Six Springs Ranch Airport	750000	DOGAMI/DAS
Critical facility	Warm Springs K-8 Academy	750000	DOGAMI/DAS
Critical facility	Communication Structure	609000	DOGAMI/DAS
Critical facility	ASHWOOD ELEMENTARY SCHOOL	600300	DOGAMI/DAS

	Name	Total Building Value	Source
Critical facility	Three Rivers VFD	288600	DOGAMI/DAS
Critical facility	Communication Structure	199950	DOGAMI/DAS
Critical facility	Communication Structure	173250	DOGAMI/DAS
Critical facility	Communication Structure	147150	DOGAMI/DAS
Critical facility	Communication Structure	83100	DOGAMI/DAS
Critical facility	Communication Structure	76950	DOGAMI/DAS
Critical facility	Communication Structure	54000	DOGAMI/DAS

Wildfire Risk Rank 5 – Jackson County 41029002800

This census tract is located north of Central Point and Medford, Oregon. The NRI reports a relatively high risk of wildfire, with a score of 96.5. According to the NRI, an estimated 7% of the population is at risk of wildfire. Higher than average exposures of critical facilities and buildings, coupled with higher-than-average burn probabilities drive wildfire risk in this area. Relatively lower levels of social cohesion also contribute.

Figure 9.3.8-6: Fifth ranked census tract for wildfire hazard

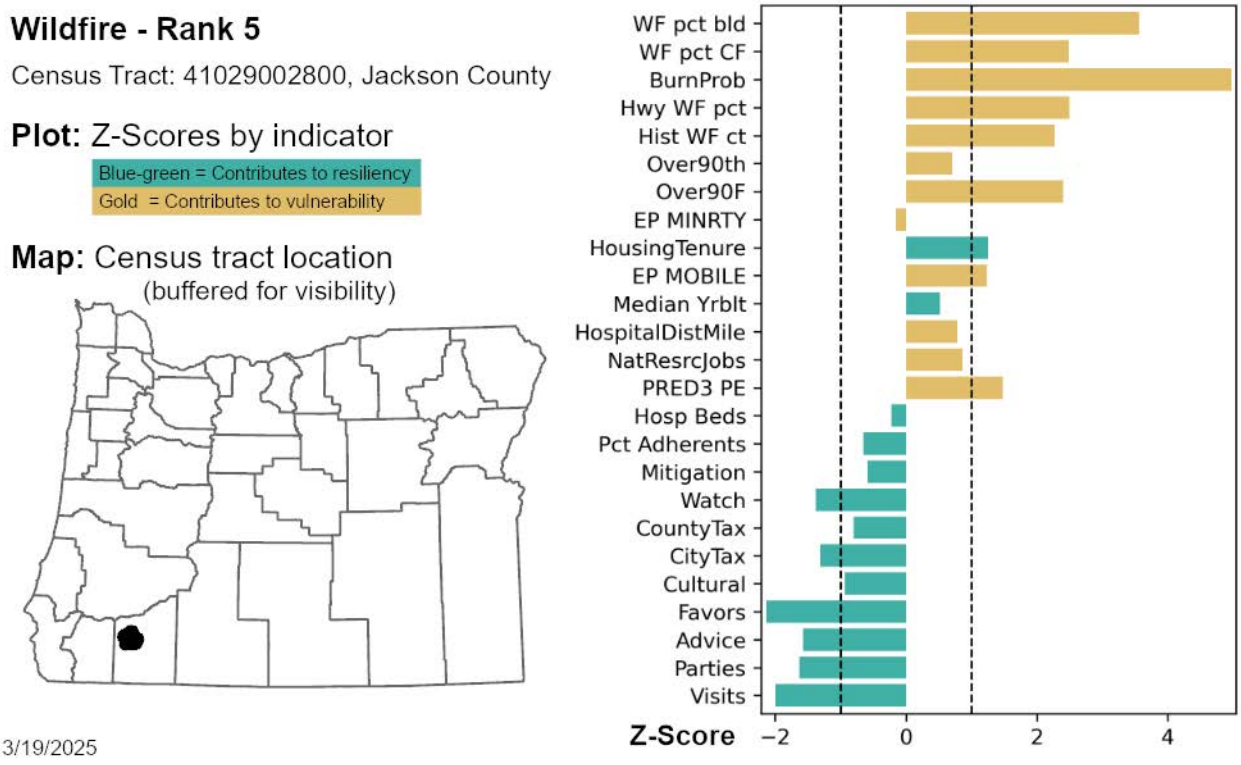


Table 9.3.8-7: State-owned buildings 41029002800

	Building Name	Value	Source
State-owned	Restroom	93457	DOGAMI/DAS

No critical facilities identified.

Wildfire Risk Rank 6 – Malheur County:

This rural census tract encompasses most of Malheur County. The NRI reports a relatively high risk of wildfire, with a score of 99. According to the NRI, 12% of the population in this area is at risk. Large distances to hospitals dominates risk drivers.

Figure 9.3.8-7: Sixth ranked census tract for wildfire hazard

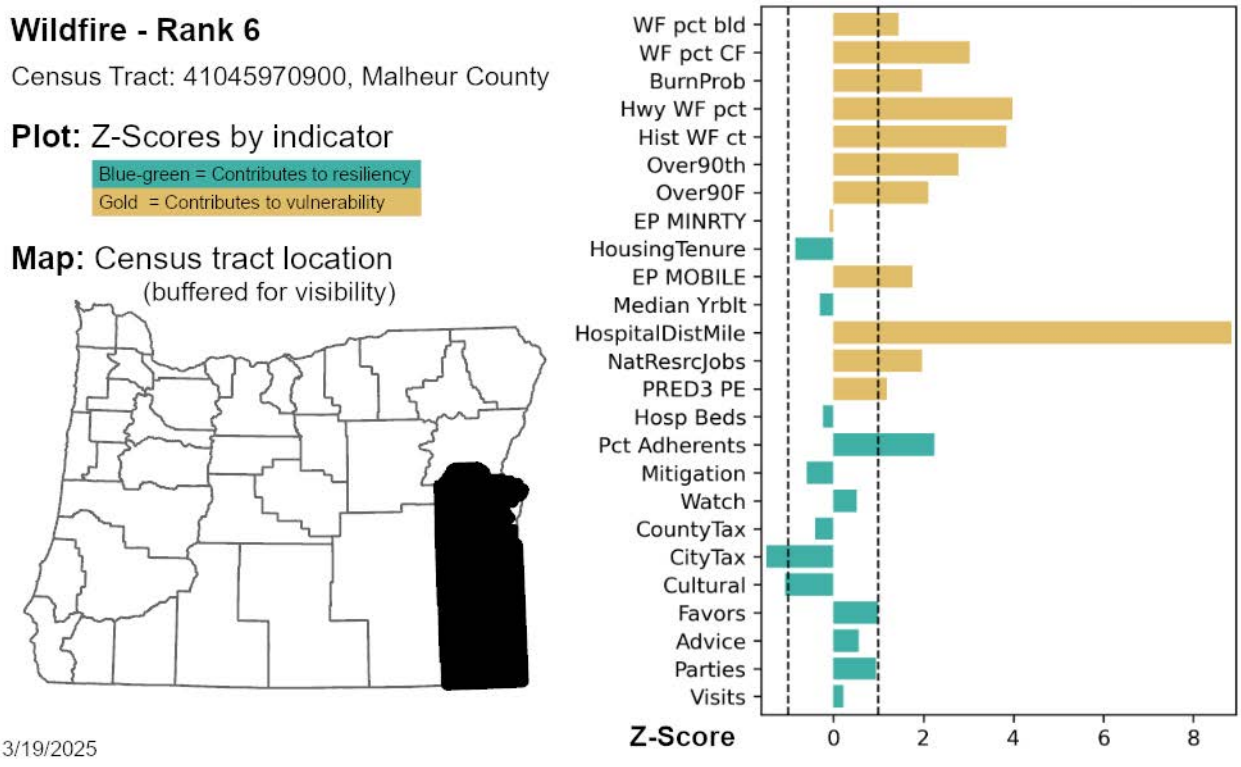


Table 9.3.8-8: State-owned buildings 41045970900

	Building Name	Value	Source
State-owned	Ontario Maintenance Station	18,655,543	DOGAMI/DAS
State-owned	Snake River Correctional Institution	504,885,082	DOGAMI/DAS

No critical facilities identified.

Wildfire Risk Rank 7: Wasco County 41065970800

This census tract in Wasco County, located just east of The Dalles, is characterized by high probability of wildfire along with high potential for harm to buildings and critical facilities. The area also has high social vulnerabilities relative the other places in the state. The FEMA National Risk Index shows this area at very high risk for wildfire, with almost 2,000 people exposed. The area is primarily agricultural. Part of the Warm Springs Reservation is located at the southern edge of the census tract.

Figure 9.3.8-8: Seventh ranked census tract for wildfire hazard

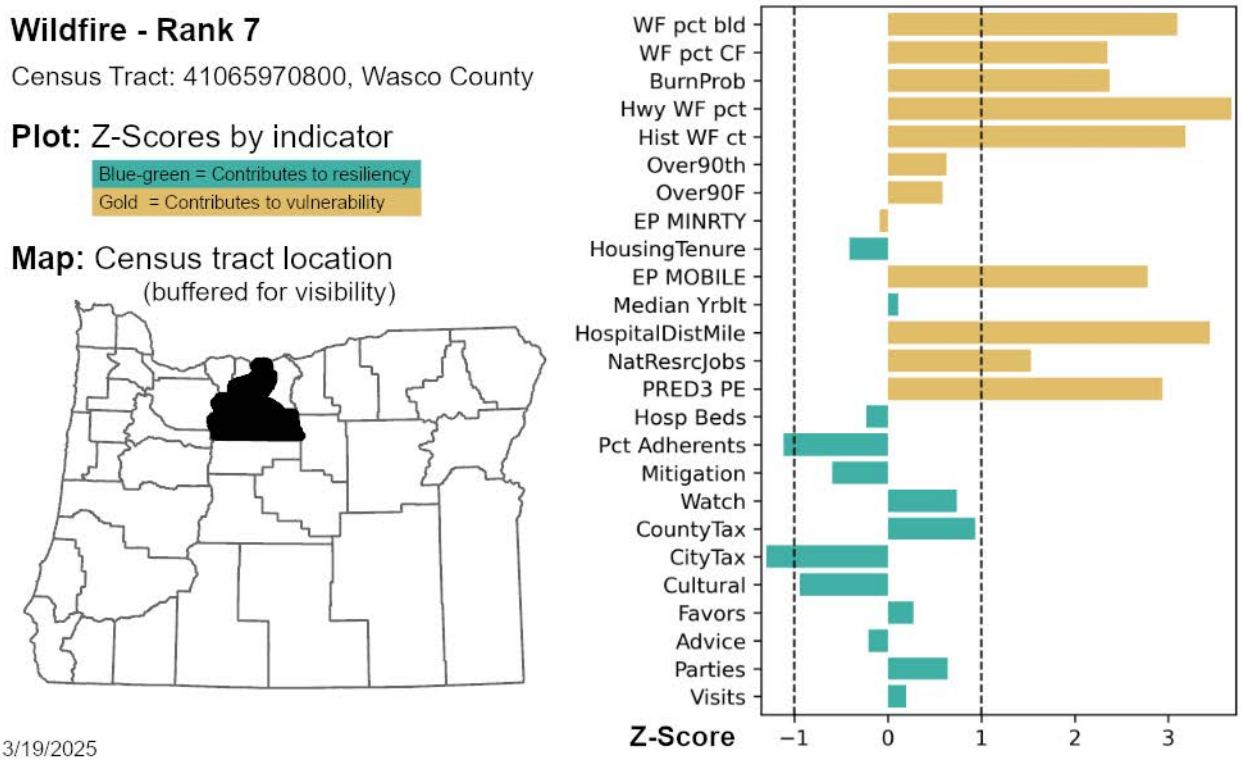


Table 9.3.8-9: Critical facilities 41065970800

	Name	Total Building Value	Source
Critical facility	Communication Structure	2269500	DOGAMI/DAS
Critical facility	Wamic RFD	1361147	DOGAMI/DAS
Critical facility	Big Muddy School	863881	DOGAMI/DAS
Critical facility	Communication Structure	750000	DOGAMI/DAS
Critical facility	Communication Structure	750000	DOGAMI/DAS
Critical facility	Communication Structure	750000	DOGAMI/DAS
Critical facility	Communication Structure	750000	DOGAMI/DAS
Critical facility	Communication Structure	750000	DOGAMI/DAS
Critical facility	Communication Structure	750000	DOGAMI/DAS
Critical facility	Communication Structure	750000	DOGAMI/DAS

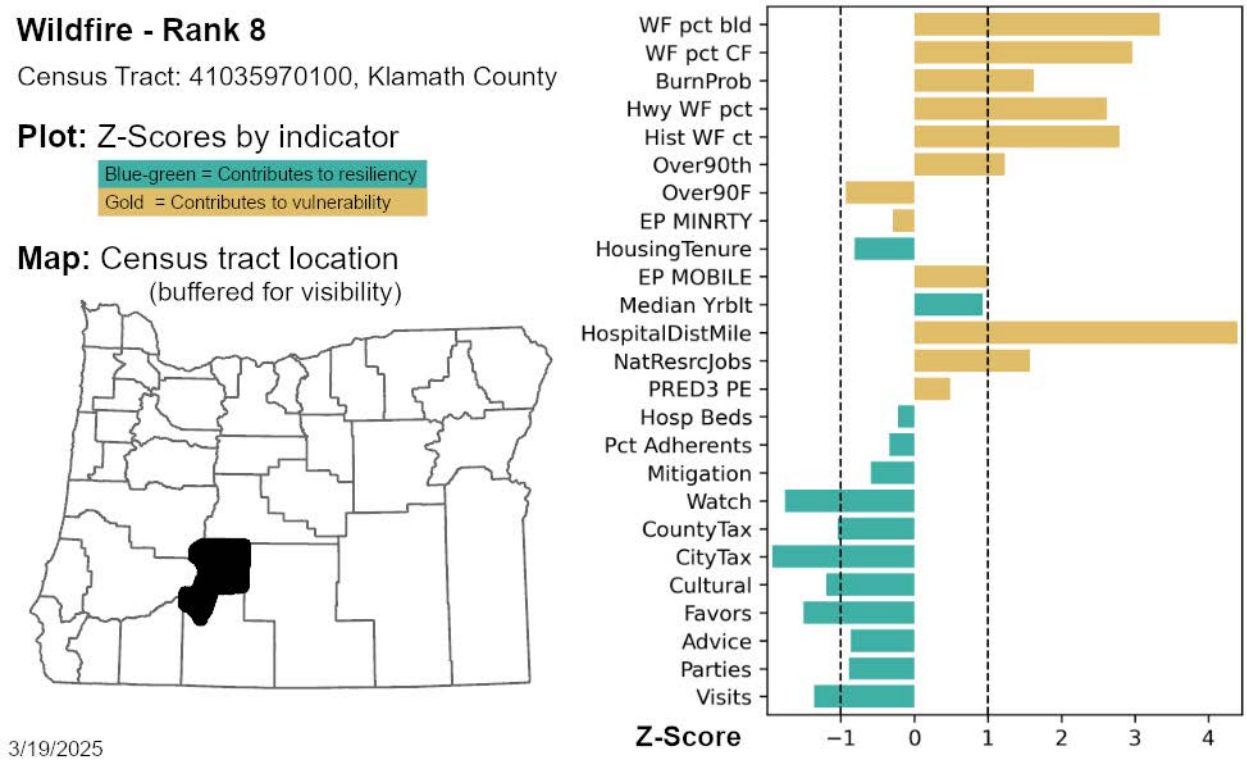
	Name	Total Building Value	Source
Critical facility	Nelson Ranch Airport	750000	DOGAMI/DAS
Critical facility	Shaniko Cattle Airport	750000	DOGAMI/DAS
Critical facility	Shaniko Ranch Airport	750000	DOGAMI/DAS
Critical facility	Wapinitia Airport	750000	DOGAMI/DAS
Critical facility	Communication Structure	727950	DOGAMI/DAS
Critical facility	Big Muddy Ranch	368110	DOGAMI/DAS
Critical facility	Communication Structure	340350	DOGAMI/DAS
Critical facility	Chenoweth Airpark	325050	DOGAMI/DAS
Critical facility	Juniper Flat Rural Fire	283650	DOGAMI/DAS
Critical facility	Communication Structure	235650	DOGAMI/DAS
Critical facility	Communication Structure	199950	DOGAMI/DAS
Critical facility	OREGON STRUT CENTER	179550	DOGAMI/DAS
Critical facility	Communication Structure	103800	DOGAMI/DAS
Critical facility	Communication Structure	87300	DOGAMI/DAS
Critical facility	Communication Structure	84450	DOGAMI/DAS
Critical facility	Communication Structure	77700	DOGAMI/DAS
Critical facility	Pointers Airport	66300	DOGAMI/DAS
Critical facility	Communication Structure	66000	DOGAMI/DAS
Critical facility	Communication Structure	43050	DOGAMI/DAS
Critical facility	Communication Structure	16957	DOGAMI/DAS

No state-owned buildings identified.

Wildfire Risk Rank 8: Klamath County 41035970100

This isolated and rural census tract in Klamath County is home to Crater Lake National Park. The FEMA National Risk Index ranks the tract as having a relatively moderate risk of wildfire. The area appears to have lower than average social resiliency.

Figure 9.3.8-9: Eighth ranked census tract for wildfire hazard

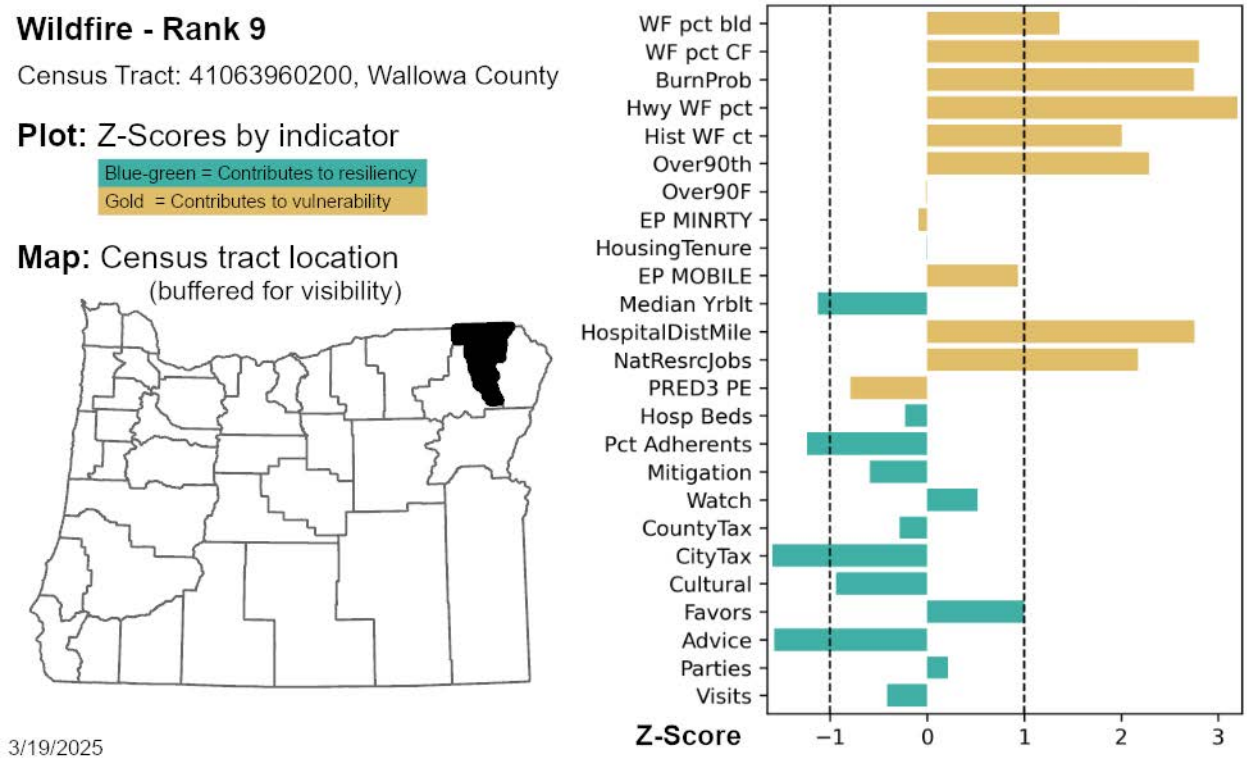


No state-owned buildings or critical facilities identified.

Wildfire Risk Rank 9 – Wallowa County 41063960200

This census tract, located east of the city of Enterprise, largely consists of publicly owned land. The largest settlement, with a population of 218, Is the unincorporated town of Imnaha. The FEMA National Risk Index ranks the area at relatively high risk for wildfire, with a score of 93.3, and an exposed population of just over 300. The area relies on natural resources, with farming, timber, ranching, and tourism driving the economy.

Figure 9.3.8-10: Ninth ranked census tract for wildfire hazard



No state-owned buildings or critical facilities identified.

Wildfire Risk Rank 10 – Douglas County 41019100000

This census tract is located east of Roseburg in southern Oregon. The NRI reports a relatively moderate risk of wildfire, with a score of 91.7. According to the NRI, an estimated 15% of the population is at risk of this hazard. “Transportation systems exposed to wildfire risk” is the primary driver of risk in this area. The area shows a higher-than-statewide average percentage of exposed structures and state-owned facilities.

Figure 9.3.8-11: Tenth ranked census tract for wildfire hazard

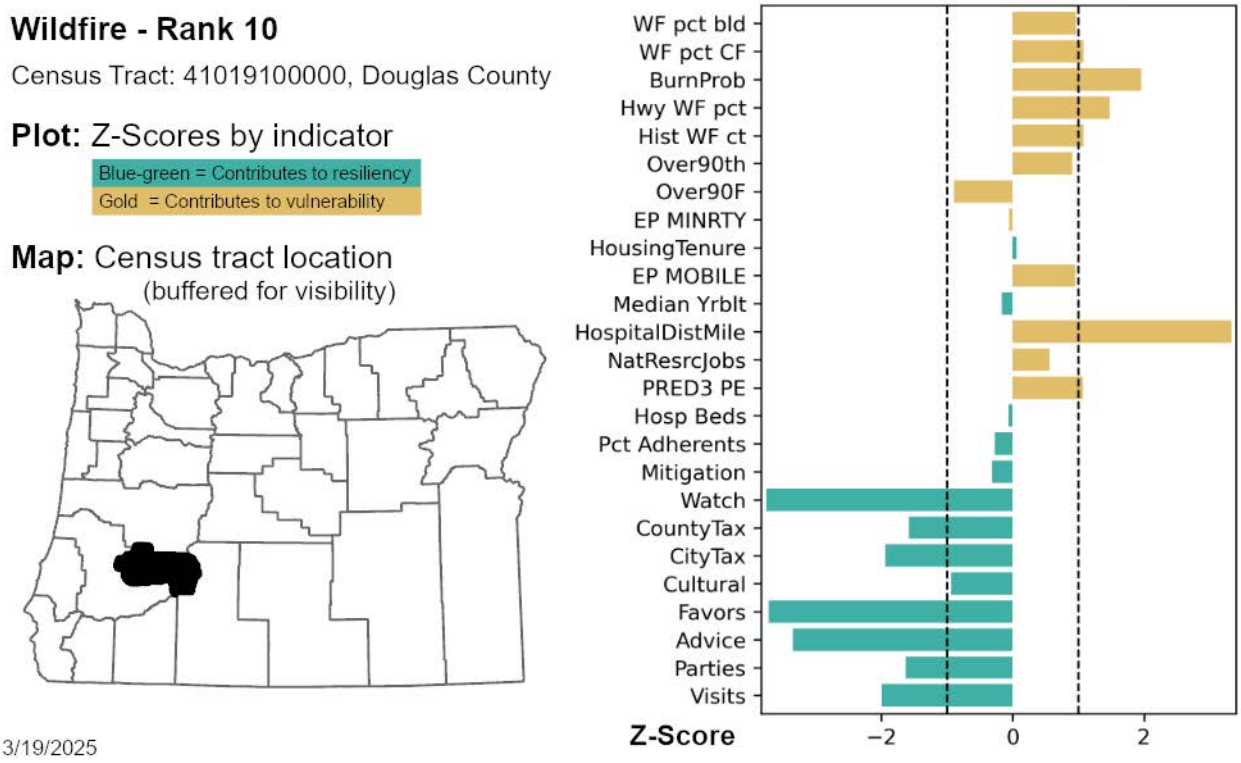


Table 9.3.8-5: State-owned buildings 41019100000

	Building Name	Value	Source
State-owned	Rock Creek Hatchery	1354306	DOGAMI/DAS
State-owned	Steamboat Maintenance Station Grounds	127168	DOGAMI/DAS
State-owned	Lemolo Sand Sheds	1018770	DOGAMI/DAS
State-owned	Storage Building	252905	DOGAMI/DAS
State-owned	kiosk	121075	DOGAMI/DAS
State-owned	Diamond Lake Bunkhouse Building	34345	DOGAMI/DAS

	Building Name	Value	Source
State-owned	Diamond Lake Residence #1 (Cabin)	34345	DOGAMI/DAS
State-owned	Site Systems - Chilcoot M/W Site	34345	DOGAMI/DAS
State-owned	Chilcoot Mountain M/W Building	118346	DOGAMI/DAS
State-owned	Canyonville Maintenance Station Grounds	1488691	DOGAMI/DAS
State-owned	Lookout Silver Butte	291239	DOGAMI/DAS

No critical facilities identified.

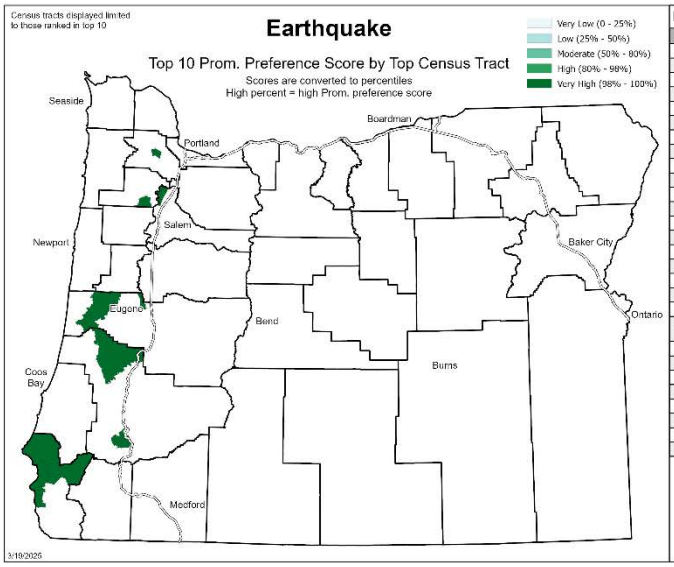
9.3.9 Earthquake

9.3.9.1 Hazard Scenario

Liquefaction	Oregon Seismic Hazard Database (OSHD) – DOGAMI (Madin and others, 2021)
CSZ Hazus Analysis (Co-seismic landslide and liquefaction, and NEHRP)	OSHD – DOGAMI (Madin and others, 2021)
2475-year Hazus Analysis (4 ground motions)	OSHD – DOGAMI (Madin and others, 2021)

9.3.9.2 Top Ranked Earthquake Risk Areas

Figure 9.3.9-1: Top Ranked Risk Areas in Earthquake Risk Areas



Indicators used for the hazard Hazard indicators are worth 35% of the total weight.

Hazard	Indicator Name	Direction	Weight	Short Description
Earthquake	LQ_pct_bld	1	0.035	Pct. SBFO buildings exposed to Moderate to Very High liq.
Earthquake	LQ_pct_CF	1	0.035	Pct. critical facilities exposed to Moderate to Very High liq.
Earthquake	EQCSZ_pct_CF	1	0.035	Pct. of red or yellow-tagged critical facilities (CSZ Deterministic).
Earthquake	EQ25_pct_CF	1	0.035	Pct. of yellow-tagged critical facilities (2500 Probabilistic).
Earthquake	Hist_LQ_ct	1	0.035	Pct. historic buildings exposed to Moderate to Very High liq.
Earthquake	Hwy_LQ_pct	1	0.035	Major roadway miles exposed to Moderate to Very High liq.
Earthquake	Eqk_NRI_rate	1	0.035	Earthquake risk from NRI.
Earthquake	LQ_Haz_Area	1	0.035	Area of tract in high or very high liquefaction hazard.
Earthquake	Bridges_LIQ	1	0.035	Number of bridges within high or very high liquefaction hazard.
Earthquake	PGA_2500	1	0.035	Average shaking in tract from 2500-year probabilistic earthquake.
General	EP_MINRTY	1	0.046	Percentage of Black, Indigenous, and People of Color (2020 Census).
General	HousingTenure	-1	0.046	Housing tenure from the US Census.
General	EP_MOBILE	1	0.046	Percentage of people that live in mobile homes
General	Median_YrBlt	-1	0.046	Median year built of general building stock based on HAZUS default.
General	HospitalDistMile	1	0.046	Distance from tract centroid to nearest hospital.
General	NatResrcJobs	1	0.046	Rate of natural resource jobs.
General	PRED3_PE	1	0.046	Community Resilience Estimate
General	Hosp_Beds	-1	0.046	Estimated number of hospital beds based on square footage.
General	Pct_Adherents	-1	0.046	Percentage of members to a religious group
General	Mitigation	-1	0.046	Number of migitation projects (grouped by zip code and evenly distributed to overlaying tracts)
General	Watch	-1	0.046	Neighborliness: Will watch neighbor's house
General	CountyTax	-1	0.046	County tax rate
General	CityTax	-1	0.046	City tax rate
General	Cultural	-1	0.009	Number of cultural-related buildings
General	Favors	-1	0.009	Neighborliness: Willing to do favors for neighbor
General	Advice	-1	0.009	Neighborliness: Seeks advice from neighbor
General	Parties	-1	0.009	Neighborliness: Attended parties that occur in neighborhood
General	Visits	-1	0.009	Neighborliness: Has visited neighbor's house

Table 9.3.9-1: Oregon Natural Hazard Risk Assessment Rank Compared to the National Risk Index

Census Tract Number	County in which census tract is located	Rank	National Risk Index Classification*	People Exposed
41015950201	Curry	1	Very high	3,513
41015950100	Curry	2	Very high	3,296
41039000404	Lane	3	Very high	4,010

Census Tract Number	County in which census tract is located	Rank	National Risk Index Classification*	People Exposed
41019200000	Douglas	4	Relatively moderate	1309
41039000500	Lane	5	High	2,244
41071031000	Yamhill	6	High	4,321
41047010100	Marion	7	Very high	1,506
41015950202	Curry	8	High	1,923
41019030000	Douglas	9	Relatively high	4047
41067032800	Washington	10	Relatively moderate	1309

*Compared to census tracts nationwide

Table 9.3.9-2: Top 10 Census Tract Demographics

Census Tract	Earthquake Risk Rank	2020 Population[1]	2023 Population[2]	% Change in Population	2016 SVI[3]	2022 SVI[4]	Change in SVI
41015950201	1	3513	3730	6%	#N/A	0.80	#N/A
41015950100	2	3296	3226	-2%	0.66	0.56	-0.10
41039000404	3	4010	4409	10%	0.83	0.74	-0.08
41019200000	4	4902	4912	0%	0.87	0.91	0.04
41039000500	5	2244	2148	-4%	0.53	0.56	0.02
41071031000	6	4321	4264	-1%	0.63	0.59	-0.04
41047010100	7	1506	1503	0%	0.42	0.40	-0.03
41015950202	8	1923	2074	8%	#N/A	0.34	#N/A
41019030000	9	4047	4107	1%	0.39	0.35	-0.04
41067032800	10	1309	1290	-1%	0.22	0.17	-0.04

[1] 2020 Decennial Census Census Tract Level Population Data HC2020.P1 - 2020 data was used rather than 2018 due to changes in census tract boundaries in 2020

[2] 2023 ACS 5-Year Estimates Census Tract Level Age and Sex Data S0101

[3] 2016 US CDC Social Vulnerability Index - "#N/A" cells represent census tracts that did not exist before changes to census tract boundaries in 2020

[4] 2022 US CDC Social Vulnerability Index

Earthquake Risk Rank 1 Curry County 41015950201

This census tract is located on the southern coast of Oregon. The NRI reports a very high risk of earthquakes, with a score of 99.6. According to the NRI, 100% of the population (3,513 people) are at risk of this hazard. High earthquake risk combined with a higher prevalence of mobile homes drives risk in this area.

Figure 9.3.9-2: First ranked census tract for earthquake hazard

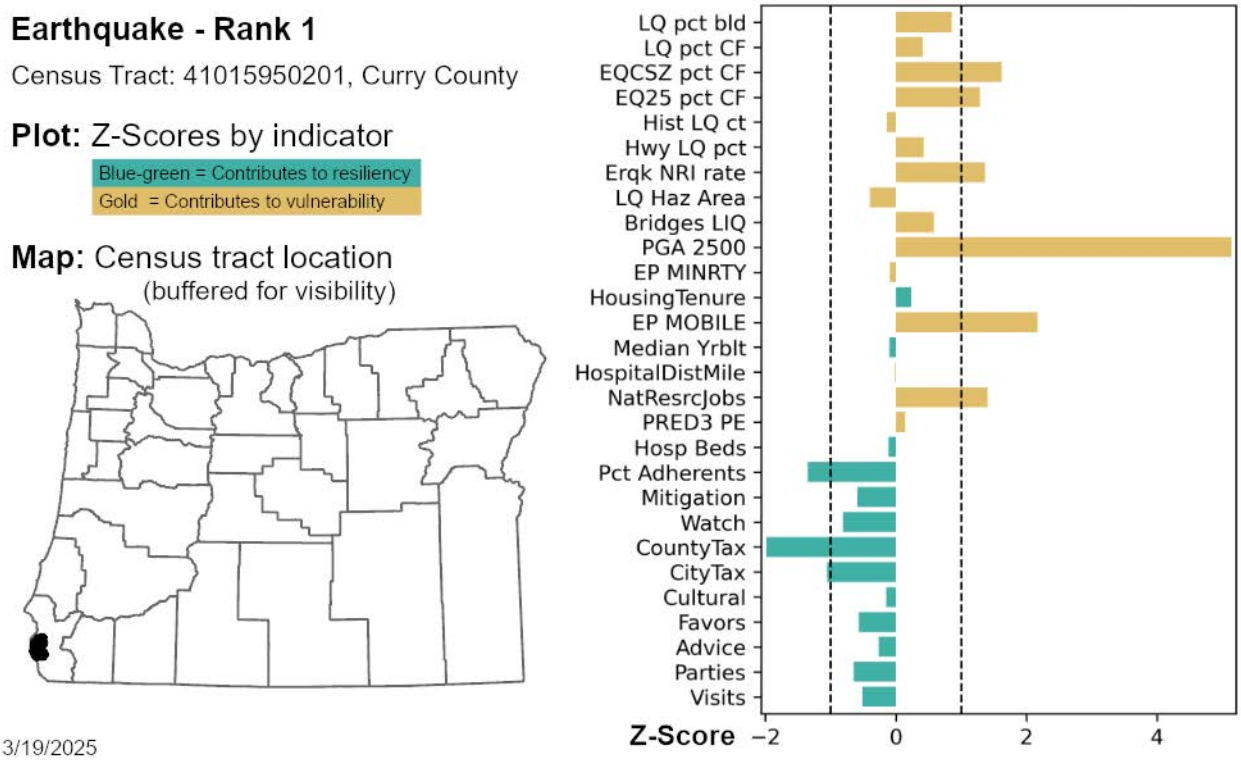


Table 9.3.9-3: State-owned buildings or critical facilities 41015950201

	State-owned Building Name 41015950201	Value	Source
State-owned	Hunter Creek Maintenance Station Grounds	682532	DOGAMI/DAS
State-owned	Hunter Creek Maintenance Station Grounds	840392	DOGAMI/DAS
Critical Facility	unknown	929953	DOGAMI/DAS
Critical Facility	unknown	971810	DOGAMI/DAS
Critical Facility	unknown	1005735	DOGAMI/DAS
Critical Facility	Curry County Circuit Court	60668	DOGAMI/DAS

Earthquake Risk Rank 2 Curry County 41015950100

This rural census tract is located on the southern Oregon coast. The NRI reports a very high risk of earthquakes, with a score of 98.2. According to the NRI, 100% (3,296 people) are exposed to this hazard. Low social cohesion along with high earthquake risk primarily drives risk in this area.

Figure 9.3.9-3: Second ranked census tract for earthquake hazard

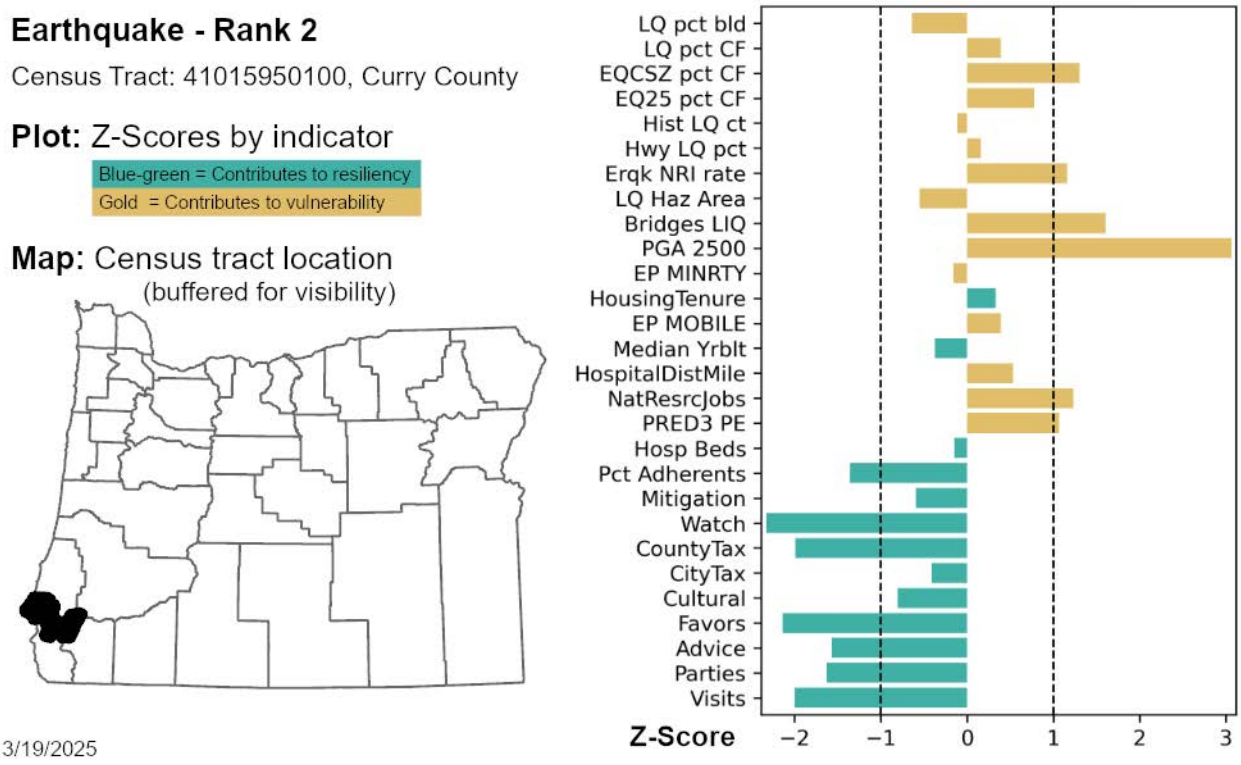


Table 9.3.9-4: State-owned buildings 41015950100

	Building Name 41015950100	Value	Source
State-owned	unknown	106834	DOGAMI/DAS
State-owned	unknown	462666	DOGAMI/DAS
State-owned	unknown	530857	DOGAMI/DAS
State-owned	unknown	98227	DOGAMI/DAS
State-owned	Port Orford Maintenance Station Grounds	243383	DOGAMI/DAS
State-owned	unknown	142009	DOGAMI/DAS
State-owned	Port Orford Maintenance Station Grounds	211401	DOGAMI/DAS
State-owned	Port Orford Maintenance Station Grounds	458532	DOGAMI/DAS

	Building Name 41015950100	Value	Source
State-owned	Port Orford Maintenance Station Grounds	122628	DOGAMI/DAS
State-owned	unknown	290531	DOGAMI/DAS
State-owned	unknown	132656	DOGAMI/DAS
State-owned	unknown	392923	DOGAMI/DAS
State-owned	unknown	489339	DOGAMI/DAS
State-owned	unknown	281356	DOGAMI/DAS
State-owned	unknown	323969	DOGAMI/DAS
State-owned	unknown	313538	DOGAMI/DAS
State-owned	unknown	226922	DOGAMI/DAS
State-owned	unknown	420940	DOGAMI/DAS
State-owned	Port Orford Maintenance Station Grounds	325501	DOGAMI/DAS
State-owned	unknown	281007	DOGAMI/DAS
State-owned	unknown	370004	DOGAMI/DAS
State-owned	Edson Butte M/W Building	86687	DOGAMI/DAS
State-owned	Site Systems - Edson Butte M/W Grounds	60668	DOGAMI/DAS
State-owned	Elk River Hatchery Storage Building	60668	DOGAMI/DAS
State-owned	Elk River Hatchery Residences	60668	DOGAMI/DAS
State-owned	Elk River Hatchery Generator Building	60668	DOGAMI/DAS
State-owned	Elk River Hatchery Building Shop Storage	60668	DOGAMI/DAS
State-owned	Elk River Hatchery STW building	60668	DOGAMI/DAS
State-owned	Elk River Hatchery Electrical Building	60668	DOGAMI/DAS
State-owned	Elk River Hatchery Service Building	60668	DOGAMI/DAS
State-owned	Cape Blanco State Airport (5S6)	60668	DOGAMI/DAS
State-owned	Port Orford MS Storage Building	450953	DOGAMI/DAS

No critical facilities identified.

Earthquake Risk Rank 3 Lane County 41039000404

This census tract is located just off the central Oregon coast, northwest of Eugene, Oregon. The NRI reports a very high risk of earthquakes, with a score of 98.5. According to the NRI, 100% (4,010 people) are exposed to this hazard. Low social cohesion and higher than average exposures of buildings and critical facilities to liquefaction due to earthquakes primarily drive this risk ranking. Additionally, higher than average liquefaction area increases risk.

Figure 9.3.9-4: Third ranked census tract for earthquake hazard

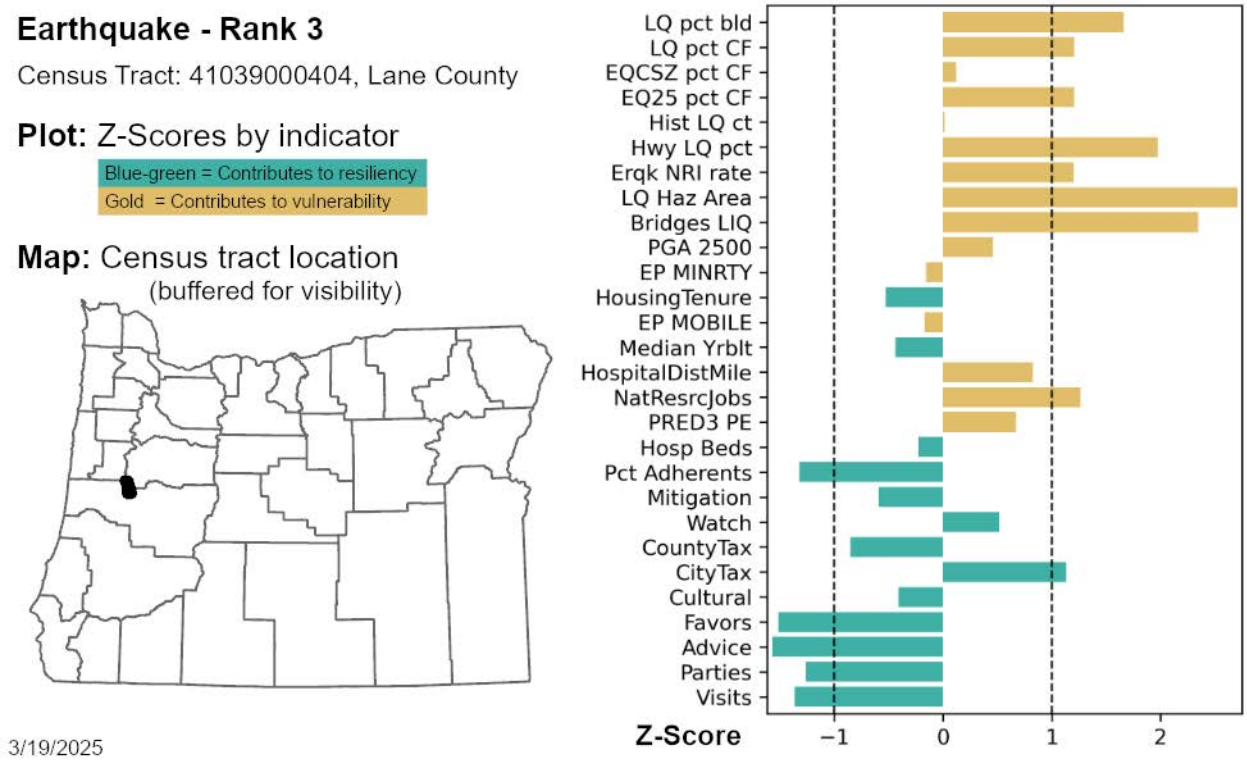


Table 9.3.9-5: State-owned buildings 41039000404

	State-owned Building Name	Value	Source
State-owned	unknown	699239	DOGAMI/DAS
State-owned	JC Main Building, State owned psychiatric hospital	117098414	DOGAMI/DAS
State-owned	JC Cottage 2	1977802	DOGAMI/DAS
State-owned	JC Cottage 1	1852553	DOGAMI/DAS
State-owned	unknown	699239	DOGAMI/DAS
State-owned	JC Main Building	117098414	DOGAMI/DAS

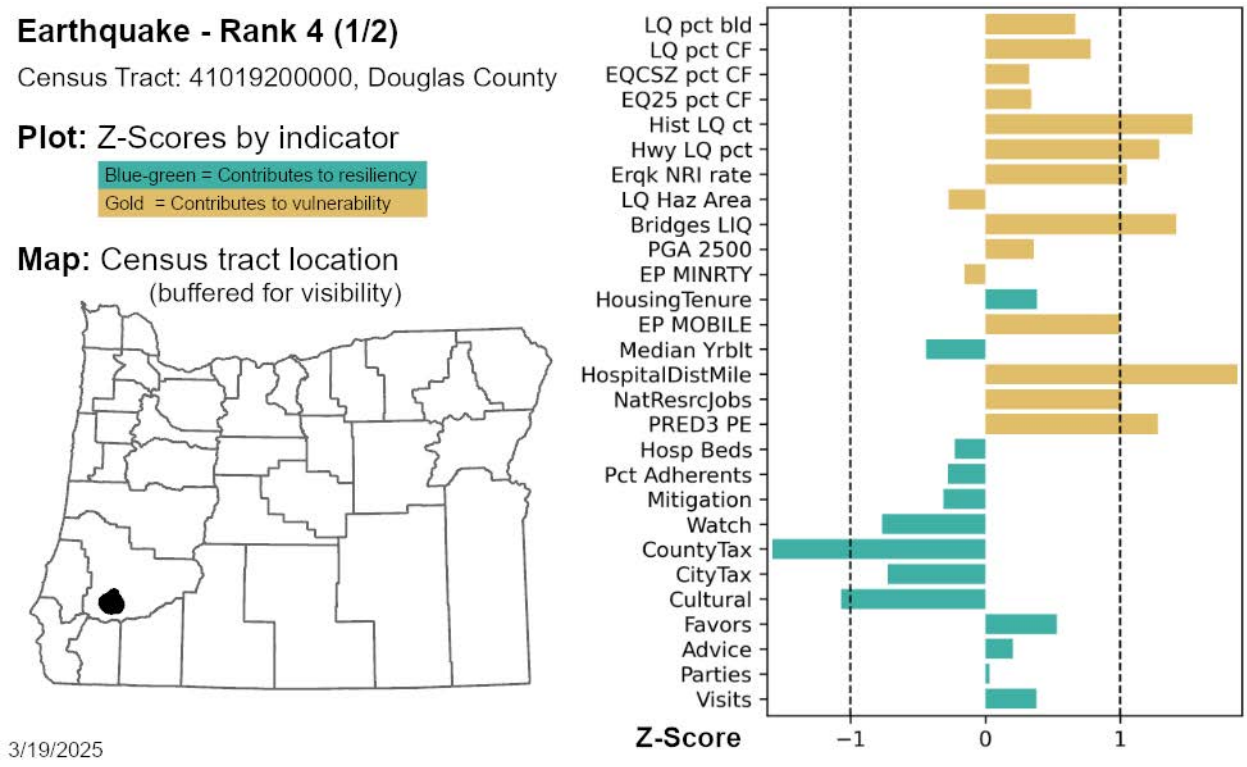
	State-owned Building Name	Value	Source
State-owned	JC Cottage 2	1977802	DOGAMI/DAS
State-owned	JC Cottage 1	1852553	DOGAMI/DAS
State-owned	JC Cottage 3	1719870	DOGAMI/DAS

No critical facilities identified.

Earthquake Risk Rank 4 Douglas County 41019200000

This Douglas County census tract is sparsely populated with most of its almost 5,000 people living in the small cities of Riddle and Canyonville. The FEMA National Risk Index ranks the area as being at relatively high risk of harm from earthquakes, with a score of 97.4. The area has a lower-than-average county tax base, and a higher-than-average social vulnerability score (PRED3). But residents appear to be within the mean for many of the social connectedness indicators.

Figure 9.3.9-5: Fourth ranked census tract for earthquake hazard

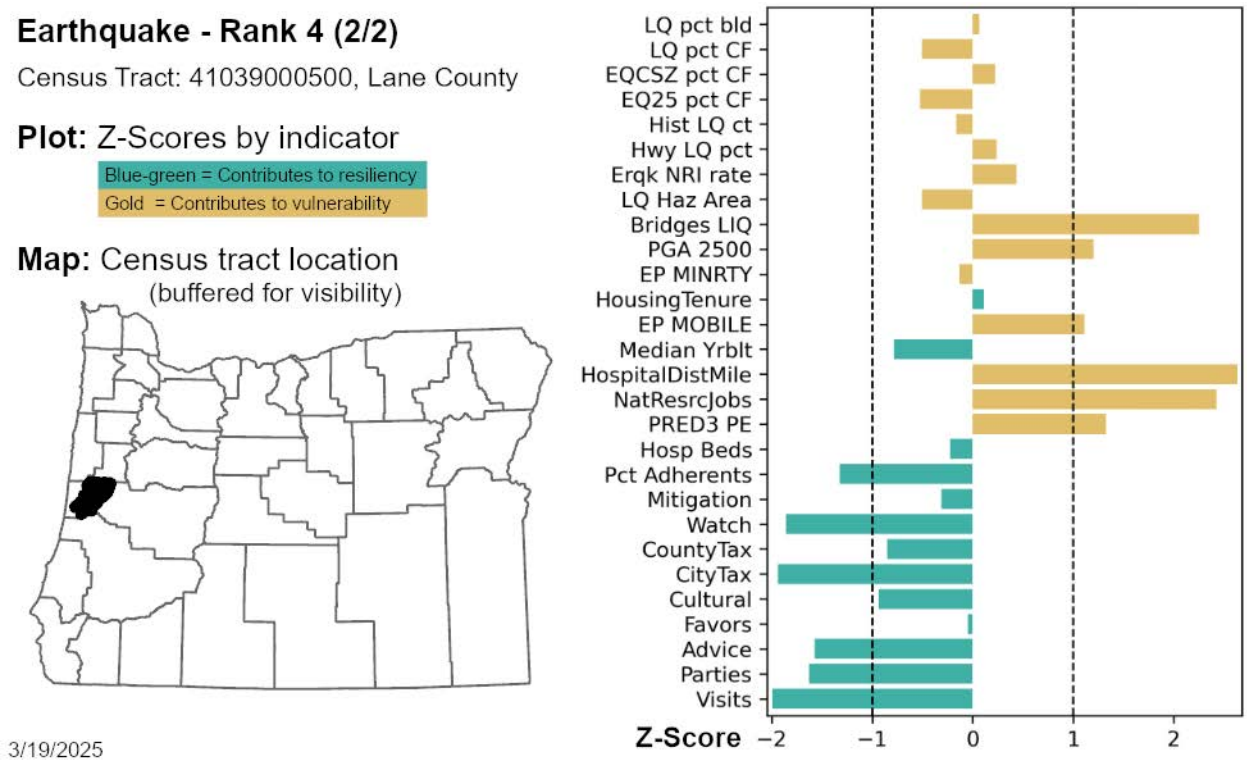


No state-owned buildings or critical facilities identified.

Earthquake Risk Rank 5 Lane County 41039000500

This rural census tract is located west of Eugene, Oregon, in proximity to the central Oregon coast. The NRI reports a relatively high risk of earthquakes, with a score of 93. According to the NRI, 100% (2,244 people) are exposed to this hazard. Large distances to hospitals, low social cohesion, and low community resilience are the primary indicators driving risk in this area. Additionally, reliance on natural resource jobs and exposure of bridges to liquefaction contributes to risk.

Figure 9.3.9-6: Fourth ranked census tract for earthquake hazard

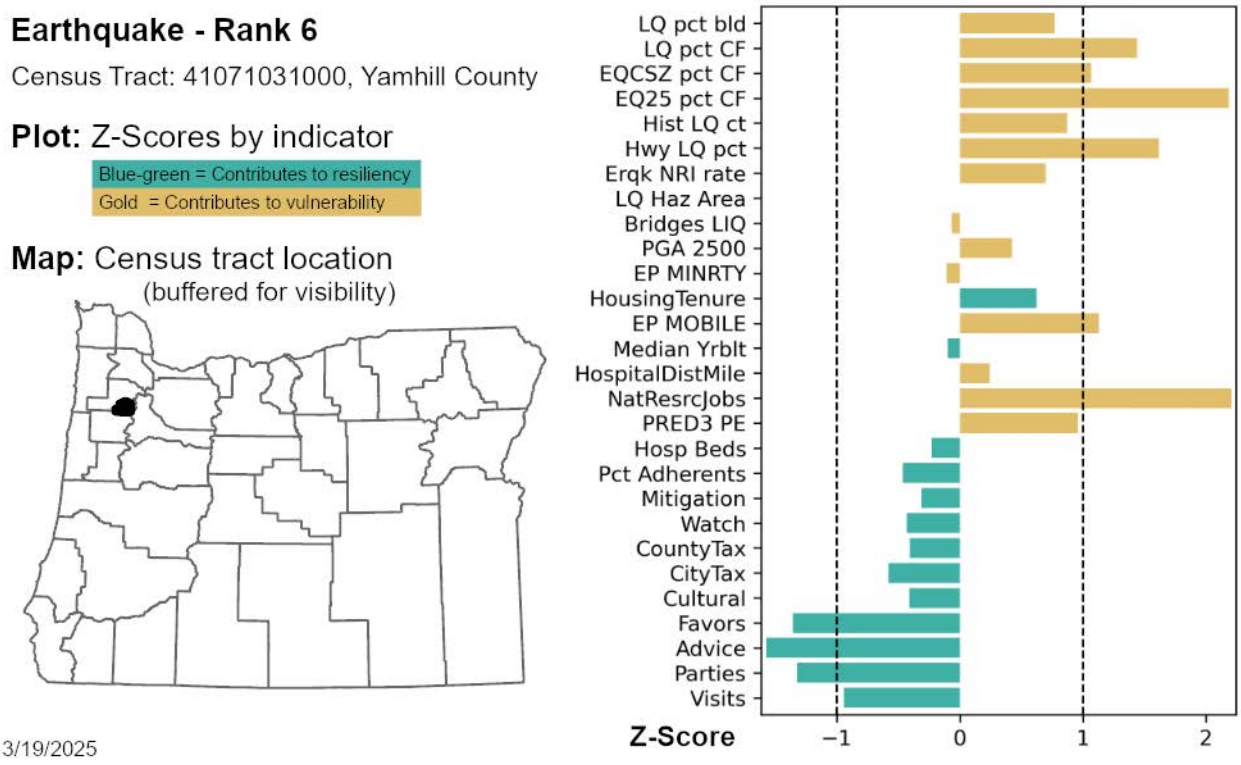


No state-owned buildings or critical facilities identified.

Earthquake Risk Rank 6 Yamhill County 41071031000

This census tract is located in northwest Oregon. The NRI reports a relatively high earthquake risk for this area, with a score of 94.9. According to the NRI, 100% (4,321 people) are exposed to earthquake hazards in this census tract. The area is characterized by social connectedness indicators well above the statewide mean.

Figure 9.3.9-7: Sixth ranked census tract for earthquake hazard

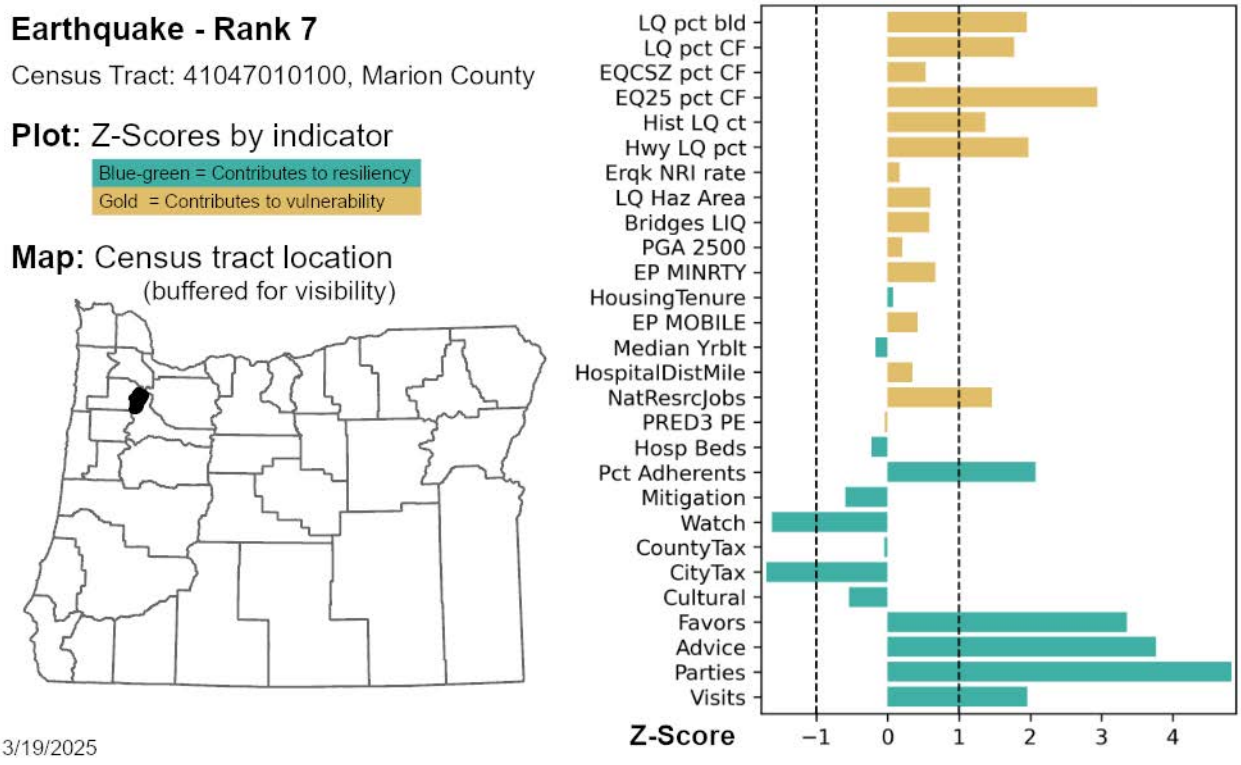


No state-owned buildings or critical facilities identified.

Earthquake Risk Rank 7 Marion County 41047010100

This census tract is located in northwest Oregon. The NRI reports a very high earthquake risk, with a score of 99.6. According to the NRI, 100% (4,808 people) are at risk of earthquake hazards in this census tract. High exposure of critical facilities drives risk in this area. Low homeownership rates also contribute. While social cohesion is moderate, exposure of highways and high potential losses from an earthquake event drive risk.

Figure 9.3.9-8: Seventh ranked census tract for earthquake hazard

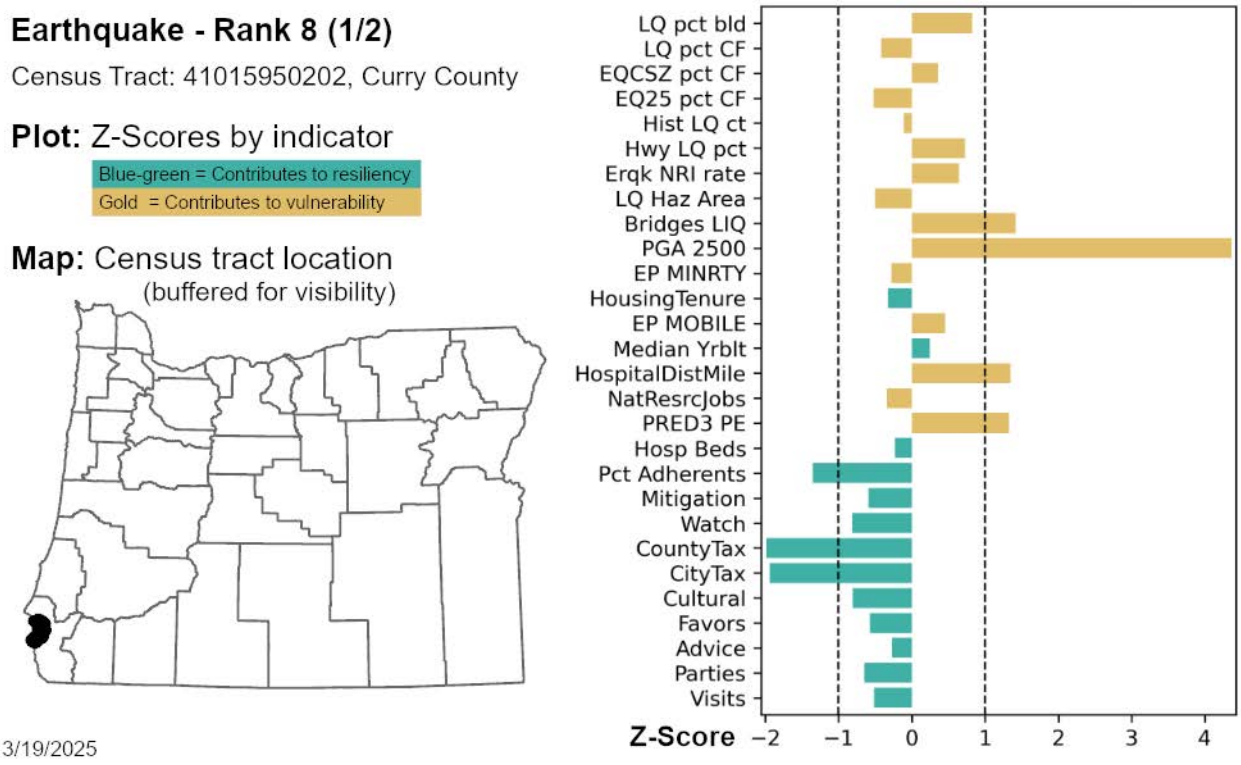


No state-owned buildings or critical facilities identified.

Earthquake Risk Rank 8 Curry County 41041015950202

This census tract is located on the southern coast, north of Gold Beach, Oregon. The NRI reports a relatively high risk of earthquakes, with a score of 94.5. According to the NRI, 100% (1,923 people) are at risk of this hazard. Exceptionally high earthquake risk drives this ranking.

Figure 9.3.9-9: Eighth ranked census tract for earthquake hazard



No state-owned buildings or critical facilities identified.

Earthquake Risk Rank 9 Douglas County, including the City of Drain 41019030000

This census tract is located in southwest Oregon, in proximity to Oregon's southern coast. The NRI reports a relatively high earthquake risk for this area, with a score of 97.4. The NRI reports 100% (4,902 people) are at risk of this hazard. Low city and county taxing ability, and low social cohesion primarily drive risk. Large distances to hospitals, and exposure of historic buildings to liquefaction also contribute to risk ranking in this area.

Figure 9.3.9-10: Eighth ranked census tract for earthquake hazard

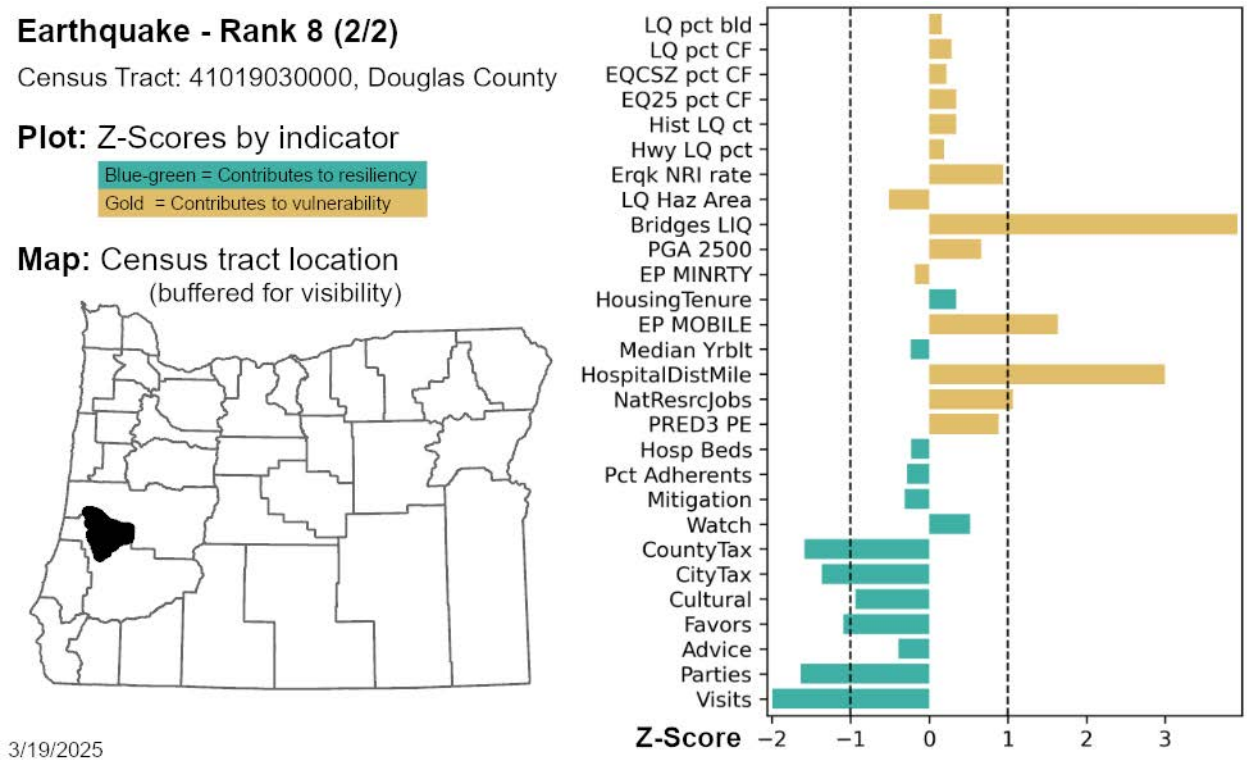


Table 9.3.9-6: State-owned buildings or critical facilities

	Building Name 41019030000	Value ($)
State-owned	Unknown	95,675
State-owned	Unknown	136,002
Critical facility	Douglas County Sheriff's Office, Drain Substation	786,450
Critical facility	Drain STP	125,100
Critical facility	Drain City Shop	1,342,950
Critical facility	Douglas County Public works	854,850

	Building Name 41019030000	Value ($)
Critical facility	Douglas County Fire & EMS, annex	190,950
Critical facility	Douglas County Fire & EMS	1,102,200
Critical facility	Elkton High School	4,927,950

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Earthquake Risk Rank 10 Washington County 41067032800

This census tract is located in northwest Oregon. The NRI reports a very high earthquake risk in this area, with a score of 99.4. According to the NRI, 100% (6,288 people) are at risk of this hazard. High prevalence of those living in mobile homes, and exposure of critical facilities to earthquake hazards, primarily drive risk. While there is strong religious institutions and average social cohesion, exposure of buildings and roadways to liquefaction greatly contributes to this risk ranking.

Figure 9.3.9-11: Tenth ranked census tract for earthquake hazard

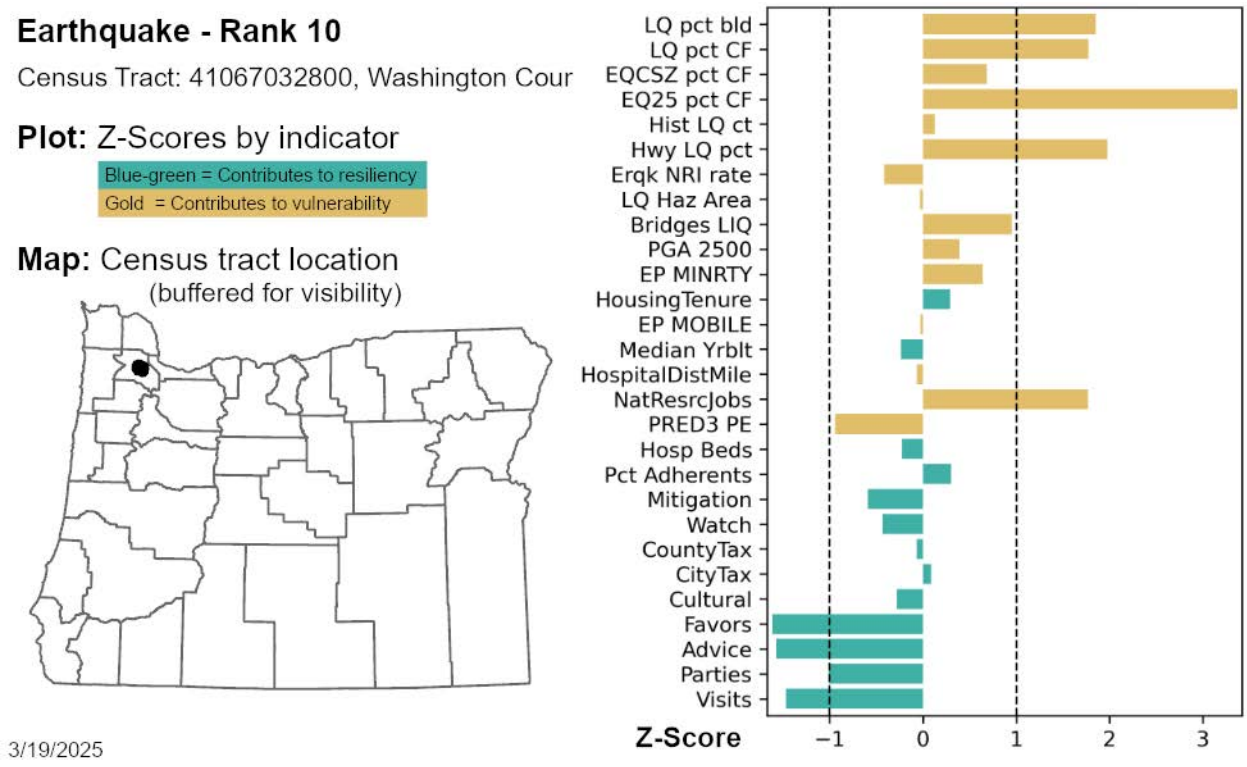

Table 9.3.9-6: State-owned building 41067032800

	State-owned Building Name	Value	Source
State-owned	unknown	232721	DOGAMI/DAS
State-owned	unknown	110969	DOGAMI/DAS
State-owned	unknown	213244	DOGAMI/DAS
State-owned	unknown	312972	DOGAMI/DAS
State-owned	unknown	216591	DOGAMI/DAS

	State-owned Building Name	Value	Source
State-owned	unknown	173738	DOGAMI/DAS
State-owned	unknown	205311	DOGAMI/DAS
State-owned	unknown	182451	DOGAMI/DAS
State-owned	unknown	108814	DOGAMI/DAS
State-owned	unknown	161278	DOGAMI/DAS
State-owned	unknown	193038	DOGAMI/DAS

No critical facilities identified.

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9.4 Comments Received

Comment #1

Commenter and Affiliation: Fran Recht

Hazard: Tsunami

Geography: Coast

Comment: I believe that development of a post tsunami rebuilding plan should be a part of the plan and an eligible priority activity for funds. The time to plan to build back better and away from hazards is before a disaster strikes when there is a rush to recover which means making quick and not the best long term decisions. Looking into transfer of development rights to other non hazard areas ...earmarking areas and applying for exceptions now that could be veted and only triggered after such an event would be valuable.

Response: Pre-disaster recovery planning is very important; however, recovery planning is outside the scope of the Oregon Natural Hazards Mitigation Plan.

Comment #2

Commenter and Affiliation: Fran Recht

Hazard: Sea Level Rise

Geography: Coast

Comment: DLCD has maps of projected sea level rise. It's important to assure that coastal shorelands along estuaries and tidally influenced streams are not developed so that these "floodplains are available to adapt to these rising seas and retain higher water levels instead of causing flooding to structures or damage downstream. These areas within the sea level rise maps (I'd suggest using a moderate to high scenario for 2100 for planning purposes) and within these areas ..any areas zoned for development should be prioritized as eligible for funds to allow land trusts and municipalities, tribes etc. to purchase and hold them for parks, open space and habitat.

Response: The list of mitigation actions in Chapter 5 includes:

> 29. Conduct a pilot project on two coastal estuaries … sea level rise modeling …use the results to minimize future damage or loss of property
>
> 38. Undertake inner bay total water level modeling to assess flooding impacts from sea level rise…

Comment #3

Commenter and Affiliation: Matt Straite, Community Development Director, Millersburg, OR

Hazard: GOALS

Geography: All

Comment: We recommend adding a Goal similar to the following:

"To have a third party review to evaluate impacts of state and federal regulations on impacts to Natural Hazard events which have occurred in Oregon over the last 50 years, such as the Forest Practices Act, Wildfire Management Practices, and Environment regulations and the impacts on Natural Hazard incidents in Oregon".

Response: This would be a mitigation action, not a goal. No change to 2025 Oregon Natural Hazards Mitigation Plan. Could be added in a future update.

Comment #4

Commenter and Affiliation: Treena Jensen, Warning Coordination Meteorologist, National Weather Service Portland, OR

Hazard: Extreme Heat

Geography: All

Comment: The NWS Extreme Heat information in section 3.3.4.1 of the Oregon NHMP February 20, 2025 draft is not correct (Page 92). The NWS Weather Forecast Offices that serve Oregon use NWS HeatRisk to determine Extreme Heat Warnings, not heat index. NWS issues Excessive Heat Warnings when Major or Extreme HeatRisk is expected. FYI - The naming of NWS heat warnings is changing from 'Excessive Heat Warning' to 'Extreme Heat Warning' on March 4, 2025.

Feel free to reach out to me if you have any questions regarding NWS HeatRisk or would like me to review any updates to the extreme heat or other weather sections of the plan.

Response: This section is now correct.

Comment #5

Commenter and Affiliation: Treena Jensen, Warning Coordination Meteorologist, National Weather Service Portland, OR

Hazard: Extreme Cold

Geography: All

Comment: I noticed that there is not a lot of information regarding extreme cold as a hazard. Oregon does not experience extreme cold like other parts of the country and is likely categorized as a low risk in the FEMA maps. Multnomah County Environmental Health Services have been publishing some interesting reports the past few winters showing a possible rise of health hazards due to exposure to extreme cold. I am not sure if other regions of the state are showing an increasing vulnerability to cold. I do not think an extreme cold section needs to be added to this update of the NHMP, but wanted to mention this for your situation awareness. Here are some of the local cold related reports in case you are interested in exploring

this further; 2012-2022 Regional Climate and Health Monitoring Report, Multnomah County Winter 2023-24 Seasonal Health Hazards Brief.

Response: No change to the 2025 Oregon Natural Hazards Mitigation Plan. Extreme cold could be considered in in the next update.

Comment #6

Commenter and Affiliation: Gillian Peden, Assistant Planner, Building & Planning Division, Marion County, OR

Hazard: All

Geography: All

Comment: CH 1: Could be more user friendly for the public. While the methodology and evidence provided is necessary to support the science-based study, I think summarizations of the findings will be important for the public to follow.

Response: We plan to produce a use-friendly summary when we have a final plan approved by FEMA.

Comment #7

Commenter and Affiliation: Philip Nel, Lead Researcher and Senior Planner, ODHS-OREM

Hazard: All

Geography: All

Comment: Strength - Identification of Vulnerable Populations

The ONHMP appropriately integrates social vulnerability factors such as:

Houseless populations, people living alone, and rent-burdened households – These groups have limited access to shelter, emergency information, and recovery resources.

People with disabilities and chronic illnesses – The document acknowledges how these populations are disproportionately affected by hazards and the need for inclusive planning.

Institutionalized populations (nursing homes, juvenile facilities, etc.) – These facilities require tailored preparedness and response plans, particularly during evacuations.

Response: Thank you for the positive comment. The Oregon Natural Hazards Risk Assessment did not use houseless population because data is not available at a census tract level.

Comment #8

Commenter and Affiliation: Philip Nel, Lead Researcher and Senior Planner, ODHS-OREM

Hazard: All

Geography: All

Comment: Strength - Public Health Considerations

The Oregon Health Authority (OHA) Resilience Goals for 2030 are well-aligned with ESF 6 objectives. Goals include:

50% reduction in heat-related illnesses.

60% reduction in hospitalizations.

70% reduction in heat-related deaths.

Funding is allocated for Healthy Homes Grants and Community-Based Organizations (CBOs), focusing on environmental justice communities.

Response: Thank you for the positive comment.

Comment #9

Commenter and Affiliation: Philip Nel, Lead Researcher and Senior Planner, ODHS-OREM

Hazard: All

Geography: All

Comment: Strength - Risk Analysis and Critical Infrastructure

The ONHMP provides a GIS-based analysis of mass care vulnerabilities, including census tracts that rank high in exposure to hazards.

It assesses state-owned critical facilities, including emergency shelters and mass care locations, identifying those in high-risk hazard zones.

The ONHMP utilizes PROMETHEE for Multi-Criteria Decision Analysis (MCDA) to assess vulnerabilities beyond FEMA's monetary-loss focus.

GIS-Based Future Integration will improve local usability for sheltering and evacuation mapping

Response: Thank you for the positive comment.

Comment #10

Commenter and Affiliation: Philip Nel, Lead Researcher and Senior Planner, ODHS-OREM

Hazard: All

Geography: All

Comment: Gap/Area for Improvement – Mass Care and Emergency Assistance Planning

Shelter Accessibility & Functional Needs Support

The document does not adequately discuss how shelters will be adapted for people with disabilities, medical conditions, and non-English speakers.

Recommendation: Incorporate functional needs support services (FNSS) explicitly into the mitigation plan.

A need for greater detail on functional needs support in emergency shelters, including ADA compliance, power for medical devices, and non-English language support should be emphasized.

Recommendation: Integrate functional needs support services (FNSS) into mass care planning.

Response: Functional needs support services (FNSS) are very important when planning for mass care emergency shelters; however, emergency response is outside the scope of the Oregon Natural Hazards Mitigation Plan.

Comment #11

Commenter and Affiliation: Philip Nel, Lead Researcher and Senior Planner, ODHS-OREM

Hazard: All

Geography: All

Comment: Gap/Area for Improvement – Mass Care and Emergency Assistance Planning

Temporary and Long-Term Housing Solutions

The ONHMP does not provide a detailed post-disaster housing strategy, particularly for houseless populations or those with pre-existing housing instability.

Recommendation: Develop adaptive housing solutions, including partnerships with NGOs, state, and federal housing programs.

Response: Post disaster housing is very important; however, post disaster recovery is outside the scope of the Oregon Natural Hazards Mitigation Plan.

Comment #12

Commenter and Affiliation: Philip Nel, Lead Researcher and Senior Planner, ODHS-OREM

Hazard: All

Geography: All

Comment: Gap/Area for Improvement – Mass Care and Emergency Assistance Planning

Preparedness Planning for Residential Care Facilities

The document does not sufficiently address emergency preparedness planning for residential care facilities, particularly regarding evacuation and climate control measures.

Recommendation: Establish facility-specific evacuation plans that account for mobility limitations, medical dependencies, and continuity of care during disasters.

A need for detailed climate control strategies in emergencies, ensuring backup power systems for air conditioning and heating, along with contingency plans for extreme weather events.

Recommendation: Integrate climate control resilience planning and redundancy systems into preparedness plans for residential care facilities.

Response: Preparedness at residential care facilities is very important; however, preparedness is outside the scope of the Oregon Natural Hazards Mitigation Plan.

Comment #13

Commenter and Affiliation: Philip Nel, Lead Researcher and Senior Planner, ODHS-OREM

Hazard: All

Geography: All

Comment: Gap/Area for Improvement – Mass Care and Emergency Assistance Planning

Evacuation and Shelter-in-Place Coordination

The ONHMP lacks clear evacuation strategies for ESF 6 priority groups (e.g., institutionalized residents, low-income populations).

There is a lack of planning to manage evacuation route failures and single-point failures in critical facilities like hospitals.

There is a lack of detailed evacuation support plans as part of evacuation and sheltering strategies.

Recommendation: Conduct multi-agency tabletop exercises focusing on ESF 6 evacuation coordination and sheltering strategies and to integrate infrastructure resilience mapping.

Response: Coordinating evacuation and sheltering in place is very important; however, emergency response is outside the scope of the Oregon Natural Hazards Mitigation Plan.

Comment #14

Commenter and Affiliation: Philip Nel, Lead Researcher and Senior Planner, ODHS-OREM

Hazard: All

Geography: All

Comment: Gap/Area for Improvement – Community-Based Support & Behavioral Health Services

Behavioral Health & Disaster Trauma Support

While acknowledging climate-related health impacts, the ONHMP does not sufficiently address behavioral health services during and after disasters.

Recommendation: Enhance mental health programs within mass care operations.

Response: Mental health services are very important; however, support services during and after disasters are outside the scope of the Oregon Natural Hazards Mitigation Plan.

Comment #15

Commenter and Affiliation: Philip Nel, Lead Researcher and Senior Planner, ODHS-OREM

Hazard: All

Geography: All

Comment: Gap/Area for Improvement – Community-Based Support & Behavioral Health Services

Coordination with Resilience Hubs

The ONHMP references cooling/warming shelters but does not define resilience hubs in its mitigation strategy.

It must be emphasized that community resilience hubs should integrate sheltering, behavioral health services, and community education.

Recommendation: Include the development of resilience hubs statewide and standardize resilience hub integration in mass care and housing plans.

Response: Resilience hubs are very important; however, sheltering and mass care during a disaster are outside the scope of the Oregon Natural Hazards Mitigation Plan.

Comment #16

Commenter and Affiliation: Philip Nel, Lead Researcher and Senior Planner, ODHS-OREM

Hazard: All

Geography: All

Comment: Gap/Area for Improvement – Equity & Inclusion Considerations

Tribal & Rural Community Coordination

The plan mentions vulnerable rural communities, but more detailed planning for tribal nations and culturally competent response strategies is needed.

There is limited solicitation of tribal input in the risk assessment process.

Recommendation: Establish formal partnerships with tribal nations for culturally responsive mass care strategies.

Response: Partnerships with tribal nations are very important; however, mass care is outside the scope of the Oregon Natural Hazards Mitigation Plan. We invited tribes to participate in the planning process for the Oregon Natural Hazard Mitigation Plan, and each tribe chose their level of engagement.

Comment #17

Commenter and Affiliation: Philip Nel, Lead Researcher and Senior Planner, ODHS-OREM

Hazard: All

Geography: All

Comment: Gap/Area for Improvement – Equity & Inclusion Considerations

Multilingual Communication in Shelters

There is limited discussion on how emergency notifications and mass care services will be linguistically and culturally accessible.

Recommendation: Expand language access policies within shelter operations.

Response: Multilingual communication is very important; however, emergency notifications and shelter operations are outside the scope of the Oregon Natural Hazards Mitigation Plan.

Comment #18

Commenter and Affiliation: Philip Nel, Lead Researcher and Senior Planner, ODHS-OREM

Hazard: All

Geography: All

Comment: Recommendations for OREM ESF 6

Short-Term Priorities (Next 12 Months)

Revise the ONHMP to include functional needs sheltering and behavioral health support.

Develop partnerships with CBOs and tribal nations for mass care equity.

Pilot evacuation and shelter exercises that test ESF 6 coordination, particularly for rural and urban houseless populations.

Long-Term Priorities (2-5 Years)

Integrate resilience hubs as a cornerstone of the mass care strategy.

Expand post-disaster housing solutions to include transitional and permanent housing options.

Increase investment in multilingual disaster communications for mass care settings.

Enhance GIS-Based Risk Visualization, ensuring local governments can customize risk assessments and shelter planning.

Response: Emergency Support Function 6 – Mass Care is very important; however, emergency response is outside the scope of the Oregon Natural Hazards Mitigation Plan.

Comment #19

Commenter and Affiliation: Gillian Peden, Assistant Planner, Building & Planning Division, Marion County, OR

Hazard: All

Geography: All

Comment: CH 1: The introduction could include how stakeholders are to be included in this plan. It should include how property owners are notified about new research.

Response: Stakeholder engagement is now covered in Chapter 7 – Planning Process. Notifying property owners about new research is outside the scope of the Oregon Natural Hazards Mitigation Plan.

Comment #20

Commenter and Affiliation: Gillian Peden, Assistant Planner, Building & Planning Division, Marion County, OR

Hazard: All

Geography: All

Comment: CH 1: The introduction addressed the relationship with other disaster preparedness agencies.

Response: Thank you for the positive comment.

Comment #21

Commenter and Affiliation: Gillian Peden, Assistant Planner, Building & Planning Division, Marion County, OR

Hazard: All

Geography: All

Comment: CH 3: Each assessment for the different hazard could preface the impacts to the following: fiscal risk, social impact, and environmental impacts. While these will likely be addressed in later chapters, I think this could be briefly discussed.

Response: No change to the 2025 Oregon Natural Hazards Mitigation Plan. These impacts (fiscal, social, and environmental) could be covered in a summary after FEMA approves the plan or analyzed in the next update.

Comment #22

Commenter and Affiliation: Gillian Peden, Assistant Planner, Building & Planning Division, Marion County, OR

Hazard: All

Geography: All

Comment: CH 3: I thought the risk assessment was extremely thorough. I especially like how almost each specific natural hazard that has ever occurred in the state was considered. There were specific examples of hazards large and small, showing how diligently the history of Oregon's natural hazards were combed through when compiling the data

Response: Thank you for the positive comment.

Comment #23

Commenter and Affiliation: Gillian Peden, Assistant Planner, Building & Planning Division, Marion County, OR

Hazard: All

Geography: All

Comment: CH 3: The document could be more user-friendly. The public will have a hard time trying to access quick information. It would be helpful to have different sections linked on the website so people can access the information they need more quickly.

Response: We plan to produce a use-friendly summary and webpages when we have a final plan approved by FEMA.

Comment #24

Commenter and Affiliation: Gillian Peden, Assistant Planner, Building & Planning Division, Marion County, OR

Hazard: All

Geography: All

Comment: CH 3: While thorough descriptions are good, I thought some sections were too wordy. For example, the "Defining Resiliency" seemed too long. It should focus more on the quick reasons as to why the public should care about resiliency.

Response: We plan to produce a summary when we have a final plan approved by FEMA. That summary will focus on quick explanations useful to the public.

Comment #25

Commenter and Affiliation: Gillian Peden, Assistant Planner, Building & Planning Division, Marion County, OR

Hazard: All

Geography: All

Comment: CH 3: It was addressed how the two risk assessments complement each other; shows that data was collected through multiple methods with a holistic approach.

Response: Thank you for the positive comment.

Comment #26

Commenter and Affiliation: Gillian Peden, Assistant Planner, Building & Planning Division, Marion County, OR

Hazard: All

Geography: All

Comment: CH 3: The assessment should include how property owners should be given the opportunity to participate in the decision to develop new data. Public involvement in decision making could indicate the need for new programs, incentives, funding toward research, or the lack of desire for new data. It is crucial that the plan addresses the needs from stakeholders that will be directly affected by natural hazards.

Response: Public involvement is now covered in Chapter 7 – Planning Process.

Comment #27

Commenter and Affiliation: Gillian Peden, Assistant Planner, Building & Planning Division, Marion County, OR

Hazard: All

Geography: All

Comment: CH 3: I am looking forward to reading how the plan addresses the importance of investing in hazard mitigation. Addressing the social, economic and environmental benefits of planning for hazards is very important and having tangible evidence to support planning would be a benefit for the public.

Response: Chapter 5 – Mitigation Strategy covers the benefits of hazards mitigation.

Comment #28

Commenter and Affiliation: Philip Nel, Lead Researcher and Senior Planner, ODHS-OREM

Hazard: All

Geography: All

Comment: Does the risk assessment achieve the goal of providing actionable information? Yes

Response: Thank you for the positive comment.

Comment #29

Commenter and Affiliation: Philip Nel, Lead Researcher and Senior Planner, ODHS-OREM

Hazard: All

Geography: All

Comment: What would make the risk assessment easier to understand? The primary challenge is complexity and data presentation. The weighting of risk factors (65% socio-economic, 35% hazard-specific) is not intuitive for all stakeholders. Additionally, the maps lack color-coded differentiation that clearly distinguishes high-risk areas.

Suggested Improvements:

Color-coded differentiation for risk categories: Use blue for positive indicators (resilience factors) and red for negative indicators (hazard risks).

Break down vulnerability weighting visually: Use Z-score plots or simple bar graphs to explain how census tracts are ranked.

Provide local risk summaries: A one-page summary for each county or city would improve usability for decision-makers.

Response: The plan now has an indicator key using color coding to distinguish vulnerability indicators from resilience indicators. The appendix includes z-score plots and summaries for the highest risk census tracts.

Comment #30

Commenter and Affiliation: Philip Nel, Lead Researcher and Senior Planner, ODHS-OREM

Hazard: All

Geography: All

Comment: What is missing from the risk assessment? Key missing elements include:

Infrastructure resilience analysis – The assessment does not fully account for single-point failures in critical infrastructure (e.g., hospitals, evacuation routes, water treatment plants).

Mass care and functional needs sheltering – There is limited information on how emergency shelters will accommodate people with disabilities, medical needs, and non-English speakers.

Integration with local zoning and development policies – Stakeholders expressed concerns that the risk rankings could conflict with housing development policies (e.g., middle housing policies in wildfire-prone areas).

Behavioral health services in disaster response – The assessment acknowledges climate-related health risks but lacks a detailed strategy for post-disaster mental health support.

Suggested Improvements:

Expand infrastructure risk assessment to highlight at-risk hospitals, emergency service hubs, and transportation corridors.

Develop clear sheltering strategies that align with FEMA Functional Needs Support Services (FNSS) guidelines.

Include policy integration recommendations to resolve conflicts between hazard mitigation and housing development plans.

Incorporate behavioral health as a mitigation priority, ensuring counseling, peer support, and culturally competent crisis care are available post-disaster.

Response: Future upgrades to the Oregon Natural Hazards Risk assessment could consider cascading effects from failures of hospitals, emergency service hubs, or transportation corridors.

Post-disaster sheltering strategies are outside the scope of the Oregon Natural Hazards Mitigation Plan.

The Oregon Natural Hazards Mitigation Plan is not a policy or regulatory document and therefore cannot resolve potential conflicts between increasing housing and hazard mitigation. Any actual conflicts would be resolved by the legislature, rulemaking commissions, tribal governments, or local governments.

Post-disaster crisis care is outside the scope of the Oregon Natural Hazards Mitigation Plan.

Comment #31

Commenter and Affiliation: Philip Nel, Lead Researcher and Senior Planner, ODHS-OREM

Hazard: All

Geography: All

Comment: What do you like about the risk assessment and why?

PROMETHEE MCDA provides a data-driven, reproducible ranking – This method avoids subjective expert bias and ensures quantifiable hazard and vulnerability assessments.

Inclusion of socio-economic vulnerability factors – The assessment goes beyond traditional monetary-loss models, considering poverty, age, access to medical care, and community resilience.

Statewide consistency – The model applies uniform risk criteria across all Oregon census tracts, making it easier to compare risk levels across regions.

Future GIS-based improvements – The plan to integrate GIS customization tools will make the assessment more interactive and useful for local planners.

Response: Thank you for the positive comments.

Comment #32

Commenter and Affiliation: Philip Nel, Lead Researcher and Senior Planner, ODHS-OREM

Hazard: All

Geography: All

Comment: What concerns do you have and why?

Limited applicability at the local level – Without city- and county-specific data inputs, local governments may struggle to apply the results to zoning, emergency planning, and infrastructure investment.

Potential conflicts with land use policies – Wildfire mitigation measures (e.g., defensible space requirements) could conflict with urban housing policies, particularly in areas promoting denser housing.

Incomplete infrastructure risk analysis – The risk assessment does not fully account for transportation failures, hospital service disruptions, or cascading effects from infrastructure damage.

Lack of integration with FEMA and insurance industry risk maps – Different methodologies between state and federal assessments may cause inconsistencies in mitigation funding and insurance rates.

Suggested Solutions:

Ensure Phase Two GIS tools allow local agencies to refine risk scores based on their specific infrastructure and land-use policies.

Improve infrastructure assessment by incorporating transportation, healthcare, and water system vulnerabilities.

Collaborate with FEMA and insurance providers to standardize risk classification for funding and policy alignment.

Response: The next phase of the Oregon Natural Hazards Risk Assessment will create an online tool that cities and counties can use to add local data to refine the analysis of high-risk areas.

Future upgrades to the risk assessment could consider cascading effects on transportation, healthcare, and water systems.

The Oregon Natural Hazards Mitigation Plan identifies general areas that may need mitigation projects. It does not set insurance rates on specific properties and does not determine whether specific projects qualify for grant funding. Different risk classifications are appropriate at different scales for different purposes.

Comment #33

Commenter and Affiliation: Philip Nel, Lead Researcher and Senior Planner, ODHS-OREM

Hazard: Coastal

Geography: Coast

Comment: Strength: Identifies erosion, storm surge, and tsunami risks.

Gap: Lacks resilience hub integration.

Recommendation: Improve local response coordination for isolated communities.

Response: Thank you for the positive comment. Emergency response coordination is outside the scope of the Oregon Natural Hazards Mitigation Plan.

Comment #34

Commenter and Affiliation: Philip Nel, Lead Researcher and Senior Planner, ODHS-OREM

Hazard: High Hazard Potential Dams

Geography: All

Comment: Strength: Acknowledges lack of quantifiable failure risk data.

Gap: Downstream vulnerability analysis is incomplete.

Recommendation: Enhance risk assessments and emergency planning.

Response: Thank you for the positive comment. The Oregon Natural Hazards Risk Assessment did not analyze downstream vulnerability because of a lack of statewide data. Downstream vulnerability analysis could be considered in a future update to the Oregon Natural Hazards Risk Assessment. Emergency response planning is outside the scope of the Oregon Natural Hazards Mitigation Plan.

Comment #35

Commenter and Affiliation: Philip Nel, Lead Researcher and Senior Planner, ODHS-OREM

Hazard: Droughts

Geography: All

Comment: Strength: Links drought to economic and agricultural impacts.

Gap: Lacks focus on rural water system resilience.

Recommendation: Expand climate adaptation for groundwater and drought-tolerant infrastructure.

Response: Thank you for the positive comment. The Oregon Natural Hazards Risk Assessment does not analyze rural water systems because of a lack of statewide data. The list of mitigation actions in Chapter 5 includes:

> 50. Develop an improved methodology for gathering data on drought and related impacts in the areas most vulnerable to drought…
>
> 81. Document the economic, social, cultural, and environmental impacts of drought, especially in the most vulnerable jurisdictions…

Comment #36

Commenter and Affiliation: Philip Nel, Lead Researcher and Senior Planner, ODHS-OREM

Hazard: Earthquakes

Geography: All

Comment: Strength: Recognizes Cascadia risk with seismic maps.

Gap: Lacks liquefaction risk analysis for infrastructure.

Recommendation: Prioritize retrofitting for transportation and hospitals.

Response: Thank you for the positive comment. The Oregon Natural Hazard Mitigation Plan does not prioritize projects for specific transportation facilities or specific hospitals. Projects to retrofit transportation systems and hospitals are in tribal and local natural hazards mitigation plans. Thus, no change to the Oregon Natural Hazards Mitigation Plan.

Comment #37

Commenter and Affiliation: Philip Nel, Lead Researcher and Senior Planner, ODHS-OREM

Hazard: Extreme Heat

Geography: All

Comment: Strength: Strong focus on public health and OHA resilience goals.

Gap: Cooling centers and resilience hubs lack funding.

Recommendation: Secure seed and long-term funding, expand public awareness.

Response: Thank you for the positive comment. The list of mitigation actions in Chapter 5 includes:

83. Provide ongoing funding for the expansion of the Oregon Resilience Hubs …

Comment #38

Commenter and Affiliation: Philip Nel, Lead Researcher and Senior Planner, ODHS-OREM

Hazard: Floods

Geography: Urban Areas

Comment: Strength: Uses FEMA floodplain mapping.

Gap: Lacks urban stormwater planning.

Recommendation: Develop strategies for flash flooding in urban areas.

Response: Thank you for the positive comment. Urban flooding is included in the hazard characterization in section 3.3.5.1. Urban flooding is not included in the Oregon Natural Hazards Risk Assessment because statewide data is not available. Tribes, cities and counties address areas of local urban flooding in their natural hazard mitigation plans.

Comment #39

Commenter and Affiliation: Philip Nel, Lead Researcher and Senior Planner, ODHS-OREM

Hazard: Landslides

Geography: All

Comment: Strength: Integrates hazard mapping.

Gap: Lacks post-wildfire landslide risk analysis.

Recommendation: Add wildfire-driven landslide projections and mitigation plans.

Response: Thank you for the positive comment. Post-wildfire landslides are included in the hazard characterization in section 3.3.7.1. Post-wildfire landslides are not included in the Oregon Natural Hazards Risk Assessment because statewide data is not available, and the area at risk will change significantly from year to year. The Oregon Department of Geology and Mineral Industries often studies landslide risk in areas burned by major wildfires. Tribes, counties, and cities can then address specific areas at risk.

Comment #40

Commenter and Affiliation: Philip Nel, Lead Researcher and Senior Planner, ODHS-OREM

Hazard: Tsunamis

Geography: Coast

Comment: Strength: Maps multiple tsunami scenarios.

Gap: Evacuation route viability needs assessment.

Recommendation: Increase drill funding and expand vertical evacuation planning.

Response: Thank you for the positive comment. Drills are outside the scope of the Oregon Natural Hazards Mitigation Plan. The list of mitigation actions in Chapter 5 includes:

> 87. Implement improved tsunami way-finding signage solutions to assist with tsunami evacuation under all conditions (day or night). Hardened and improved evacuation routes may include the use of elevated safe areas (vertical evacuation structures)…

Comment #41

Commenter and Affiliation: Philip Nel, Lead Researcher and Senior Planner, ODHS-OREM

Hazard: Volcanoes

Geography: All

Comment: Strength: Identifies risks from ashfall.

Gap: Lacks air quality and infrastructure disruption planning.

Recommendation: Develop regional response plans for ashfall impacts.

Response: Thank you for the positive comment. Emergency response plans are outside the scope of the Oregon Natural Hazards Mitigation Plan.

Comment #42

Commenter and Affiliation: Philip Nel, Lead Researcher and Senior Planner, ODHS-OREM

Hazard: Wildfires

Geography: All

Comment: Strength: Aligns with wildfire risk mapping.

Gap: Lacks clarity on housing policy conflicts.

Recommendation: Integrate mitigation with zoning and housing policies.

Response: Thank you for the positive comment. Integrating hazards mitigation with land use zoning is an important mitigation action for cities and counties; however, local zoning decisions are outside the scope of the Oregon Natural Hazards Mitigation Plan.

Comment #43

Commenter and Affiliation: Philip Nel, Lead Researcher and Senior Planner, ODHS-OREM

Hazard: Windstorms

Geography: All

Comment: Strength: Identifies risks but lacks historical data.

Gap: Does not account for power grid vulnerabilities.

Recommendation: Strengthen utility coordination to reduce outages.

Response: Section 3.3.11.2 list historic windstorm events. The Oregon Natural Hazards Risk Assessment does not analyze windstorms and power grid vulnerabilities because of a lack of suitable statewide data. The list of mitigation actions in Chapter 5 includes:

> 88. Strengthen wildfire and winter storm resilience of electrical transmission and distribution systems…

Comment #44

Commenter and Affiliation: Philip Nel, Lead Researcher and Senior Planner, ODHS-OREM

Hazard: Winter Storms

Geography: All

Comment: Strength: Recognizes transportation and power risks.

Gap: Lacks sheltering plans for vulnerable populations.

Recommendation: Expand warming shelters and improve transportation resilience.

Response: Post-disaster sheltering is outside the scope of the Oregon Natural Hazards Mitigation Plan.

Comment #45

Commenter and Affiliation: Marshall Curry

Hazard: All

Geography: All

Comment: I was just doing a brief skim. This section on page 58 has a broken link at the end.

Ham Radio Amateur radio, or ham radio, is a service provided by licensed amateur radio operators. Ham radio is an alternate means of communicating when normal systems are down or at capacity. Emergency communication is a priority for the Amateur Radio Relay League (ARRL), the national association for amateur radio operators. Each region is served by Amateur Radio Emergency Service (ARES) districts. Radio Amateur Civil Emergency Services (RACES) is a special phase of amateur radio recognized by FEMA that provides radio communications for civil preparedness purposes including natural disasters. Official ham emergency station calls for each region can be found with the American Relay Radio League Oregon Chapter, www.arrloregon.org. "

Response: Corrected link to https://oregonarrl.org/ares/.

Comment #46

Commenter and Affiliation: Chantal Wikstrom, Water Quality Specialist & Emergency Coordinator, OHA - Drinking Water Services

Hazard: None

Geography: All

Comment: Feedback on Chapter 2 – Oregon Profile

"Pg 58: Drinking water supplies in Oregon are primarily groundwater (GW) sources. There are 686 Community Water Systems (CWSs) with GW as their primary source of water supply. There are 234 CWSs with surface water as their primary source of water supply. Some systems do have multiple types of sources

(SW, GW or GWUDI). You can search public drinking water inventories here: https://yourwater.oregon.gov/inventorylist.php. We also have a map showing the different public water systems: https://geo.maps.arcgis.com/apps/webappviewer/index.html?id=86938c6844be48b0b75a9326f500a748.

Pg 59: Region 2 - might be good to add that Portland sells a lot of water to surrounding communities such as Tualatin Valley Water District, etc. "

Response: Used the website suggested to update wording to be more specific and give counts of surface and groundwater sources and filtered by systems over 10,000 people to give an understanding of larger municipal systems. Added information about Portland Water Bureau's water wholesale relationship with surrounding cities.

Comment #47

Commenter and Affiliation: Chantal Wikstrom, Water Quality Specialist & Emergency Coordinator, OHA - Drinking Water Services

Hazard: None

Geography: All

Comment: Feedback on Chapter 4 – Statewide Mitigation Capability Assessment

"Pg 22: OHA contracts source water protection activities for public water systems to DEQ.

Pg 23: OHA - Public Health Division - Drinking Water Services implements the Safe Drinking Water Act for Oregon's public water systems."

Response: Both comments incorporated into the IHMT table.

Comment #48

Commenter and Affiliation: Chantal Wikstrom, Water Quality Specialist & Emergency Coordinator, OHA - Drinking Water Services

Hazard: All

Geography: All

Comment: Feedback on Chapter 5 –Mitigation Strategy

"Priority 47: public water systems are susceptible to all hazards depending on their geography, infrastructure, and operations - not just landslides. All natural hazards can all impact drinking water quality, source water availability, operations, and infrastructure."

Response: This action (renumbered to 72) remains focused on erosion and landslides so that it is specific enough to meet the criteria for a mitigation action. The next update to the Oregon Natural Hazard Mitigation Plan could include additional specific actions to address other hazards that threaten drinking water supplies.

Comment #49

Commenter and Affiliation: Lisa Dawson, Executive Director, Northeast Oregon Economic Development District

Hazard: Wildfire

Geography: All

Comment: Feedback on Chapter 5 –Mitigation Strategy

"42 Continue to analyze interdependencies between lifelines and energy:

assess and plan for backup power needs for critical facilities, such as

water/wastewater, fire stations, and hospitals). Provide support for

energy resilience at certain facilities. See the Oregon Energy Security

Plan for further background. - this should also apply to wildfires"

Response: Wildfire added to this action (renumbered to 64).

Comment #50

Commenter and Affiliation: Brandy Bishop, Emergency Preparedness Coordinator, The Confederated Tribes of Grand Ronde

Hazard: None

Geography: Grande Ronde Reservation

Comment: Feedback on Chapter 2 – Oregon Profile

"In the section 2.3 Human Geography in the subsection for the information on The Confederated Tribes of Grand Ronde I would like to make a couple corrections as follows:

While there are over 30 tribes and bands within the confederated tribes of grand ronde there are five main bands and those are, Molalla, Rouge River, Kalapuya, Chasta, and Umpqua. The CTGR reservation is located in western Oregon in Yamhill county but also in Polk County. In section 2.3.5 under the Confederated Tribes of Grand Ronde subsection ceded and ancestral homelands are mentioned but in the previous sections it states there are only two types of Tribal lands reservations and trust lands. I feel that a quick definition of what ceded lands are might be helpful here. "

Response: Description corrected to refer to the five main bands of the Confederated Tribes of Grand Ronde and to add Polk County. A definition for ceded lands added to section 2.3.2 land ownership.

Comment #51

Commenter and Affiliation: Jason McClaughry, RG, Geological Survey and Services Program Manager, DOGAMI

Hazard: Many

Geography: All

Comment: For at least many of the hazards, there is a disconnect between the extensive background information in the Risk Assessment chapter and the specific indicators that were used to score the hazard and risk preference rankings. It is unclear why the specific indicators were chosen among many possibilities. The subjective choices of which indicators are used ultimately drive how the hazard is perceived through this analysis. Perhaps the indicators are generally a reasonable set for most hazards, but eliciting opinion from a group of interested experts and describing the reasoning for this set of indicators would greatly strengthen the assessment.

Response: Explanations and justifications of the indicators added to Chapter 9 – Appendix.

Comment #52

Commenter and Affiliation: Jason McClaughry, RG, Geological Survey and Services Program Manager, DOGAMI

Hazard: Many

Geography: All

Comment: For many of the indicators, much of the available information about the likelihood of a hazard is being discarded through simplification into binary options, i.e., is a structure in a moderate to very high hazard zone or not. If these indicators were recast such that high hazard/ higher probability factors were scored higher than lower hazard areas, it would better represent our current understanding of these hazards. As currently implemented, communities with exposed structures in predominantly very high hazard zones are scored equivalently to communities with a similar fraction of structures in moderate hazard zones for many of the indicators.

Response: The next phase of the Oregon Natural Hazards Risk Assessment will give users more flexibility to use different hazard scenarios or add additional hazard indicators to better represent hazards.

Comment #53

Commenter and Affiliation: Jason McClaughry, RG, Geological Survey and Services Program Manager, DOGAMI

Hazard: Many

Geography: All

Comment: Many of the hazards include exposure of historic buildings as one of the indicators, and for at least some of the high priority tracts, hazard to historic buildings is a key indicator on the z score plots in the appendix. The numbers and statewide distribution of these buildings was not clear from the report, but based on a discussion with Matt Williams, some census tracts have small numbers of historic structures so that the % exposure could produce a wide range of values depending on the details of a few buildings. This

(potentially) non-robust indicator is weighted equally to more impactful parts of the hazard. In general the use of percentages involving small sample numbers per tract should be evaluated critically.

Response: Risk analysis was changed to use number of historic buildings in a census tract rather than percentage.

Comment #54

Commenter and Affiliation: Jason McClaughry, RG, Geological Survey and Services Program Manager, DOGAMI

Hazard: Volcanic

Geography: Volcanic Hazard Areas

Comment: As raised in a previous email to Trisha Patterson, the volcanic hazard analysis is particularly problematic, as most of the factors discussed in the hazard description are excluded from the indicators used in the risk scoring.

Response: Thank you for your comment. Further discussion is warranted concerning data availability and map symbology.

Comment #55

Commenter and Affiliation: Jason McClaughry, RG, Geological Survey and Services Program Manager, DOGAMI

Hazard: All

Geography: All

Comment: DOGAMI staff are interested in improving the maps and making improvements. What is the timeline to make these changes? If there is no time and capacity to improve the maps, would DLCD be open to revising the language describing the nature of these maps? For example, since many of the maps are primarily a demonstration of social vulnerability and not hazard or risk, they could be reframed to inform the readers understanding and interpretation of the maps.

Response: Thank you for your comment. DLCD anticipates further work to improve the risk assessment by creating a public facing tool for use in local jurisdictions' natural hazard mitigation planning.

Comment #56

Commenter and Affiliation: Jason McClaughry, RG, Geological Survey and Services Program Manager, DOGAMI

Hazard: All

Geography: All

Comment: Given the complexity of the analysis and the choice to make the hazard exposure subordinate to socioeconomic factors, it is unclear if improvements to the hazard scoring system would change the risk prioritization in a significant way. In an extreme case, some of the top 20% census tracts for volcano hazard preference are tracts with 0% hazard. Perhaps this relative insensitivity of the overall ranking to the hazard does not motivate any revision to the scoring in this round (except for the volcanic hazard?). However, justification of how and why the indicators were used should be added to the assessment document.

Response: Thank you for your comment. We have included additional explanation and justification of how and why indicators were used in this particular hazard to *Chapter 9, Appendix*.

Comment #57

Commenter and Affiliation: Erica Fleishman, Director, Oregon Climate Change Research Institute, Professor, College of Earth, Ocean, and Atmospheric Sciences, Oregon State University

Hazard: Drought

Geography: All

Comment: On page 37 of chapter 3, there is a reference to snow drought that is incomplete. There are two types of snow drought. Dry snow drought: precipitation falls as snow, but little precipitation falls. Warm snow drought: ample precipitation, but falls as rain. See https://www.drought.gov/topics/snow-drought#definitions

Response: Thank you for your comment. This change has been made.

Comment #58

Commenter and Affiliation: Erica Fleishman, Director, Oregon Climate Change Research Institute, Professor, College of Earth, Ocean, and Atmospheric Sciences, Oregon State University

Hazard: All

Geography: All

Comment: Table 2.2.4-1. - Habitat is a species-specific construct. It's not clear to me how changes in species' habitats lead to coastal hazards. I suggest deleting this row. Also consider deleting the windstorms column. And spell out CMZ.

Response: Thank you for your comment. We will remove the windstorms column and remove CMZ from the Floods column. Habitat changes can affect coastal hazards; for example, loss of kelp near the shoreline can influence coastal erosion.

Comment #59

Commenter and Affiliation: Erica Fleishman, Director, Oregon Climate Change Research Institute, Professor, College of Earth, Ocean, and Atmospheric Sciences, Oregon State University

Hazard: Coastal Hazards

Geography: Oregon Coast

Comment: Coastal Hazards Section, next-to-last paragraph, "…surfing resources." I don't understand this. Waves?

Response: Thank you for your comment. We have reviewed and deleted "surfing resources".

Comment #60

Commenter and Affiliation: Erica Fleishman, Director, Oregon Climate Change Research Institute, Professor, College of Earth, Ocean, and Atmospheric Sciences, Oregon State University

Hazard: All

Geography: All

Comment: "%" - Symbol or written out? Not consistent across document.

Response: Thank you for your comment. We have updated the text for consistency.

Comment #61

Commenter and Affiliation: Amie Hyatt, Producer, Thelittlethings503

Hazard: Earthquake, High Hazard Potential Dam

Geography: Salem

Comment: Feedback on Chapter 6:

Oregon has done the very minimum when it comes to informing the public. I live in Salem Oregon and we are one the top cities with the highest probability for disaster yet I havent noticed any true form of community education or preparedness. The city should be doing things for instance my grandson's School is located in one of the main areas that would be affected if the Detroit dam were to break our entire neighborhood would be fully submerged underwater. High School doesn't have earthquake drills or flood drills. Should have something happen tomorrow no one would be prepared and nobody would know what to do and that's a serious problem. Educating its citizen is one of the top things that they should be prioritizing under the circumstances because when the cascadia quake does take place we're going to have to rely on ourselves for survival oregon is in no way shape or form prepared for such a catastrophe. They should be doing something to compensate for that for instance providing each community with free EMS courses and search and rescue training so people are prepared to take action as they're going to be forced to do. Two weeks is a long time without help and that's what they're predicting. It should be training its communities to be able to help themselves. It should be providing swim classes for low-income children and families it should be requiring schools churches and community watch organizations to establish an emergency plan and providing them with the things they might need such a storage to begin gathering the necessities they will need to have ready in order for its community members to survive. Water, food, medical supplies, shelters, emergency blankets etc. if every single neighborhood was prepared to take care

of its own people this is what's going to save lives. It should be encouraging people to get to know their neighbors and create a buddy system and not just mentioning it on the internet but repeatedly reminding people that this is a serious disaster that we need to be preparing for on a regular basis that way when it does come we're actually prepared. The other thing is the Detroit dam. The state of Oregon's been informed that that damn is it's not up to par to withstand an earthquake of such magnitude the aftermath if that should break would be horrific and the death toll would be astronomical. Reinforcement of our dams should be a top priority. They've been aware of this for several years and and have no excuse for not addressing the issue.

Response: Local capabilities are very important; however, most of the specific suggestions in this comment are outside the scope of the Oregon Natural Hazards Mitigation Plan. Text added to Section 6.2.2.6 - Educational Outreach, Groups, & Organizations to incorporate the general comments about the level of local capability.

Comment #62

Commenter and Affiliation: Camille Collett, Geotechnical Specialist, ODF

Hazard: Landslides

Geography: All

Comment: I'm wondering if in chapter 3.3.7 you would want to include a sentence or two about how logging and clearcutting can increase the likelihood of there being landslides. You mention the ODF 1996 study but don't really mention that aspect. There are rules that try to prevent this from happening but they still do occur in forestry operations – also frequently along forest roads.

Response: Logging and forest roads added to section 3.3.7.1 – Analysis and Characterization.

Comment #63

Commenter and Affiliation: Hilary Olivos-Rood, UCF Grant Program Administrator, ODF

Hazard: All

Geography: All

Comment: Hello,

The DLCD Community Green Infrastructure Grant Program (CGI) works with the Oregon Department of Forestry's Urban & Community Forestry Subaward Program to collaborate and provide technical assistance for the DLCD CGI program, codified through Oregon Legislation (2023) House Bill 3409. As agency partners, there is much intersectionality between the two programs. ODF requests to add the following paragraph to Chapter 4 - Statewide Mitigation Capability Assessment under section "4.2.3 New Natural Hazard Mitigation and Resilience Programs, Plans, and Funding."

ODF Request to add the following section:

4.2.3.7 Urban and Community Forestry

In 2023, the Oregon Department of Forestry's Urban and Community Forestry (UCF) Program was awarded two domestic grants ($26.6 million, in total) from the U.S. Forest Service to develop and implement two subaward programs. These programs fund urban, rural community, and Tribal forestry projects across the state for social, environmental, and resiliency benefits. The Urban and Community Forestry Program has six priority areas: 1) supporting forestry assessment and planning; 2) supporting culturally responsive forestry education and community-building initiatives; 3) enhancing the urban and community forestry network; 4) expanding urban forestry workforce and career development; 5) expanding tree production, planting, and maintenance; and 6) supporting monitoring, adaptive management, and lesson sharing. These priorities promote resilience in urban and wildland-urban interface areas where communities stand to gain significant benefits from trees and forests.

Response: Added as section 4.2.3.4, immediately following the section on DLCD Community Green Infrastructure program.

Comment #64

Commenter and Affiliation: Mandy Watson, Coastal Conservation Manager, Oregon Shores Conservation Coalition

Hazard: All

Geography: All

Comment: March 19, 2025

To: Oregon Department of Land Conservation and Development and Oregon Department of Emergency Management

RE: Oregon's Natural Hazard Mitigation Plan Update

I want to express my gratitude for allowing public comments on the Oregon Natural Hazard Mitigation Plan Update (NHMP), as well as, my admiration for the work that has gone into this document. Thank you for your efforts to make Oregon communities, people, and places more resilient to natural hazards.

Oregon Shores Conservation Coalition is a non-profit organization that is dedicated to protecting the natural shoreline and equal access to it. We are committed to progressing diversity, equity, and inclusion in coastal and ocean spaces in the face of planning, management, and adapting to climate change. We want to applaud all you've done to recognize and mitigate the disproportionate impact of natural hazards on historically marginalized groups and underserved communities and the incorporation of current and future effects of climate change into this plan.

As organizations strive to meaningfully engage, listen, and amplify the voices of marginalized peoples, we must also acknowledge the additional burden this can place and the risk of unintentionally imposing extractive practices through this work. In light of this, we suggest the agencies think about, and discuss with impacted Tribes, how indigenous Traditional Ecological Knowledge could be incorporated into this or future NHMPs. Currently, the plan seems to lack this important perspective, which would enhance its effectiveness and inclusivity.

We also would like to see the conservation and restoration of estuaries and wetlands distinguished as a mitigation strategy for global climate change due to their ability to sequester carbon as well as localized protection from storms and flooding. Updating Estuary Management Plans should be prioritized as Oregon's estuaries require strong, updated management policies to continue providing their ecosystem benefits. In addition, we would like to see stronger language that discourages the use of hard armoring such as rip rap as it prioritizes short-term private property protection over long-term public beach access.

See specific comments organized by chapter and section below.

Thank you for taking my comments into consideration. Feel free to reach out if you would like to discuss any points further. Again, I appreciate the Department of Land Conservation and Development and Office of Emergency Management efforts in making Oregon more resilient to natural hazards.

Sincerely,

Mandy Watson, Coastal Conservation Manager

Oregon Shores Conservation Coalition

Response: Thank you for the positive comments.

Comment #65

Commenter and Affiliation: Mandy Watson, Coastal Conservation Manager, Oregon Shores Conservation Coalition

Hazard: All

Geography: All

Comment: Specific comments by chapter and section.

1.1

❖ "All three perspectives – local practitioners, state hazard experts, and objective data – are necessary for reaching the best assessment of vulnerability. However, they can complement one another and lead to more robust mitigation." p. 18 ➢ Traditional ecological knowledge from indigenous populations are also perspectives required for reaching the best assessment of vulnerability.

❖ "Local risk assessments therefore can add depth and granularity to the state risk assessment. As the state strives to incorporate local risk assessments into the state risk assessment (Section X.X), this deeper local understanding of local vulnerability and risk, based in part on state data and analysis and in part on local knowledge and experience, will help the state focus its limited resources in communities that need them most and in the ways those communities need them most. This partnership or linkage between state and local mitigation planning promises to be beneficial to both local and state government and most importantly, to the citizens of Oregon." p. 18 ➢ Thank you for acknowledging the importance of local knowledge. The NHMP would benefit from describing how the state incorporates local risk assessment into state risk assessment or what the current status between them is. "As the state strives" is vague and noncommittal.

Response: Added traditional ecological knowledge to the list of perspectives for understanding risk in section 1.1.4.

The 2025 update to the Oregon Natural Hazard Mitigation Plan uses the National Risk Index and a new Oregon Natural Hazards Risk Assessment. The new statewide risk assessment uses a different method than local risk assessments. The new risk assessment method will be available to tribes, counties, and cities as they update their local risk assessments, which will better integrate state and local risk assessments.

Comment #66

Commenter and Affiliation: Mandy Watson, Coastal Conservation Manager, Oregon Shores Conservation Coalition

Hazard: Coastal Hazards

Geography: Coast

Comment: Specific comments by chapter and section.

2.2.4

❖ "Public access is one of the coastal resources most at risk from accelerating sea level rise. Rising seas may dramatically impact beaches, accessways, recreational amenities (e.g., parking lots, bathrooms, signage), and even surfing resources. Public access to the coast is important to the economic viability, quality of life, and health and well-being of members of the community, including low-income and underserved populations. By providing low-cost outdoor recreational opportunities through public access to Oregon's beaches and estuaries, communities can improve their overall economic and health outcomes. Where development already exists, and particularly where there is substantial shoreline armoring to protect this development, Oregon may lose significant recreational beach areas. Additional shoreline armoring can decrease access to sandy recreational beaches, remove or impact public access locations to the water, diminish the ability to include accessibility features at public access sites, require increased costs and maintenance of public access amenities, and contribute to a general loss of public access locations." p.18-19

➢ We appreciate this paragraph. It could be improved by specifically calling out rip rap as a threat to public beach access, as the most common shoreline armoring

method in Oregon. Having a picture to illustrate how it hinders lateral beach access would help demonstrate.

Response: Thank you for your comment. We have added wording about how riprap hinders lateral beach access to the sentence that describes the ways that shoreline armoring hinders beach access. We were not able to include an image to illustrate it at this time.

Comment #67

Commenter and Affiliation: Mandy Watson, Coastal Conservation Manager, Oregon Shores Conservation Coalition

Hazard: All

Geography: All

Comment: Specific comments by chapter and section.

2.3.5

❖ “Tribal Natural and Cultural Resources Indigenous people often do not draw a hard line between natural resources and cultural resources because they are so intertwined. (NOAA, 2025)” p. 41 ➢ Citing a tribal literature, group, or member rather than a federal agency would be the best practice here.

Response: Updated the text and source with a resource from Cultural Survival, an indigenous led NGO and registered non-profit that advocates for indigenous rights.

Comment #68

Commenter and Affiliation: Mandy Watson, Coastal Conservation Manager, Oregon Shores Conservation Coalition

Hazard: All

Geography: All

Comment: Specific comments by chapter and section.

3.2.1.1

❖ Regarding the whole section ➢ It’s great to see the acknowledgement of the intricacies to measuring vulnerability and equitable mitigation. Thank you for your work.

Response: Thank you for your positive comment.

Comment #69

Commenter and Affiliation: Mandy Watson, Coastal Conservation Manager, Oregon Shores Conservation Coalition

Hazard: Coastal Hazards

Geography: Coast

Comment: Specific comments by chapter and section.

3.3.1

❖ “All of these sites are highly susceptible to increased impacts as erosion processes and flood hazards intensify, driven by rising sea level and increased storminess.” p. 17 ➢ Add, “especially when combined with shoreline armoring such as rip rap.”

❖ “Human influences associated with jetty construction, dredging practices, coastal engineering, and the introduction of non-native dune grasses have all affected the shape and configuration of the beach, including the volume of sand on a number of Oregon’s beaches, ultimately influencing the stability or instability of these beaches.” p. 18 ➢ Add stronger language that highlights that most settler human influences have had long-term negative consequences on the beaches, dunes, estuaries.

➢ Such as, “Human activities such as jetty construction, dredging, coastal engineering, shoreline armoring, and the planting of non-native dune grasses have led to long-term negative impacts on Oregon's beaches and dunes. These developments restrict the natural movement of sand and the ability of estuaries to migrate inland, causing the phenomenon known as 'coastal squeeze.' Coastal squeeze occurs when coastal habitats, like beaches and wetlands, are confined between human-made structures and rising sea levels, preventing them from naturally shifting or adapting to environmental changes. This not only undermines the natural resilience of coastal ecosystems but also increases the vulnerability of coastal communities to flooding, erosion, and storm surges.”

❖ “The estuaries are all ecologically important to many fish and wildlife species and in many cases are the sites of important recreational and commercial enterprise.” p. 20 ➢ Recognize estuaries as a mitigation measure. Add, “Additionally, estuaries play a crucial role in carbon sequestration, acting as natural carbon sinks that help mitigate climate change. When unaltered, undeveloped estuary also provide valuable localized protection against storms and flooding, buffering coastal communities from extreme weather events and rising sea levels.”

❖ “In some areas, the erosion has become acute, requiring various forms of coastal engineering (commonly riprap) to mitigate the problem (Figure 3.3.1-4B), and in a few cases the landward relocation of the homes.” p. 20 ➢ Change to “as an attempt to mitigate the problem”

Response: Complete. Thank you for your comment.

Comment #70

Commenter and Affiliation: Mandy Watson, Coastal Conservation Manager, Oregon Shores Conservation Coalition

Hazard: All

Geography: All

Comment: Specific comments by chapter and section.

3.3.3

❖ “Since the mid-1980s, an increasing body of geologic and seismologic research has changed the scientific understanding of earthquake hazards in Oregon, and in recent years several large and destructive earthquakes around the world have heightened public awareness. Recognized hazards range from moderate sized crustal earthquakes in eastern Oregon to massive subduction zone megathrust events off the Oregon coast. ” p. 49 ➢ Add, “Indigenous peoples in the Pacific Northwest, who experienced the 1700 earthquake

and tsunami, passed down their knowledge through oral histories and storytelling long before Western science fully recognized these hazards."

❖ 3.3.3-2 Table. Historic Earthquake Events ➢ Add acknowledgement sentences such as, “This is a settler account of historic earthquakes and does not include earthquakes experienced and documented by indigenous peoples before 1873.”

➢ Or better yet, include examples of earthquakes documented by indigenous histories

➢ Same for 3.3.5-2. Table Historic Damaging Floods in Oregon, Table 3.3.8-1. Historic distant tsunamis that have been observed on the Oregon Coast, and all similar tables.

Response: Thank you for your comment. We considered this comment and added clarifying language.

Comment #71

Commenter and Affiliation: Mandy Watson, Coastal Conservation Manager, Oregon Shores Conservation Coalition

Hazard: All

Geography: All

Comment: Specific comments by chapter and section.

5.2

❖ “2. Prioritize and direct state mitigation resources and investments to build resilience in the populations and communities indicated by the risk assessment to be the most vulnerable. 3. Align natural hazards mitigation and climate adaptation efforts based on the evolving understanding of the relationships between climate change and climate-related natural hazard events.” p. 1

➢ In other sections, the pros and cons of the risk assessment are discussed. Consider who is left out by the risk assessment, who doesn’t get captured based on the framework of the decided risk assessment.

Prioritized Mitigation Action

❖ “21 Conduct a pilot project on two coastal estuaries to develop a framework for modeling sea level rise and to assess the overall impact of sea level rise on the estuaries. Implement sea level rise modeling for the pilot study areas. Use study results to guide a future, more comprehensive and coast-wide assessment of sea level rise impacts. Once completed, use the results to minimize future damage or loss of property and the environment. In 2024, DLCD completed an updated version of the Sea Level Rise Guide for local governments based on this work. Integration through the Climate Change Adaptation Framework.” p. 10 ➢ I would love to be kept in the loop about this if possible.

Response: It is important to be aware of who and what is left out of the National Risk Index and the Oregon Natural Hazards Risk Assessment. This is covered in *Chapter 3* but not repeated in *Chapter 5*.

Request to be kept in the loop forwarded to the Oregon Coastal Management program.

9.5 Ongoing Mitigation Actions

Ongoing mitigation actions showcase the work that state agencies engage in on a daily basis to advance natural hazards mitigation, separate from the mitigation actions the state agencies aspire to accomplish during the next five years. State IHMT members updated the status of these mitigation actions in July 2024, but did not review or prioritize them further for this plan update.

Table 9.5.1 2025 Oregon NHMP Ongoing Mitigation Actions

2025 Oregon NHMP Ongoing Mitigation Actions		
Priority	**2025 Oregon NHMP Ongoing Mitigation Action**	**Lead or Collaborating Agencies**
108	Continue to refine statewide natural hazard identification and characterization. The Oregon NHMP identifies the types of natural hazards affecting Oregon, their geographic extent, history, and probability of occurrence, and as they may be affected by climate change. Throughout the life of the Plan, new and continuing research studies and projects provide new data and analysis, improving our ability to identify and understand Oregon's natural hazards and their probability of occurrence. To advance hazard mitigation in Oregon, it is important for the State to plan, budget, and take advantage of opportunities that arise for continued research and new studies to enhance our knowledge of Oregon's natural hazards.	DOGAMI ODF OEM ODOT OHA
109	Continue to refine the State's risk assessment methodology and statewide assessments of natural hazard exposure, vulnerability, and potential losses. At the core of the Oregon NHMP is a statewide risk assessment of exposure and vulnerability, and an estimate of potential dollar losses to state-owned/leased buildings, infrastructure, and critical or essential facilities from natural hazard events. Schools, emergency facilities, water and wastewater, dams and levees, transportation, telecommunications, and energy facilities are examples of structures, infrastructure, and facilities that could be exposed and vulnerable to natural hazards. Other examples include populations, businesses, and industries. At this time, the state does not have a standardized risk assessment methodology across all hazards at the state and local levels. To advance hazard mitigation in Oregon, it is important for the State to plan, budget, and take advantage of opportunities that arise for continued enhancement of the risk assessment, better enabling limited mitigation resources to be directed to the areas that most need them.	DLCD
110	Continue to refine statewide identification and prioritization of the greatest risks from and communities most vulnerable to Oregon's natural hazards. Identifying and prioritizing the greatest risks from and communities most vulnerable to natural hazard events will enable the state to leverage its limited mitigation resources in ways that efficiently protect life, property, and the environment from natural hazard events and facilitate recovery.	DLCD
111	Continue to develop and implement resilience initiatives statewide. Natural hazard mitigation is a fundamental element of resilience. It is important for the state to plan, budget, and partner with other public and private entities to alleviate potential damage from natural hazard events before they occur by (a) improving the reliability of critical/essential facilities, services, and infrastructure during and after a natural hazard event; (b) developing evacuation routes and facilities; (c) informing the public; (d) planning for long-term recovery; and (e) taking other necessary actions.	DOGAMI, ODF, OWRD, OEM, ODOT, OHA, OSFM
112	Provide support for development and update of local and state hazard mitigation plans. The State of Oregon provides support for development of local NHMPs and the Oregon NHMP by managing federal grant funding in ways that assist the state and local governments with NHMP development and update tasks and processes.	OEM

2025 Oregon NHMP Ongoing Mitigation Actions		
Priority	**2025 Oregon NHMP Ongoing Mitigation Action**	**Lead or Collaborating Agencies**
113	Improve and sustain public information and education programs aimed at mitigating the damage caused by natural hazards. While ongoing efforts are being made in this area, a strong message conveyed by several State IHMT Reports notes the need to strengthen and sustain public information, education, and training efforts by providing additional resources. Although commonly recognized that interest in reducing losses increases during and after events, there is an ongoing need to provide residents and key stakeholder groups (such as infrastructure operators) with hazard mitigation information. These reports cite the need to have timely seasonal information available, better methods to inform residents of sources of hazard mitigation information, use improved electronic methods (e.g., web sites), and materials oriented toward the intended users. This helps keep awareness levels higher, will stimulate actions by some, and reminds users to consider and include hazard mitigation measures in the contexts of regular activities, such as building a new home, relocating an office, or repairing a business.	OEM DOGAMI
114	Continue to improve inventory of state-owned/leased buildings in all hazard areas. Using DAS's data, DOGAMI developed an inventory of state-owned/leased buildings and identified those in hazard areas for the 2012 Plan and updated the inventory for the 2015 Plan. The data should be continuously updated by DAS-CFO to facilitate DOGAMI's inventory updates in future plan cycles.	DAS-CFO
115	Encourage citizens to prepare and maintain at least two weeks' worth of emergency supplies. State agencies should work with the American Red Cross and local emergency managers to encourage citizens to be prepared to survive on their own for at least two weeks.	OEM
116	Use lidar for statewide analysis of all natural hazards. Lidar is currently the best source of regional topographic data and allows for highly precise and accurate natural hazard mapping (landslide, flooding, volcanic hazards, channel migration zones, tsunami, geologic faults, wildfire, etc.) and infrastructure inventories (buildings, utilities, lifelines, etc.). Many Oregon state agencies currently use lidar for natural hazard analyses and will continue to do so where lidar is available.	DOGAMI
117	Support research proposals by PSU, OSU, and UO to improve Oregon's disaster resilience. Support research proposals by PSU, OSU, and UO to improve Oregon's disaster resilience, in particular to federal agencies including the National Science Foundation	DOGAMI
118	Evaluate and update mitigation priorities regularly and as otherwise necessary. The current pandemic has created a less-than-optimal situation for full vetting and prioritization of mitigation actions. With the changing revenue, budget, and social landscapes, continuing to review the actions and assess priorities on a regular basis and as otherwise necessary is the most prudent and practical course of action for continuing to advance mitigation in the State of Oregon.	DLCD
119	Integrate Climate Change Adaptation throughout agency operations. Require that state agencies address climate change adaptation at every budget cycle in their strategic plans. Regularly assess progress towards adaptation objectives.	DLCD
120	Embrace diversity, equity, and inclusion (DEI) in climate change adaptation planning and investment. Produce and implement a DEI Blueprint that will outline guiding principles and include one or more Equity Lens tools that will assist state agencies in taking the first steps toward integrating DEI best practices into their climate-related work. The DEI Blueprint will draw from the Environmental Justice Task Force (EJTF) Best Practices Handbook and other existing resources.	DLCD
121	Support the Interagency Workgroup on Climate Impacts and Impacted Communities. Many of the agencies involved in the Climate Adaptation Framework (CAF) are also beginning to engage in a new workgroup on climate impacts and impacted communities as directed through Governor Kate	DLCD

2025 Oregon NHMP Ongoing Mitigation Actions		
Priority	**2025 Oregon NHMP Ongoing Mitigation Action**	**Lead or Collaborating Agencies**
	Brown's Executive Order 20-04 on Climate Change. This workgroup will intersect with the work of the CAF Climate Equity Workgroup. This work, along with future interagency vulnerability analysis, will further define and identify populations most vulnerable to climate change in Oregon.	
122	Continue to act upon opportunities to advance the State's lifeline mitigation investment practice. Expand upon the State's mitigation investment practice by (a) supporting efforts by jurisdictions and transportation districts to develop mitigation policy and retrofit plans for lifeline assets and service facilities; (b) continuing to advance design and maintenance standards and requirements for bridges and unstable slopes, transit, rail, ports, and priority lifeline airfields; (c) developing a temporary bridge installation policy and standards; (d) supporting research on retrofit methods and strategies for Cascadia subduction zone earthquake loads and tsunamis.	ODOT
123	Improve reliability and resiliency of critical infrastructure statewide by adopting industry-specific best practices, guidelines, and standards. Lifeline Service Delivery Systems (critical infrastructure), including electric supply, natural gas, telecommunications, water/wastewater, hydraulic structures (e.g., dikes, levees, dams), transportation corridors, pipelines and petroleum fuels storage facilities, are all vital resources for a community's life-safety and economic viability. However, much of Oregon's existing critical infrastructure has not been designed or constructed to withstand the impact of severe natural disasters such as extreme wind & winter storms, major earthquakes, or large landslides. Lifeline Service Delivery Systems (critical infrastructure) should be evaluated statewide, and reliable and measurable performance objectives which insure the region's critical infrastructure can withstand future damage without crippling consequences should be instituted.	OPUC, OWRD, ODOT, DOGAMI
124	Acquire statewide lidar coverage for the purpose of improving natural hazard mapping and infrastructure inventories. Lidar is currently the best source of regional topographic data and allows for highly precise and accurate natural hazard mapping (landslide, flooding, volcanic hazards, channel migration zones, tsunami, geologic faults, wildfire, etc.) and infrastructure inventories (buildings, utilities, lifelines, etc.). The state should continue to invest in lidar acquisition for the purpose of understanding risk to natural hazards at a local scale.	DOGAMI
125	Provide technical assistance and funding to local governments to evaluate the need and opportunities for inter-tie projects in Local Natural Hazards Mitigation Plans. The capital expense associated with this action needs to be carried mostly by local governments, perhaps with some grant or low-interest loan funding provided by the state or federal governments. The role of the state in this action is to encourage local governments located proximate to one another, yet with separate water systems, to develop the physical capability to send water from one system to the other. Often during drought situations, one local government will have a bit of water to spare while a nearby government is struggling to meet its needs. Transferring water by truck is expensive and inefficient when compared to transferring water via pipeline. Water interties are also effective mitigation for the flood and earthquake hazards where one system can serve as backup for another.	OWRD
126	Continue the Oregon Safety Assessment Program. The Oregon Safety Assessment Program (OrSAP) provides professional resources to local governments to help with post-disaster building safety evaluations. When disaster strikes a community, numerous facility and infrastructure inspections may be necessary. At the request of local government, OrSAP makes volunteers available to conduct rapid post-disaster building safety evaluations related to structural safety and habitability. OrSAP evaluators also provide recommended posting of placards that denote the condition of each structure evaluated. OrSAP seeks qualified volunteers to provide these services. Volunteers are engineers, architects, building inspectors, general contractors, or people with ICC certifications who want to be certified as a post-disaster safety evaluator and have completed an approved ATC-20 or OrSAP training course.	BCD

2025 Oregon NHMP Ongoing Mitigation Actions		
Priority	**2025 Oregon NHMP Ongoing Mitigation Action**	**Lead or Collaborating Agencies**
127	Expand the state's stream gaging network. Seek stable funding for the operation, and maintenance of stream gages. The availability of timely and accurate telemetered data from stream gages is essential for flood forecasting, for prediction of imminent flood hazards, and for response to flood emergencies. Streamflow data also provides basic hydrologic information for floodplain mapping and watershed management by communities throughout the state and is critical for understanding and forecasting drought conditions. Numerous local, state and federal water management agencies rely on data from stream gages for effective management of projects and resources. The installation and maintenance of stream gages have traditionally been a responsibility of state and federal agencies. State agencies plan to work with their partners, including the United States Geological Survey and Bureau of Reclamation, to ensure adequate funding and support for existing gages and for the installation of new gaging sites where needed. It is recommended that state agencies endeavor to leverage federal funding with state resources and local matching commitments to achieve a reliable network of stream gages around the state. The data from these gages is used to support the RAFT and Raptor tools highlighted in Action #10, Priority.	OWRD
128	Educate homeowners about choosing ice and windstorm-resistant trees and landscaping practices to reduce tree-related hazards in future ice storms. Trees that don't stand up well to ice and wind, especially when planted near power lines, can cause power outages and other damage. Certain species of trees hold up better to winter's fury than others. Other factors, such as where a tree is planted and use of proper pruning techniques, can also help trees be more resistant to ice storm damage.	ODF
129	Each year, ask the Governor to designate October to be Earthquake and Tsunami Awareness Month. Practicing to "Drop, cover, and hold" is critical in reducing injury and loss of life in the workplace and home during an earthquake. The more people practice the drill, the better they will respond to a real event. A gubernatorial declaration will promote increased participation in the Great Oregon ShakeOut, or other annual earthquake Drop, Cover, and Hold On drill.	OEM
130	Continue to facilitate accessibility and use of the Coastal Atlas GIS resources. Make the Coastal Atlas geographic information system (GIS) more useful for a wider audience, from local and state staff to interested citizens, by continuing to improve its data and tools, and providing training on how to access and use them.	DLCD OPRD
131	Research the effects of changing ocean water levels and wave dynamics along the central and southern Oregon coast and use that data to augment the coastal geomorphic database. As recent research has shown, ocean water levels and wave dynamics along the Oregon coast are changing. These will, in turn, affect beach sand budgets and rates of erosion. More research must be done on alternative shore protection methods, effects of hard shore protection structures, near-shore circulation processes and sediment budgets, sea cliff erosion processes, and other hazard processes.	DOGAMI, OSU
132	Survey coastline to monitor erosion. Continue to periodically measure and monitor the Oregon coastline in order to document the response of Oregon's beach and bluffs to changes in ocean water levels (sea level rise and storm surges), storms (frequency and intensity), precipitation patterns that may threaten lives and property. Maintain a long-term, permanent Oregon Beach and Shoreline Mapping and Analysis Program (OBSMAP). The program will be a partnership with local, state, and federal agencies that have responsibility over coastal and ocean activities.	DOGAMI
133	Maintain the updated inventory of shoreline protection structures. Maintain the inventory of existing and new coastal engineering (shore protection) structures on the Oregon Coast in order to provide local governments and applicable agencies with an important coastal management tool to address anticipated increasing coastal erosion. It is anticipated that this inventory and information will assist in potential future policy changes to address a changing climate and associated coastal erosion impacts.	OPRD
134	Provide information and technical assistance to implement mitigation of non-structural hazards in K-12 schools. Provide training to school officials and teachers in reducing non-structural hazards in schools such as unsecured bookcases, filing cabinets, and light fixtures, which can cause injuries and block exits. The program should include a procedure for periodic life safety inspections of non-structural seismic hazards in schools that can be	OEM

2025 Oregon NHMP Ongoing Mitigation Actions		
Priority	**2025 Oregon NHMP Ongoing Mitigation Action**	**Lead or Collaborating Agencies**
	implemented by local fire department inspectors. BCD will have an important role in providing technical assistance in the development of educational materials.	
135	Each year, ask the Governor to designate the third Thursday of the month of October as the Great Oregon ShakeOut Day by proclamation. Practicing to "drop, cover, and hold" is critical in reducing injury and loss of life in the workplace and home during an earthquake. The more people practice the drill, the better they will respond to a real event. A gubernatorial declaration will promote increased participation in the Great Oregon ShakeOut, or other annual earthquake Drop, Cover, and Hold On drill.	OEM
136	Include information about the benefits of purchasing earthquake insurance in public outreach materials and disseminate those materials through appropriate public outreach programs and venues. Unlike flood insurance, which is underwritten by the U.S. Government (through the National Flood Insurance Program), earthquake insurance is offered by private sector agents, generally as a rider to a standard homeowner or business property insurance policy. Because earthquake insurance is a type of catastrophic coverage, most policies carry a high deductible. Oregon's Department of Consumer and Business Services Insurance Division offers information about earthquake insurance on its website and provides personal assistance through its insurance hotline. In addition, the Division is active in outreach activities, partnering with other agencies and organizations to bring insurance information to the public.	DCBS-DFR
137	Continue seismic rehabilitation of hospital, fire, and police facilities under the Seismic Rehabilitation Grant Program administered by Business Oregon's Infrastructure Finance Division. Continue to rehabilitate to operational readiness in the event of an earthquake essential hospital buildings, fire, and police stations that pose a threat to occupant safety. Senate Bill 15 of the 2001 Legislative Session requires that rehabilitation or other actions to be completed by January 1, 2022. Senate Bills 2 to 5 (2005) provided the mechanism to accomplish some of these legislatively mandated tasks. Under SB 2, Oregon Department of Geology and Mineral Industries developed a seismic needs assessment database of emergency response facilities buildings. These data are being used by the Seismic Rehabilitation Grant Program to provide funding for seismic rehabilitation of eligible buildings (SB 3). Senate Bill 5 allows the State Treasury to sell Government Obligation Bonds to fund the program.	BusOR-IFA
138	Continue seismic rehabilitation of public school buildings under the Seismic Rehabilitation Grant Program administered by Business Oregon's Infrastructure Finance Division. Continue to rehabilitate to occupant life safety standards certain public school and community college buildings. Senate Bill 14 from the 2001 Session of the Oregon Legislature requires that the State Board of Education examine buildings used for both instructional and non-instructional activities, including libraries, auditoriums, and dining facilities in order to determine which buildings are in most need of additional analysis. Following the identification of high-risk buildings and additional analysis, high-risk buildings must be rehabilitated by January 1, 2032, subject to available funding. SJR 21 and 22 are bond measures (November 2002 election) which would provide funding to implement this proposed action. SB 2 to 5 (2005) provided the mechanism to accomplish some of these legislatively mandated tasks. Under SB 2, Oregon Department of Geology and Mineral Industries developed a seismic needs assessment database of K-12 and Community College public school buildings. These data are being used by the SRGP to administer a grant program for seismic rehabilitation of eligible buildings (SB 3). SB 4 allows the State Treasury to sell Government Obligation Bonds to fund the program.	BusOR-IFA
139	Track progress on the 2013 Oregon Resilience Plan. In 2013, OSSPAC released the Oregon Resilience Plan with over 100 recommendations. A tracking method is needed to better understand where resilience progress is being made and where more attention is needed. This is in the area of responsibility of the State Resilience Officer in the Governor's Office.	OSSPAC

2025 Oregon NHMP Ongoing Mitigation Actions		
Priority	**2025 Oregon NHMP Ongoing Mitigation Action**	**Lead or Collaborating Agencies**
140	Monitor the effectiveness of the statewide strategy to encourage the purchase of flood insurance by demonstrating that the number of flood insurance policies held throughout the state continues to increase. Despite the statewide availability of flood insurance, coverage in place in most communities in Oregon varies from 10% to 20% of the homes and businesses located in the Special Flood Hazard Area (100-year floodplain). Not only does flood insurance reduce the financial vulnerability of individuals, families, businesses, government agencies, other organizations, and the community to the costs posed by flooding, but through the "increased cost of compliance" provision of flood insurance, it also provides funding for the elevation, flood-proofing, demolition, or relocation of homes and businesses when required due to "substantial damage" to the structure.	DLCD
141	Maintain the Riparian Lands Tax Incentive Program. This program is administered by the ODFW. This program involves the preparation of a plan and agreement between the landowner and the ODFW. The plan details measures the landowner will implement to preserve, enhance, or restore the riparian areas. Landowners receive a complete property tax exemption for the riparian property (up to 100 feet from the top of stream bank or the edge of non-aquatic vegetation). This program helps reduce sediment and protect stream banks which helps reduce the filling of river and stream channels.	ODFW
142	Provide information and potentially resources to local governments for developing "flood fight" plans and protocols. Several post-disaster mitigation strategy reports call for the development of flood fight plans and protocols in advance of flood emergencies. In addition to the state agencies potentially involved in flood fighting such as OEM and OWRD, environmental protection and habitat conservation agencies such as DEQ and ODFW should be involved in flood fight planning. At the federal level, the U.S. Army Corps of Engineers is a key partner. These plans and protocols might include improving emergency warnings, strengthening communications systems, stockpiling needed materials, preparing procedures for emergency vehicle access to flooded areas, and other related subjects, including ongoing public education efforts.	OEM DLCD
143	Continue the State's active Floodplain Management Outreach Program. DLCD has an active floodplain and natural hazards outreach program. The department publishes and distributes newsletters and other outreach information to local governments and other interested parties. DLCD also maintains a website which includes a link to this NHMP. The natural hazards website (https://www.oregon.gov/lcd/NH/Pages/Mitigation-Planning.aspx) contains information and links to floodplain management information including many of the documents and booklets prepared by FEMA. DLCD uses an email distribution service for its Natural Hazard Newsletter and other correspondence. The email distribution service affords interested subscribers a greater opportunity to obtain flood management and natural hazards information from DLCD in a timely manner and for DLCD to more readily share information from a variety of sources.	DLCD
144	Continue the State's active Floodplain Management Training Program. DLCD and other State IHMT participants conduct or sponsor training sessions and meetings throughout the year focused on up-to-date floodplain management practices and projects. DLCD will continue to deliver focused training to surveyors, building officials, real estate agents and planners as well as local floodplain managers. The interdependent relationships among these key players in providing comprehensive floodplain management will also be highlighted during trainings.	DLCD
145	Prepare text for local broadcast of one Public Service Announcement (PSA) each year on a seasonal topic. PSAs are an effective method for disseminating pertinent seasonal information about hazard preparedness and mitigation.	DLCD
146	Assist local communities in securing funding to mitigate damage to repetitive flood loss properties or those substantially damaged by flooding. The state maintains an inventory of high priority repetitively damaged buildings located in floodplains. DLCD and OEM have worked closely with communities to secure funding to mitigate buildings located in the flood hazard zone and to buyout properties located in the floodway. These agencies will continue to provide such expertise statewide where needed.	OEM DLCD

2025 Oregon NHMP Ongoing Mitigation Actions		
Priority	**2025 Oregon NHMP Ongoing Mitigation Action**	**Lead or Collaborating Agencies**
147	Continue developing Emergency Action Plans for all remaining high hazard dams in Oregon. In Oregon, money from FEMA grants and state funds is used to help dam owners create Emergency Action Plans (EAP). An EAP helps identify situations where a dam failure might occur, actions to take that could save the dam, if possible, and evacuation routes for a dam failure situation. There is an Oregon-specific EAP template available, designed for owners of remote dams that have limited personnel. Approximately 75% of state-regulated high hazard dams have or are currently developing EAPs. There are 67 state-regulated high hazard dams, and another 65 federal high hazard dams in which OWRD plays a coordinating role.	OWRD
148	Assist local governments in implementing the tsunami land use guidance. The risk of tsunami hazard for Oregon's coastal communities is well-documented with the completion of comprehensive tsunami inundation maps developed by DOGAMI. The State of Oregon can assist affected communities with its implementation, leading to better protection of life and property from tsunamis.	DLCD
149	Monitor implementation of the tsunami land use guidance by tracking the number of jurisdictions that have used it. The risk of tsunami hazard for Oregon's coastal communities is well-documented with the completion of comprehensive tsunami inundation maps developed by DOGAMI. Monitoring success of the guidance will allow the State to adjust its approach and update the guidance as necessary, leading to better protection of life and property.	DLCD
150	Continue to renew coastal communities' enrollments in the Tsunami Ready Program. The Tsunami Ready Program is a program sponsored by the National Weather Service that is designed to provide communities with incentives to reduce their tsunami risk. Cannon Beach was the first community for Oregon. Under a proposed plan through the NTHMP, additional communities will be added until there is full participation. This program is currently evolving through a review process being carried out by the NTHMP National Coordinating Committee. OEM is the primary point of contact for more information about the Tsunami Ready Program.	OEM
151	Continue supporting school participation in annual tsunami evacuation drills. Increase the ability of Oregonians to prepare for and recover from earthquakes and tsunamis on the Oregon Coast.	OEM DOGAMI
152	Continue supporting local agencies and local non-profits, such as CERT, in participating in educational efforts such as door-to-door campaigns to educate those living or working in the inundation zone on how to respond to an earthquake and tsunami. Increase the ability of Oregonians to prepare for and recover from earthquakes and tsunamis on the Oregon Coast.	OEM DOGAMI
153	Continue innovative outreach activities, such as tsunami evacuation route fun runs. Increase the ability of Oregonians to prepare for and recover from earthquakes and tsunamis on the Oregon Coast.	OEM DOGAMI

2025 Oregon NHMP Ongoing Mitigation Actions		
Priority	**2025 Oregon NHMP Ongoing Mitigation Action**	**Lead or Collaborating Agencies**
154	Continue to develop training and information packets and articles for local building officials informing them of their responsibilities and authority under ORS 455.446 and 455.447 and the State Building Code. Statutes and the State Building Code limit construction of new essential facilities and special occupancy structures in the mapped tsunami inundation zone. Definitions of essential and special occupancy structures are in the Oregon State Structural Specialty Code. As personnel change and time passes, additional training and information for officials will be provided.	BCD DLCD
155	Each year, ask the Governor to designate May to be Volcano Awareness Month by proclamation. Working with federal partners, such as the USGS Cascades Volcano Observatory, the state of Oregon will increase the ability for citizens to respond to volcanic eruptions by increasing the level of awareness and preparedness in the public and governmental agencies.	OEM
156	Support development, enhancement and implementation of local education programs designed to mitigate the wildfire hazard and to reduce wildfire losses, such as the Firewise Communities/NFPA Program and the annual Wildfire Awareness Week Campaign. As part of its statewide fire prevention program, the Oregon Department of Forestry actively encourages and promotes local education and awareness programs that are designed to mitigate or reduce the impacts of wildfires. This action reflects ODF's ongoing intentions to: (a) collaborate with agencies and organizations to promote consistency in the development and application of fire prevention standards, (b) work to make individuals aware of their personal accountability and responsibility for wildfire safety, (c) determine local resources and capacity, and (d) define needs and solutions required to increase capacity.	ODF
157	Continue to increase the number of local governments using the Wildfire Hazard Zone process to mitigate wildfire risk and losses. The Wildfire Hazard Zone (WHZ) process allows local governments to require the use of fire-resistant roofing materials in jurisdictions assessed to be at a high risk of wildland fire. Currently, only a few eligible entities have used the WHZ process. To promote additional use, an assessment will be made of the portions of the state where it appears the WHZ process will have the greatest benefit. Following this assessment, local governments in the areas identified will be educated on the desirability of implementing the process. Those governments that express an interest in applying the process will be assisted in completing the required analysis work.	ODF BCD
158	Continue to develop and increase the number of updated Community Wildfire Protection Plans (CWPPs) with the goal of aligning CWPP updates with 5-year NHMP updates, where possible. The federal Healthy Forests Restoration Act (HFRA) includes statutory incentives for federal agencies to give consideration to the priorities of local communities as they develop and implement wildfire hazard mitigation projects. To become eligible for priority consideration under HFRA, a community must first prepare a Community Wildfire Protection Plan (CWPP). Most Oregon counties and many Oregon communities have completed CWPPs. To encourage the completion of additional CWPPs, as well as future updates of CWPP's counties and communities will be informed of the benefits to be gained from maintaining a CWPP and assistance will be offered to help facilitate the development and/or update of the plans. Because the majority of Counties refer to CWPP's as their Wildfire Chapters, aligning CWPP updates with NHMP updates will ensure consistency and promote efficiencies in planning processes.	ODF

2025 Oregon NHMP Ongoing Mitigation Actions		
Priority	**2025 Oregon NHMP Ongoing Mitigation Action**	**Lead or Collaborating Agencies**
159	Continue to provide technical assistance in accessing funding for fire prevention or wildfire mitigation projects through Title III, the National Fire Plan, or other funding mechanisms. Under the federal Secure Rural Schools and Community Self-Determination Act of 2000 (Title III, Section 301(5) of PL 106-393, commonly known as Title III), counties have the ability to receive and spend federal funds for projects that educate homeowners about wildfire mitigation efforts they can apply on their property and for planning projects that increase the protection of people and property from wildfires. National Fire Plan and other funding mechanisms may also be available for assisting communities in preventing wildfires and implementing wildfire mitigation projects.	ODF
160	Analyze wildfire ignition probability statistics to better target prevention efforts at the leading causes of fires. There is currently no single database or common method of collecting fire cause information for wildfires occurring in Oregon. This results in different entities focusing their prevention and mitigation efforts on those causes which may not be the state's leading causes of fires. This likelihood can be lessened by developing a process to compare fire cause data collected by the Oregon Department of Forestry, the Office of the Oregon State Fire Marshal, and federal wildfire agencies. It is also important to understand the ignition probability from homes within and adjacent to the wildland interface because of the ignition risk to nearby wildlands. While there is no centralized database, wildland and structural fire agencies will continue to work collaboratively to determine leading fire causes and focus efforts statewide and locally to prevent future ignitions.	ODF
161	Collaborate through work groups within the Pacific Northwest Coordination Group (PNWCG) to continue collecting and analyzing wildfire occurrence data using the standardized statewide method and report to the state legislature as required. Previously, data concerning the causes of wildfire incidents was collected and analyzed by at least two state agencies, five federal agencies, and numerous local fire departments. These agencies had no database standardization or common reporting requirements. A standardized data collection system has been developed, and data collection and reporting continue collaboratively through work groups within the Pacific Northwest Coordination Group (PNWCG). The new system allows rapid identification of fire ignition trends and permits timely design and delivery of targeted prevention programs and activities.	ODF
162	Develop a single, comprehensive statewide method or process to collect and analyze wildfire occurrence data in a timely manner. Currently, data concerning the causes of wildfire incidents is collected and analyzed by at least two state agencies, five federal agencies, and numerous local fire departments. These agencies have no database standardization or common reporting requirements. This results in great difficulty, when attempting to determine the number of wildfires that occur in Oregon, when identifying fire cause trends, and generally in obtaining information concerning wildfire trends in a timely manner. Under this action item, all agencies responsible for suppressing wildfires will be requested to report incident occurrence information to a central data repository, in a standard format, and within prescribed reporting time limits. Such a system would allow for the rapid identification of fire ignition trends and would permit the timely design and delivery of targeted prevention programs and activities. The State Fire Marshal's Oregon All Incident Reporting System (OAIRS) may be a key component in the solution.	OSFM ODF

2025 Oregon NHMP Ongoing Mitigation Actions		
Priority	**2025 Oregon NHMP Ongoing Mitigation Action**	**Lead or Collaborating Agencies**
163	Upload the newest available data into the Oregon Wildfire Explorer portal as available. In 2019 the Oregon Wildfire Risk Explorer (OWRE) Tool was completed through federal grant funding to make available the most up to date information available on wildfire risk. This tool was created to develop an online portal available to the public to look at current and potential risk and assist in planning and development. Data utilized as a base for this wildfire risk portal was taken from the Quantitative Wildfire Risk assessment developed by the USFS. The purpose of this online tool is to deliver the best wildfire risk information to homeowners, communities, local managers, and planners. It has been utilized in updating CWPP's and provides guidance and educational resources for the public. Beyond the wildfire risk information, this tool is used as an avenue to show current large fire perimeters and where historical fire starts have happened. ODF has goals to improve and add to this mapping tool in collaboration with OSU into the future by adding in a new Wildland Urban Interface layer and a new Communities at Risk layer. Other updates will be implemented as data becomes available to help planners and the public assess wildfire risk.	ODF
164	Continue to educate communities, workers, and the public about the role of proper tree pruning and care in preventing damage during windstorms. Arboricultural groups, public agencies, and utilities should cooperate in promoting proper tree pruning and care practices that can reduce the risk of tree failure and property damage. Common messages refined by state level entities such as the Oregon Department of Forestry (ODF) and OSU Extension can help provide continuity and efficiency across the state. While implementation of this action largely takes place at the local government level, the state has a role in encouraging and providing incentives for best management practices. ODF maintains and implements a communication plan that includes educational initiatives aimed at improving tree health in cities. This includes a variety of products, including a bimonthly newsletter, a website, and brochures that help convey these messages. OSHA requires utilities to: • Provide training to crews working on power lines in worker safety and the identification of trees to prune or remove; and • Review regulations and standards for easement and right of way maintenance, and provide training to foresters and logging crews. Utilities should instruct homeowners in pruning of vegetation, tree care safety, and proper tree care for trees bordering utility corridors and public rights of way.	ODF
165	Use industry best practices to minimize impact and outages to service delivery system of overhead line operators, during windstorm events. Implement outreach efforts through existing safety-related programs managed by the PUC in coordination with private and public utilities. Compliance with PUC administrative rules includes safety codes and vegetation management. The PUC provides administrative support to the Oregon Utility Safety Committee where all utility operators (electric, natural gas, telecommunication & water) discuss safety issues and best practices.	PUC

2025 Oregon NHMP Ongoing Mitigation Actions		
Priority	**2025 Oregon NHMP Ongoing Mitigation Action**	**Lead or Collaborating Agencies**
166	Educate citizens about safe emergency heating equipment. Improper use of alternate heat sources during winter storms can cause fires. Ongoing efforts of the Office of Oregon State Fire Marshal and its work with local fire departments through the Oregon Life Safety Team (Oregon State Fire Marshal : Oregon Life Safety Team : Education : State of Oregon). In addition, people can be killed by carbon monoxide emitted by fuels such as charcoal briquettes when used for heating homes. To reduce the threat of carbon monoxide poisoning, known as the silent killer, the 2009 Legislature passed HB 3450a requiring landlords to install carbon monoxide alarms in rentals with a carbon monoxide source and homeowners must ensure they are installed in homes at the time of sale, if the home has a source. Sources include gas heating or fireplaces, wood-burning fireplaces or stoves and attached garages. Partnerships for consistent public education messages and outreach are underway and will include information on the dangers of introducing a carbon monoxide risk.	OSFM
167	Continue educating motorists on safe winter driving, including how to be prepared for traveling over snowy and icy mountain passes. Actions such as sanding, applying de-icing chemicals, and snowplowing do not make the road safe. Motorists must drive at speeds appropriate for the weather and road conditions and be prepared to handle adverse conditions. Many drivers do not carry chains and do not know how or simply do not install them when conditions warrant. Also, many drivers are not prepared for a long wait in their car. Education programs would help save lives on snowy and icy roads.	ODOT

9.6 Status of 2020 Oregon NHMP Priority and Ongoing Mitigation Actions

9.6.1 Status of 2020 Oregon NHMP Priority Mitigation Actions

The following table reports the status of the 2020 Oregon NHMP priority mitigation actions. DLCD gathered this data in July 2024 in preparation for evaluating the 2024 Oregon NHMP.

Table 9.6.1 2020 Oregon NHMP Priority Mitigation Actions

STATUS: 2020 Oregon NHMP Priority Mitigation Actions							
Priority #	**2020 Oregon NHMP Priority Mitigation Action**	**Lead Agency**	**Not Started**	**Progressing**	**Completed**	**Not Pursuing**	**Explanation**
1	Update hazard probabilities in NHMP for all hazards. The method to develop probabilities in the 2025 NHMP should incorporate best scientific methods.	DOGAMI		X			Doing this through the Risk Assessment Upgrade. DOGAMI is involved in that project.
2	Develop guidance for local Gov'ts on how to use Goal 7 together with other pertinent Statewide Land Use Planning Goals to classify lands subject to natural hazards in the buildable lands inventory and adjust urban growth boundaries in a manner that minimizes or eliminates potential damage to life, property, and the environment while continuing to provide for efficient development patterns. Goal 7 discourages new development in areas subject to natural hazards. Goal 14 and other Statewide Land Use Planning Goals encourage development within urban growth boundaries. Local Gov'ts need guidance on how to classify lands subject to natural hazards in their buildable lands inventories and adjust urban growth boundaries to protect life, property, and the environment from natural hazards while providing for efficient development patterns within urban growth boundaries. This guidance will assist local Gov'ts in integrating local natural hazards mitigation plans with comprehensive plans.	DLCD		X			We have had several conversations about this within the agency, specifically related to the Governor's and Legislature's focus on housing. Work has begun and will continue. The guidance may take the form of a guidebook as envisioned here, or another form.
3	Provide funding and technical assistance to local Gov'ts to use the new guidance on classifying lands subject to natural hazards in their buildable lands inventories and adjusting urban growth boundaries. Local Gov'ts need funding and technical assistance to be able to use the new guidance on how to classify lands subject to natural hazards and adjust urban growth boundaries to protect life, property, and the environment from natural hazards while providing for efficient development patterns within urban growth boundaries. Comprehensive Plan	DLCD	X				This has not been started because it is dependent on action #2. We will strive to obtain funding for this action.

STATUS: 2020 Oregon NHMP Priority Mitigation Actions							
Priority #	2020 Oregon NHMP Priority Mitigation Action	Lead Agency	Not Started	Progressing	Completed	Not Pursuing	Explanation
	amendments are likely to result. This funding and technical assistance will promote integration of local natural hazards mitigation plans with comprehensive plans.						
4	Update Risk Scores in NHMP based on updated hazard probabilities and vulnerabilities for all hazards. The method to develop the 2025 Risk Scores should incorporate best scientific methods.	DLCD		X			Through the Risk Assessment Upgrade project, DLCD is leading development of a risk assessment tool in a geospatial environment. The tool uses a multiple-criteria decision analysis technique called, "Preference Ranking Organization Method for Enrichment Evaluations (PROMETHEE)." PROMETHEE is a sound scientific outranking method that has been used in Europe, but not to date in the US.
5	Provide technical assistance to local Gov'ts to help integrate hazard mitigation plans with local comprehensive plans. Local NHMPs are often adopted as an appendix to the comprehensive plan or separately and are therefore in practice not used to their full potential. By assisting local Gov'ts in integrating the two plans, hazard mitigation will be more easily and meaningfully implemented in local land use planning practice.	DLCD, OPDR		X			This is funded and being done with coastal communities. It is being done on an ad hoc basis with inland communities because there is no funding specifically allocated for this task.
6	Use the lessons learned from the 2020 Risk Assessment to develop a more robust and scientific standardized risk assessment methodology across all hazards, at the state and local levels. Oregon does not have a clear and common methodology to identify the most vulnerable populations across all hazards at the state and local levels. In 2013, the State IHMT Risk Assessment Subcommittee in partnership with the OPDR and the U of O InfoGraphics Lab developed a model concept, work plan, and budget. Pending funding, this model could be fully developed between 2014 and 2019 and then be used to inform the 2020 Oregon NHMP. Upon full development, the model will allow state and local Gov'ts to strategically target mitigation resources. In the intervening years the state has not been able to fund development of the model, so in 2020, we implemented a simple risk assessment pilot on seven hazards. The lessons learned from this pilot will help the state support the need for funding a more robust and scientific methodology.	DLCD		X			Through the Risk Assessment Upgrade project, DLCD is leading development of a risk assessment tool in a geospatial environment. The tool uses a multiple-criteria decision analysis technique called, "Preference Ranking Organization Method for Enrichment Evaluations (PROMETHEE)." PROMETHEE is a sound scientific outranking method that has been used in Europe, but not to date in the US.
7	Develop and fund a legislative package for general funds or lottery funds to match federal funding for local hazard mitigation planning, including additional funds for DLCD Technical Assistance Grants. Continue — and enhance where possible — state technical and planning grant assistance to cities and counties for addressing issues associated with local hazards.	DLCD		X	X		State funding for local governments to cover the non-federal cost share for FEMA grants: This has been suggested but not taken up as a DLCD POP. The legislature did, however, on its own and on a one-time basis provide funding of $20,000,000 to cover the non-federal cost share for HMGP grants. (HB 5006, 2021 Regular Session) Lack of cost-share dollars remains an obstacle for local governments, especially smaller ones, to

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							access FEMA grant funding for mitigation. It would be appropriate for OEM to take the lead on this in the future. Technical Assistance Grants: The legislature has continued to provide general funds for DLCD to award Technical Assistance Grants to local governments on a biennial basis, following each of the state budget cycles. The amount of general fund appropriated varies from one biennium to another. For a number of years, Technical Assistance Grants for natural hazards mitigation and climate change adaptation have been available, but not requested often, primarily because local governments have needed funding to address legislative mandates for initiatives such as greenhouse gas mitigation and middle housing, and additional housing. Natural hazards mitigation and climate change adaptation have been elevated in priority for awarding Technical Assistance Grants from #3 to #2.
8	Pursue Enhanced Plan status. Oregon is losing enhanced plan status in September 2020 due in large measure to budget and capacity issues. It has been definitively demonstrated that investing in mitigation generates a significant return and reduces the need for costly response and recovery activities. OEM and IHMT agencies need non-federal financial support for additional staff to match federal mitigation dollars and to engage in non-federally supported yet necessary mitigation activities. These activities include but are not limited to implementation of related state programs; integration among related state programs; integration with local government and tribal programs; and technical assistance, both financial and non-financial, for local governments and tribes.	OEM		X			While OEM has been working to correct the issues that have caused Oregon to lose enhanced status, given the very brief Oregon NHMP update planning window, OEM has determined that we will work on obtaining enhanced plan status once again in January 2026. Marian OEM has staffed up and restructured to include one SHMO, two Deputy SHMOs, and a special projects coordinator who lead three units within the Mitigation Section. OEM has hired staff to provide grants management and compliance while providing free technical assistance. OEM is working toward meeting the grants management piece using data from previous FEMA monitoring visits and Oregon Secretary of State audits to inform its decisions.
9	Establish an online platform and procedure for collecting and sharing mitigation actions from state, local, and tribal NHMPs. Currently there is no easy way for governments to research and share mitigation actions. Having an online "mitigation action tracker" would	DLCD	X				While this has been contemplated and desired for a number of years, there has not been capacity or funding to accomplish it. It is a priority now for OEM's new Director, so we anticipate

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	facilitate communication, cooperation, collaboration among state, local, and tribal governments, enhancing mitigation planning statewide.						that it will be funded and completed before the next Oregon NHMP Update.
10	Establish an online repository and procedure for storing finalized, FEMA-approved local and tribal NHMPs as well as the Oregon NHMP. Currently there is no single repository for local and tribal NHMPs and very few that can be found online are in their final format. Assisting local governments and tribes with finalizing their NHMPs after FEMA's final approval and uploading them to a single, online repository in a timely manner will provide opportunities for collaboration and improving state and local coordination in mitigation planning.	DLCD	X				While this has been contemplated and desired for a number of years, there has not been capacity or funding to accomplish it. It is a priority now for OEM's new Director, so we anticipate that it will be funded and completed before the next Oregon NHMP Update.
11	Create a statewide georeferenced digital database of critical infrastructure including Emergency Transportation Routes (ETR). Develop a critical infrastructure database that is suitable for sharing with the public for the purposes of hazard vulnerability assessments. This should include emergency transportation routes (ETR).	DOGAMI		X			Through the Risk Assessment Upgrade, we are developing a critical infrastructure GIS layer that will be suitable for sharing with the public. It will include transportation lifelines. Emergency Transportation Routes are a subset of transportation lifelines.
12	Establish the Oregon NHMP as a living document. Establish a platform for housing the Oregon NHMP and a procedure for continually updating and enhancing it.	DLCD	X				This was not possible to do with the 2020 Oregon NHMP due to funding and capacity issues. We look forward to doing this with the 2025 Oregon NHMP.
13	Request the Oregon Legislature to fund the State Disaster Loan and Grant Account" immediately following a presidentially declared disaster or other disaster. The State Disaster Loan and Grant Account includes an account that can be used to fund local government and school district mitigation projects after a Presidentially declared disaster. The Oregon Legislature may authorize deposits to the account when requested.	OEM		X			The state has made progress with this via HB 5006 (2022) and HB2854 (2023). With the passing of HB5006, OEM received $20M in cost share assistance for jurisdictions devastated by the 2020 wildfires. This allowed OEM and the state to cover all the cost share for DR4562 and HMGP-PF 5327. The funds left over are intended to continue helping jurisdictions with cost share issues, but OEM will need to draft administrative rules. This is on pause with the recent change of OEM from being an office to an agency, along with a shift in priorities. OEM will continue to advocate for legislative funds to assist in cost share barriers. OEM will work with our federal partners to identify federal funds that could be utilized as cost share, examples are the HUD Community Development Block Grant (CDBG) and FEMA's STORM Act.

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14	Improve state agency procedures for tracking data on state-owned/leased buildings and critical or essential facilities. Create a policy standard for facilities data collection required from state agencies on an annual basis. Develop a facilities data framework standard that best enables hazard mitigation analysis; incorporate data into DAS-CFO DataMart and make available to partner agencies at will.	~~DAS-CFO,~~ DAS-CIO, DOGAMI/DAS-GEO		X			This is being pursued through the Risk Assessment Upgrade and other initiatives.
15	Create a "Clearinghouse" for natural hazards data. Emergency responders and community planners alike need access to the best and most current natural hazards data that is available. This project would be a cooperative effort between authoritative data sources — DLCD, DOGAMI, OEM, OWRD, and federal partners (FEMA, USACE, NWS, USGS) — and would include: • Establishing a single point of online access to reliable data, maps, and information about natural hazards; • Developing, in conjunction with DAS-GEO, a "portal" to distribute this data; • Developing a multi-agency State of Oregon flood hazard website; • Providing an ongoing inventory and assessment of existing natural hazards data; and • Creating a central library for natural hazard risk assessments.	DLCD, DOGAMI		X			The Oregon Explorer was a type of natural hazards data clearinghouse but is no longer being updated due to lack of funding for agency support. The new risk assessment tool will provide this function to a certain extent, but also will need funding for continued support and maintenance. Data supplied to the risk assessment tool by state agencies should be standardized and made authoritative data layers by the Oregon Geospatial Enterprise Office's FIT program.
16	Develop a database of non-state-owned critical/essential facilities and their property values. FEMA requires the state's plan to: (a) identify critical facilities located in the identified hazard areas, and (b) estimate the potential dollar losses to those structures. Data for non-state-owned critical facilities are incomplete and lack standardization, therefore creating a wide margin of error. Identifying local non-state-owned critical facilities and gathering descriptive data for these structures will help increase the quality of the data, resulting in a more precise understanding of state and regional vulnerabilities and mitigation priorities.	OEM, DAS-GEO		X			This data was developed for previous versions of the Oregon NHMP and is currently being updated not as a database, but as a data layer to be used in the tool being developed through the Risk Assessment Upgrade project.
17	Coordinate development of a post-disaster scientific and technical clearinghouse with other state and federal agencies, higher education, and associations. When an earthquake, flood, tsunami, or other disaster strikes the state, there will be an influx of scientists and engineers from inside and outside the state to study the event and offer help. There needs to be a coordination of their efforts to put them to use in the most efficient and effective way possible. This clearinghouse will work with the emergency coordination center established immediately after the earthquake, flood, tsunami, or other disaster.	DOGAMI, DLCD	X				Nothing has been done. No agency has taken the lead.

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18	Complete a hazard mitigation policy legislative needs assessment. The Oregon NHMP contains a number of specific policy recommendations. In addition, the state of Oregon maintains a number of policies related to natural hazards and the mitigation thereof. It is unclear at this time what legislative action may be needed in order to fully implement existing and proposed mitigation actions. The State IHMT recommends completing an assessment of the potential legislation needed to implement hazard mitigation policies.	OEM, IHMT	X				The IHMT is in the process of obtaining formal recognition by the legislature. That process has been tabled temporarily until the staffing and structural changes taking place at OEM are settled. Once the IHMT has formal recognition, it will be appropriate to begin this action.
19	DCBS-DFR will teach classes for the business community about financial resiliency against natural disasters in 2020-21. Fire, flood, winter storms, and earthquakes impact Oregon's businesses as much as they do individual Oregonians. DFR is committed to leading Oregon's business community towards financial resiliency. DCBS hosts information for businesses about insurance against natural disasters. They also have published an insurance guide for small businesses. DFR will also lead disaster preparedness classes with Oregon's business community.	DCBS-DFR		X			DFR works especially with the Construction Contractors' Board; it has begun to work with the Small Business Development Centers as well, work it intends to increase.
20	Establish formal and official authority for the State IHMT. Since its formation, the State IHMT has continued to play a major role in hazard mitigation activities, including the development of this hazard mitigation plan. There is strong agreement that the State IHMT is important, should be continued, and ought to be made permanent because it is the only state body focused on coordination of natural hazard mitigation. It is recommended that the State IHMT be formally and officially established.	OEM		X			OEM and the State IHMT members crafted a draft charter for the State IHMT. OEM is continuing to work with Oregon DOJ and the Governor's Office to determine the most effective way to formally recognize the State IHMT. OEM leadership believes in the value of the State IHMT and that it should be a permanent group to provide recommendations on overall mitigation strategies, collaborate on mitigation-focused programs, and provide OEM with guidance on HMA grant reviews.
21	Review and adjust State IHMT membership. As state and agency priorities and personnel change, agency membership should be reviewed and adjusted, and member agencies should be encouraged to budget for participation in State IHMT activities. In late 2014, Emergency Support Functions were reassigned, and the new structure should be considered when reviewing State IHMT membership. When membership is aligned with its goals and mitigation actions, the State IHMT will provide better oversight and leadership of the state's mitigation strategy and programs.	OEM		X			OEM adjusts IHMT membership continuously. OEM does not have authority to require other agencies to budget for State IHMT work, especially without formal recognition and any authority that recognition may confer. The Governor's Office has authority to require agencies to budget for State IHMT work.
22	Provide technical assistance to "most vulnerable communities" to undertake resilience activities for the hazards to which they are most vulnerable. Most vulnerable communities require technical support to understand how to best improve their resilience. A priority region is the coast, and should include critical facilities, specifically hospitals, healthcare facilities and vulnerable populations, and lifeline infrastructure, specifically water and power.	DOGAMI		X			DLCD has contracted with DOGAMI to assess and identify communities vulnerable to natural hazards. Just getting started identifying indicators, test runs with model, becoming familiar with assessment tool (PROMETHEE).

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23	Complete comprehensive multi-hazard and climate change vulnerability assessments Vulnerability assessments are necessary for assessing risk and developing mitigation actions and adaptation strategies. There is a significant amount of overlap between them, providing opportunities to coordinate, integrate, streamline, and leverage resources.	DLCD		X			The Risk Assessment Upgrade will produce ranked list of vulnerable areas statewide. A climate change social vulnerability assessment has been completed by DLCD. Many other agencies are involved in producing vulnerability assessments to serve the scopes of their work.
24	Develop plans to create a lifelines backbone for the 11 coastal communities with hospitals. Coastal hospitals will require fuel, electricity and water to operate after a Cascadia event. Currently, power and water infrastructure is extremely vulnerable. Cost effective methods to ensure a reliable power and water are urgently needed.	OHA		X			In 2019, OHA and DOGAMI worked together on a Coastal Hospital Resilience Project to improve disaster resilience to a Cascadia Subduction Zone earthquake. These plans include guidance to be locally self-sufficient for three weeks, evaluate seismic vulnerabilities of hospitals and identify alternate care sites, and develop a hospital resilience plan. Additionally, the Project engaged the Oregon Coastal Hospital Resilience Network, local emergency managers, and power and water service providers.
25	Set climate change adaptation policies and priorities. The state is working on developing a leadership structure for leading, directing, and resourcing coordinated statewide climate change adaptation strategies. In the near term (2021-23), the Governor's Carbon Policy Office, Natural Resources Cabinet, Global Warming Commission, and Environmental Justice Task Force intend to work together to set climate change adaptation policies and priorities.	The Governor's ~~Carbon Policy~~ Office Natural Resources and Climate Policy Advisor, DLCD		X			With the change in Governor in 2022, there is no longer a Carbon Policy Office. The Global Warming Commission is now the Oregon Climate Action Commission, and although it could address climate adaptation, it has focused on reducing carbon emissions and increasing sequestration.
26	Request and compile seismic and flood information for personnel-occupied buildings from other agencies. Determine flood and earthquake damage and losses expected to occur to the state-owned building inventory and provide advice on higher education buildings. Produce information to enable development of statewide priorities and strategies to guide mitigation of earthquake risk, to protect lives during an earthquake, and to preserve ongoing operations after an earthquake. Use accepted methods to determine building type, construction and occupancy, to estimate damage and losses due to various earthquake scenarios and probabilities relating to building codes.	DAS-CFO, DOGAMI		X			DOGAMI has requested the state-owned buildings data from Oregon Department of Administrative Services. Next steps include characterizing and identifying vulnerabilities within state owned buildings. After these vulnerabilities are developed, we will run HAZUS on this dataset to estimate damage and loss.

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27	Prioritize resilience activities in "most vulnerable communities" for the hazards to which they are most vulnerable. Most vulnerable communities require analyses and technical support to improve their resilience. A priority region is the coast, and should include critical facilities, specifically hospitals, healthcare facilities and vulnerable populations, and lifeline infrastructure, specifically water and power.	DOGAMI		X			DLCD has contracted with DOGAMI to assess and identify communities vulnerable to natural hazards. Just getting started identifying indicators, test runs with model, becoming familiar with assessment tool (PROMETHEE). Results of this study will be used by DLCD to prioritize communities.
28	Provide outreach to "most vulnerable communities" and tribal governments to help citizens understand hazards and how to better prepare for the hazard events to which they are most vulnerable. Most vulnerable communities and tribal governments require educational and learning opportunities to understand how to best improve their resilience. A priority region is the coast, and should include critical facilities, specifically hospitals, healthcare facilities and vulnerable populations, and lifeline infrastructure, specifically water and power.	DOGAMI		X			DLCD has contracted with DOGAMI to assess and identify communities vulnerable to natural hazards. Just getting started identifying indicators, test runs with model, becoming familiar with assessment tool (PROMETHEE). Results of this study will be used by DLCD to prioritize communities and develop dedicated outreach strategies.
29	Identify funding to support various public transportation providers and local jurisdictions to conduct comprehensive vulnerability assessments of their transportation facilities and services. OSSPAC, in the Oregon Resilience Plan has identified an immediate near-term need to inventory and assess vulnerability and mitigation opportunities for local street networks, transit assets, ports, airports, and railroads. The Oregon Resilience Task Force in its October 2014 report to the Oregon Legislature suggested ongoing funding inventory, assessment, and mitigation. These activities would serve to reduce vulnerability to a Cascadia Subduction Zone event.	ODOT, OSSPAC (OEM)	X				There is no funding for OSSPAC to do this. There might be better agencies that could do this. ODOT continues to identify and pursue funding sources for vulnerability assessments, but focus is being placed on actual mitigation projects vs. new assessments. ODOT is working on creating and maintaining a grant application group for the Agency. Pursuing these grants is difficult due to lack of resources, but ODOT is hoping to alleviate those difficulties with the grant application group once it is established (official name to come).
30	Develop probabilistic multi-hazard risk maps for the Oregon Coast. Consider and examine combinations and permutations of multi-hazard risk exposure and maps for the entire Oregon Coast.	DOGAMI			X		DOGAMI published earthquake and tsunami impact analyses for every coastal county and are working on a coastwide update/summary now, to be published later this year. They're based on DOGAMI's tsunami modeling (i.e. XXL, Large, Medium) which are deterministic in nature, not probabilistic. They use FEMA's tsunami and earthquake hazus models in combination with robust population models that account for permanent and temporary visitors to the coast. The reports contain community-specific profiles that summarize a lot of the findings at the city-level for Medium, Large and XXL. Curry: www.oregon.gov/dogami/pubs/Pages/ofr/p-O-23-08.aspx

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							Lane, Douglas, Coos: https://pubs.oregon.gov/dogami/ofr/O-22-06/p-O-22-06.htm Lincoln: https://pubs.oregon.gov/dogami/ofr/p-O-21-02.htm Tillamook: https://pubs.oregon.gov/dogami/ofr/p-O-20-14.htm Clatsop: https://pubs.oregon.gov/dogami/ofr/p-O-20-10.htm Pilot study of 5 coastal communities that did a much deeper dive into population: https://pubs.oregon.gov/dogami/ofr/p-O-20-10.htm DOGAMI has also published a more general multi-hazard analysis for Tillamook County (flood, landslide, coastal erosion, wildfire, EQ and tsunami): https://pubs.oregon.gov/dogami/ofr/O-23-01/p-O-23-01.htm
31	Conduct critical infrastructure vulnerability analysis in "most vulnerable communities" for the hazards to which they are most vulnerable. Most vulnerable communities require analyses and technical support to improve their resilience. A priority region is the coast, and should include critical facilities, specifically hospitals, healthcare facilities and vulnerable populations, and lifeline infrastructure, specifically water and power.	DOGAMI		X			DLCD has contracted with DOGAMI to assess and identify communities vulnerable to natural hazards. Critical infrastructure data is being developed and will be used for risk analysis.
32	Activate the Climate Change Adaptation Work Group. The Climate Change Adaptation Workgroup begins supporting the ~~Carbon Policy~~ Office, Natural Resources Cabinet, and Global Warming Commission.	The Governor's Office Natural Resources and Climate Policy Advisor, DLCD	X				The Global Warming Commission is now the Oregon Climate Action Commission, and although it could address climate adaptation, it has focused on reducing carbon emissions and increasing sequestration. Therefore, no support on climate adaptation has been called for or provided.
33	Formalize the Climate Change Adaptation Work Group. The purpose of the Climate Change Adaptation Work Group is to continue interagency collaboration and lend technical support to the ~~Carbon Policy~~ Governor's Office, Natural Resources Cabinet, and Global Warming Commission. One state agency will be assigned to coordinate the Work Group.	The Governor's Office Natural Resources and Climate Policy Advisor, DLCD		X			DLCD is the agency supporting the Climate Change Adaptation Work Group (now known as the Climate Change Adaptation Framework Implementation Team). Members of this group follow the activities of the Oregon Climate Action Commission and contribute to the Environmental Justice Council's work.

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34	Establish a Multi-agency Climate Change Adaptation Leadership Structure. Establish a climate leadership structure including both a short- and long-term plan for leading, directing, and resourcing coordinated statewide climate change adaptation strategies.	The Governor's Office Natural Resources and Climate Policy Advisor, DLCD	X				This has not been prioritized within the current Governor's Office or the Natural Resources Cabinet. We continue to strive to achieve this. Delete #43 in favor of this action.
35	Develop coastal staging areas to address post-Cascadia disaster damage. Coastal Oregon will be geographically isolated into "islands" after a Cascadia event. Staging areas and equipment should be identified and developed. Pre-disaster planning and mitigation should be conducted factoring in the staging areas and include identifying how to connect islands using various modes of transportation, such as planes and boats, and with use of temporary emergency roads, such as with culverts and gravel.	DOGAMI, DLCD		X			OEM completed "Island Mapping Pilot Project" and subsequent workshops to identify islanding impacts from potential Cascadia events. Results are available for download on RAPTOR Oregon Department of Emergency Management : Cascadia Island Mapping : Hazards and Preparedness : State of Oregon ODHS used Oregon Resilience Plan and transportation assessment to create Oregon Resilience Island Map: Oregon Resilience Island Map (arcgis.com) ODHS mass care service planning for Cascadia event- 31 islands identified, XXL event used, 36% of Hwy101 in non-accessible zone ODHS also tested Oregon's first set of evacuation assembly point equipment in Tillamook in 2023 after identifying Tiillamook as a suitable staging area following a Cascadia event ODHS News Release (oregon.gov).
36	Request seismic and flood information from landlords as part of analyzing potential leased spaces going forward in new leases and potential renewals. Determine flood and earthquake damage and losses expected to occur to the state-owned building inventory including higher education buildings. Produce information to enable development of statewide priorities and strategies to guide mitigation of earthquake risk, to protect lives during an earthquake, and to preserve ongoing operations after an earthquake. Use accepted methods to determine building type, construction and occupancy, to estimate damage and losses due to various earthquake scenarios and probabilities relating to building codes.	DAS-EAM, DOGAMI		X			DOGAMI treats state-owned and –leased buildings similarly in the seismic and flood risk dataset. DOGAMI has requested new leased building information from DAS and will include it in the new 2025 dataset.

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37	Establish funding for climate change adaptation activities. Establish 2023-2025 biennial funding targets for climate change adaptation activities. Continue to fund the Oregon Climate Change Research Institute to provide Oregon state agencies with usable, down-scaled climate change information.	The Governor's Office Natural Resources and Climate Policy Advisor, DLCD		X			Cannot establish biennial funding targets without Governor Office involvement. The Oregon Climate Change Research Institute has continued to be funded for usable, down-scaled climate change information. Break into 2 parts.
38	Use DAS-CFO data and investigation/inventory of seismic and flood risk to DAS-owned/leased buildings in an effective, routine decision-making process for building occupancy, maintenance, use and potential mitigation treatments. This information over time can provide for strategic and responsible voluntary flood and seismic upgrades in areas of greatest need for reasonable cost as a part of broader facilities management.	DAS-CFO		X			DAS is reviewing all the buildings the state leases for potential downsizing, including flood and seismic risks. The data is intended to be used in decision-making processes. Once the data is collected, it will be used as described.
39	Collaborate on a landslide workshop to increase the State's understanding of co-seismic landslides. We believe there will be many co-seismic landslides triggered in the next earthquake. However, we don't understand where and how far inland and the risk. The co-seismic landslides will be a significant portion of the earthquake hazard and understanding it will help with pre and post disaster mitigation.	DOGAMI		X			Started in 2019. DOGAMI has issued some publications regarding dating landslides to determine if they are co-seismic. This is an ongoing priority project until the region experiences a Cascadia earthquake event, and then further studies will be needed.
40	Pursue funding for developing data to support assessments of probability, vulnerability and risk for drought, extreme heat, windstorms, and winter storms. Drought, extreme heat, windstorms, and winter storms are significant hazards in Oregon, but very little data is available to properly assess probability, vulnerability and risk. To better protect the public, Oregon must find funding to develop the necessary data.	DLCD		X			This has not been taken on as a single action in a coordinated fashion, in part due to funding, personnel, and capacity issues. Through the Risk Assessment Upgrade, we are gathering data and using it to better assess these hazards.
41	Conduct a pilot project on two coastal estuaries to develop a framework for modeling sea level rise and to assess the overall impact of sea level rise on the estuaries. Implement sea level rise modeling for the pilot study areas. Study results will be used to guide a future, more comprehensive and coast-wide assessment of sea level rise impacts. Once completed, the results can be used to minimize future damage or loss of property and the environment.	DOGAMI, DLCD		X			DLCD is completing in 2024 an updated version of the Sea Lever Rise Guide for local governments based on this work.

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42	Collaborate on a workshop to increase the State's understanding of co-seismic landslide triggered tsunami. We have a very poor understanding of co-seismic landslides which can cause tsunamis. Some of these can occur underwater. New high resolution bathymetry data would help us understand what has happened in past earthquakes and thus understand the future.	DOGAMI	X				Funding is lacking. Start date will be based on when funding becomes available.
43	Formalize a small Climate Change Adaptation Leadership Team. The CCA Leadership Team would focus on prioritizing actions that optimize use state resources to achieve multiple co-benefits among the most affected communities and ecosystems and have the ability to strategically plan over multi-biennium.	The Governor's ~~Carbon Policy~~ Office Natural Resources and Climate Policy Advisor, DLCD		X			This would be the first step to #25, setting climate change adaptation policy at the state level. Efforts to establish such a leadership team so far not been successful, be we continue to strive to achieve this action. Delete – duplicates #34.
44	Undertake open-coast assessment of the impact of future sea-level rise combined with storm wave erosion assessments. Undertake assessments of future sea level rise change for open coast beaches and shorelines to determine susceptibility and risk from storm-induced erosion, overtopping and flooding.	DOGAMI			X		Dune-backed beach coastal erosion analysis/hazard zone reports cover most if not all dune-backed beaches on the coast. Bluffs included in some reports but not all. Erosion due to storms is always incorporated. Also considered when relevant: large landslides, geology, CSZ subsidence, etc. The newer reports include SLR, the oldest ones do not. Clatsop Plains: https://pubs.oregon.gov/dogami/ofr/O-01-04.pdf Tillamook County (new, but dunes only): https://pubs.oregon.gov/dogami/ofr/p-O-14-02.htm Till Co (old, but includes bluffs): https://pubs.oregon.gov/dogami/ofr/O-01-03.zip South Clatsop County: https://pubs.oregon.gov/dogami/ofr/O-09-06.zip South Lincoln County: https://pubs.oregon.gov/dogami/ofr/O-07-03.zip North Lincoln County: https://pubs.oregon.gov/dogami/ofr/O-04-09.zip Central Curry County: https://pubs.oregon.gov/dogami/ofr/O-04-20.zip

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45	Undertake inner bay total water level modeling. Modeling would incorporate inner bay and outer coast processes, similar to modeling performed in Grays Harbor, WA.	DOGAMI		X			DOGAMI has completed tsunami modeling extending into all the major estuaries: Columbia River, Coos Bay, and Umpqua. They also generated maritime guidance documents for the major ports in the estuaries above as well as Newport/Toledo. A NOAA CRRC grant application has been submitted by the Columbia River Estuary Study Taskforce, Pacific Northwest National Laboratories, DLCD, and Clatsop County to complete modeling for the Columbia Estuary.
46	Develop an improved methodology for gathering data and identifying the communities most vulnerable to drought and related impacts. Although we know that areas in Oregon have suffered from drought, there has not been a coordinated effort to systematically characterize how frequently droughts have occurred, or the impact on Oregonians and ecosystems. Communities are beginning to plan for worst case drought scenarios and need better information about the frequency, duration, and intensity of previous droughts in order to assess the appropriate response. Comprehensive information is not currently available by region, or statewide.	OWRD, OCCRI		X			This is being done through the Risk Assessment Upgrade, but more could be done to improve the data gathering methodology. The Oregon Climate Service and OCCRI characterized historical drought occurrences in Oregon from 1950–2022 on the basis of common indices of meteorological drought (evaporative demand that exceeds precipitation over a long period) and hydrological drought (extended periods of meteorological drought that affect surface water supply or soil moisture). Analyses were conducted at three levels: statewide, six regions delineated on the basis of drought conditions, and counties.
47	Implement the improved methodology for gathering data and identifying the communities most vulnerable to drought and related impacts. Although we know that areas in Oregon have suffered from drought, there has not been a coordinated effort to systematically characterize how frequently droughts have occurred, or the impact on Oregonians and ecosystems. Communities are beginning to plan for worst case drought scenarios and need better information about the frequency, duration, and intensity of previous droughts to assess the appropriate response. Comprehensive information is not currently available by region, or statewide.	OWRD		X			This is being done through the Risk Assessment Upgrade, but more could be done with an improved data gathering methodology. See comments for Action #46.
48	Document the economic, social, cultural, and environmental impacts of drought. Documenting drought conditions, especially its impacts on people and the environment, is an important component of understanding and preparing for future droughts. Oregon does not have the resources to conduct a thorough analysis of drought's impact to various sectors. Today, most impact-related data is collected anecdotally. The state should invest in ways to track and quantify the effects of drought and assist the most vulnerable communities.	OWRD		X			Part of this is being done through the Risk Assessment Upgrade and part will be done through the Oregon NHMP Update for 2025. The Oregon Drought Monitor Advisory Committee issues weekly consensus recommendations on classification of

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	Any drought assessment should also include a summary of drought frequency, distribution, intensity, and duration. Doing so is critical, especially as climate projections indicate that the Pacific Northwest will more regularly experience warmer temperatures.						drought to the U.S. Drought Monitor. Accurate classification of drought severity and extent is essential to determine eligibility for federal drought-assistance programs, such as low-interest loans from the U.S. Department of Agriculture and tax deferrals on livestock sales from the Internal Revenue Service. The Oregon Drought Readiness Council advises the Governor's office on county-level requests for state-issued drought declarations. These declarations affect issuance of emergency water use permits, transfers of water diversions, and other forms of support. Outreach on these subjects to the public, government agencies, and local organizations aids in preparation for changes in water supply. Each year, the Oregon Climate Service, Office of the Washington State Climatologist, Idaho Department of Water Resources, NOAA's National Integrated Drought Information System, and collaborators assess the impacts of the preceding water year on diverse sectors in Oregon, Washington, and Idaho. For example, the assessments address the effects of temperature and precipitation on water supply, irrigation, hydropower generation, forestry, fisheries, recreation, selected agricultural crops, and production of forage for livestock. Some of the data included in the assessment come from an annual Pacific Northwest Water Year Impacts Survey distributed by the University of Washington and from Condition Monitoring Observer Reports submitted to the National Drought Mitigation Center. The former is distributed at the end of the water year to natural resource managers, agency staff, and all registrants for the annual water year recap and outlook meeting. The latter are submitted throughout the year by members of the public. For an example, see https://www.drought.gov/sites/default/files/2024-03/NIDIS_PNW_Water_Year_Impacts_Assessment_2023.pdf.
49	Support and implement the actions in the February 2013 Oregon Resilience Plan and recommended in the Oregon Resilience Plan Task Force's October 2014 report. The Oregon Resilience Task Force was established by Senate Bill 33. It was tasked to facilitate a	OEM			X		2014

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	comprehensive and robust plan to implement the strategic vision and roadmap of the Oregon Resilience Plan for responding to the consequences of naturally occurring seismic events associated with geologic shift along the Cascadia subduction zone. The Task Force's report was delivered to the legislature on October 1, 2014.						
50	Update the Statewide HAZUS analyses for earthquakes. The State requires an updated analysis to understand and improve its resilience. The last analysis was conducted in 1999 and is very outdated. The analyses should include a magnitude 9 Cascadia earthquake and tsunami including soil types, co-seismic landslides and liquefaction. Also, a probabilistic analysis should be completed.	DOGAMI	X				This is a very high priority action and DOGAMI is currently looking for funding. Start date will be based on when funding becomes available.
51	Prioritize mitigation actions of critical State of Oregon infrastructure for Cascadia Continuity of Government (COG) in high-risk communities. Identify vulnerable critical State of Oregon infrastructure for Continuity of Government, including emergency service buildings and other important government buildings, and prioritize mitigation actions starting in high-risk communities. Include state assets in Marion County.	DOGAMI		X			DOGAMI evaluated critical facilities and plans to continue the evaluation, with an update from the 2020 data set.
52	Prioritize mitigation and retrofit projects on seismic lifelines. ODOT Seismic Lifelines Evaluation, Vulnerability Synthesis and Identification Report provides recommended priority corridors but does not provide sufficient detail to actually prioritize retrofit investment packages. Engineering evaluations and cost estimation are ongoing on a funding-available basis and will inform that prioritization process.	ODOT		X			ODOT continues to prioritize mitigation and retrofit projects on seismic lifelines as funding and resources allow.
53	Update Statewide Ground deformation maps. Updated maps of soil amplification and liquefaction should be used to make new maps of the risks of co-seismic liquefaction and landslide ground deformation to be included in an update of 2013 statewide earthquake hazard layers.	DOGAMI			X		Oregon Seismic Hazard Database (OSHD) has been completed (see https://pubs.oregon.gov/dogami/dds/p-OSHD-1.htm).
54	Conduct an earthquake risk analysis that focuses on hazards relating to hazardous materials. The State does not understand the risk that earthquakes pose to sites with hazardous materials and does not have location specific awareness or emergency plans.	DEQ				X	This action should not have been included as a mitigation action in 2020 because the NHMP does not address hazardous materials.

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							However, with the 4/19/23 effective date of the State Mitigation Planning Policy Guide, the NHMP must address hazardous materials (one of the FEMA Lifelines).
55	Conduct seismic mitigation of 5 coastal facilities for the purposes of medical care and sheltering. The coast will experience the strongest shaking and a tsunami from a Cascadia disaster, resulting in injuries and displaced people. Residents and visitors will require medical attention. Tsunami refugees will require sheltering.	Business Oregon, OHA-HSPR, DHS-OREM		X			Progressing but there are barriers to full implementation. The Business Oregon Seismic Rehabilitation Program awarded funds to Samaritan Pacific Communities Hospital in Newport in 2017 and Peace Harbor Medical Center in Florence in 2019. Many of the hospitals on the coast are too small to have inpatient services and space for sheltering; they typically have a small ER or clinic and then transport patients to larger facilities. It is very difficult to retrofit a hospital for $2.5 million, and hospitals may not apply due to need for a local match as the grant program requires a full seismic retrofit and it can be hard to segment off areas of buildings.
56	Update Statewide Liquefaction maps. New highly detailed geologic maps produced with LIDAR should be used to make new maps of soil types which may liquefy due to earthquake shaking to be included in an update of 2013 statewide earthquake hazard layers.	DOGAMI		X	X		Oregon Seismic Hazard Database (OSHD) has been completed (see https://pubs.oregon.gov/dogami/dds/p-OSHD-1.htm). However, this action should be an ongoing action since there is necessary upkeep of the database.
57	Publish new probability of earthquake damage maps. New USGS hazard data should be used to make simple maps showing the probability of experiencing damaging shaking be included in an update of 2013 statewide earthquake hazard layers.	DOGAMI		X	X		Oregon Seismic Hazard Database (OSHD) has been completed (see https://pubs.oregon.gov/dogami/dds/p-OSHD-1.htm). However, this action should be an ongoing action since there is necessary upkeep of the database.
58	DCBS-DFR will teach classes about earthquake insurance in 2020-21. Earthquake insurance is offered by private sector agents, generally as a rider to a standard homeowner or business property insurance policy. Because earthquake insurance is a type of catastrophic coverage, most policies carry a high deductible. Oregon's Department of Consumer and Business Services Division of Financial Regulation offers information about earthquake insurance on its website and provides personal assistance through its insurance hotline. In addition, the Division is active in outreach activities, partnering with other agencies and organizations to bring insurance information to the public.	DCBS-DFR		X			This material is typically included along with related topics; one source utilized is the Earthquake Insurance Guide produced by NAIC; they also do social media work with CREW (including occasionally receiving funding via CREW); also participate in The Great Oregon ShakeOut and utilize that annual event for education.

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59	Update Statewide NEHRP maps. New highly detailed geologic maps produced with LIDAR should be used to make new maps of soil types which may amplify earthquake shaking to be included in an update of 2013 statewide earthquake hazard layers.	DOGAMI		X	X		Oregon Seismic Hazard Database (OSHD) has been completed (see https://pubs.oregon.gov/dogami/dds/p-OSHD-1.htm). However, this action should be an ongoing action since there is necessary upkeep of the database.
60	Publish available information about new faults. DOGAMI has identified dozens of new faults from LIDAR acquired to date, few of which have been described in publications, which is a prerequisite for inclusion in the USGS hazard maps. Summary data about these faults should be published as part of a currently funded update of statewide earthquake data.	DOGAMI		X			Numerous studies have been published regarding new faults. This is an ongoing action until all areas are completed. Funding dependent.
61	Assess hazards associated with active crustal faults newly discovered by statewide lidar program. Particularly in central and eastern Oregon, the major earthquake hazards result from poorly known crustal faults. Lidar has greatly expanded the ability to find these faults, which should be systematically evaluated for their potential to generate damaging earthquakes using trenching, geophysical and field studies. This action would help communities prepare and mitigate for newly defined hazard areas in central and eastern Oregon.	DOGAMI		X			To achieve or start this action, Action #60 needs to occur first. Although several studies have been conducted as indicated above under #60, the hazards have not been assessed. Start date unknown.
62	Create new regulatory authority to address the State's fuel insecurity at the Critical Energy Infrastructure Hub. The State requires new regulatory authority that may be created through new legislation. OSSPAC issued a CEI Hub report with recommendations in Dec 2019.	OEM	X				This was not started under the previous leadership at OEM (the state agency supporting OSSPAC). Once the changes at OEM are settled, OEM's current leadership can coordinate with OSSPAC, IHMT, and ODOE to implement this action.
63	Develop State of Oregon Cascadia Continuity of Government (COG) plan. Develop a response and recovery plan that integrates state assets to ensure State continuity of government at the leadership and agency levels for a Cascadia earthquake. Improve capacity of state agencies to minimize damage and be responsive to urgent post-disaster needs.	DOGAMI		X			Not currently working on a COG plan, however DOGAMI has a completed a continuity of operations plan and is working on an internal disaster response plan. DOGAMI has also been working on a data clearinghouse plan to manage scientific requests for and organization of data after a Cascadia event. Related to action #11.
64	Evaluate earthquake hazards in Bend region. Faults in the Bend-Sisters area should be systematically mapped and evaluated for evidence of recent activity in order to assess the earthquake hazards for Central Oregon communities.	DOGAMI	X				Funding is lacking. Start date will be based on when funding becomes available.
65	Update DOGAMI Rapid Visual Survey database on emergency service buildings. Update the Rapid Visual Survey data for the emergency service buildings in DOGAMI 2007 statewide seismic needs assessment. Include data to assist with conducting benefit cost analyses and for prioritization of mitigation.	DOGAMI		X			DOGAMI will be updating this data for Klamath, Crook, and Yamhill Counties. Planned but the timing is unknown.
66	Lidar survey the State's ROW (rights of way), west of the Cascade Range, to determine where seismic fault potential exists. The acquired information can improve critical	DOGAMI		X			DOGAMI does this determine with each fault mapping project it conducts. This is an ongoing action as funding dictates.

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	infrastructure resilience in the face of seismic events, by providing useful information to planners, design professionals and decision makers prior to delivery system construction.						
67	Rectify state "border" faults with Nevada, Idaho, CA and Washington. The USGS fault database includes numerous discontinuous faults, particularly in Eastern Oregon, so that the probabilistic national seismic hazard maps underestimate the hazard. The continuation of mapped faults needs to be evaluated and descriptions need to be published in order for them to be used by USGS.	DOGAMI	X				Funding is lacking. Start date will be based on when funding becomes available.
68	Plan using Regional Resilience Assessment Program (RRAP) multi-modal transportation report. Develop local and state plans including push solutions to connect islands as discussed in the DHS Regional Resilience Assessment Program (RRAP) report. Integrate emergency transportation routes, including multimodal transportation methods by air, land and water. Include Willamette Valley planning and coastal communities planning.	DOGAMI				X	No funding streams available.
69	Achieve 100% state agency participation in the Great Oregon ShakeOut. Practicing to "drop, cover, and hold" is critical in reducing injury and loss of life in the workplace and home during an earthquake. The more people practice the drill, the better they will respond to a real event. State agencies are setting an example by conducting a drill annually. The State of Oregon will have 100% State agency participation in the Great Oregon ShakeOut and will encourage schools and universities to participate.	OEM		X			Many state agencies participate in the ShakeOut.
70	Increase penetration of air conditioning systems for most vulnerable communities in areas most at risk to extreme heat events. Increasing penetration of air conditioning systems particularly in manufactured homes in Cooling Zone 3 and in multifamily homes/apartments across the state, would help alleviate adverse impacts from extreme heat events.	OHA		X			OHA has dedicated 1 FTE to plan to fund and install air conditioning units in communities most affected by extreme heat, such as manufactured homes and multifamily homes and apartments, among others. Work continues to establish a consistent supply chain of air conditioning units.
71	Map climate and environmental data with demographic and health data. Map climate and environmental data with demographic and health data to help identify most impacted communities for targeted interventions and investment.	OHA		X			OHA has multiple streams to map climate and environmental data with demographic data. OHA has the Oregon Tracking Program, which includes the Oregon Tracking Data Explorer. The Data Explorer provides dynamic maps, graphs, and information about a broad range of environmental and health indicators and measures.
72	Produce new lidar-based flood hazard maps Lidar-based flood hazard maps are produced for counties or watershed as funding is provided. These maps have newly delineated flood zones based on new detailed studies, new coastal analysis, and/or delineation of existing zones based on new topography data (lidar). Lidar-based flood hazard maps are being produced for rivers in Marion, Morrow, Benton, Hood River, Wasco, and Sherman Counties.	DOGAMI		X			DOGAMI and FEMA have recently produced new lidar-based flood depth grids for Tillamook, Washington, Clackamas, Polk, Douglas, Morrow, Wallowa, Marion, Morrow, Benton, Hood River, Wasco, Sherman, and Harney Counties. New maps are in-progress for Linn County to be completed by the end of 2024. New maps are planned and will be completed after 2025

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							for Columbia, Yamhill, Crook, Grant, Gilliam, Umatilla, Klamath, and Malheur Counties.
73	Through FEMA's Risk MAP program, update 1,000 miles of streams with lidar-based flood mapping. FEMA's Risk MAP program funds revisions of Flood Insurance Studies and Flood Insurance Rate Maps. The State should focus on updating these products so they are based on high quality topographic data (e.g., lidar). Lidar-derived streams are a by-product of high-quality topographic data. These more accurately located streams will assist in the improvement of a community's flood maps to more accurately show flood risk to life and property. The State should continue to pursue Risk MAP funds for this purpose.	DOGAMI		X			FEMA has updated Flood Insurance Studies for ~2,300 miles of stream between 2020-2024 and an additional ~300 miles of streams are planned to be updated in 2025. DOGAMI supports these efforts by providing technical assistance to communities across the state, coordinating with other state and federal agencies, and compiling and distributing flood-related datasets. The original intended number of miles were achieved, but this type of work will continue beyond 2025.
74	Install real-time monitoring capabilities on the remaining 51 state-operated stream gages, with the goal of making the network 100% real-time by the year 2020. The availability of timely and accurate data from stream gages is essential for flood forecasting, for prediction of imminent flood hazards, and for response to flood emergencies. Today, 178 of the state's 229 stream gages provide real-time data. Upgrade the state's existing stream gaging network, with the goal of installing real-time capability on all remaining gages.	OWRD		X			248 gages are real-time; 7 remain to be updated.
75	Investigate the impact of climate change on flood conditions in Oregon. Research and Investigations. Flood risk is strongly associated with the dominant form of precipitation in a basin, with mixed rain-snow basins in Oregon already seeing increases in flood risk. Generally, western Oregon basins are projected to experience increased precipitation, and therefore flood risk, in future decades. Federal and state agencies should seek to learn more about the potential impacts of climate change on flood conditions in Oregon and identify mitigation actions that will reduce the potentially increased risk.	DOGAMI		X			DOGAMI's risk assessments have provided qualitative statements about the impacts of climate change on flood conditions in Oregon but do not quantitatively assess these impacts. DOGAMI has incorporated the findings from the Oregon Climate Change Research Institute on future climate conditions into its studies, but additional resources will be needed to produce a detailed understanding of the impact of climate change on floods in Oregon.
76	Add at least five jurisdictions, with emphasis on coastal jurisdictions, to the Community Rating System (CRS) program during the life of each Oregon NHMP. The CRS, part of the NFIP, is a program that rewards communities for going above and beyond the minimum requirements of the NFIP in minimizing potential losses due to flooding. Participating in the CRS benefits the jurisdiction with extra flood protection and benefits property owners by lowering flood insurance rates. See the CRS Information Center at: http://training.fema.gov/EMIWeb/CRS/ for more information. Each year DLCD conducts community assistance visits in an average of five NFIP communities. During this process, qualified jurisdictions will be encouraged to participate in	DLCD		X			Description needs revised. Last sentence needs to be deleted (A regional CRS Users Group hosts quarterly CRS Users group meetings.) No jurisdictions have joined CRS in the last 5 years. Phoenix is currently attempting to become a CRS community. Clatsop County may be interested in becoming a CRS community.

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	CRS or strengthen CRS ratings. DLCD will also create a "pathway to CRS" schedule for each jurisdiction for which it conducts a community assistance visit. The state has also started CRS Users' Groups (#C, Removed and #112, Ongoing) to encourage greater participation in the CRS program.						
77	Update the state's Peak Discharge Estimation Program. Peak discharge estimation tools can help determine the magnitude and frequency of floods. The state's program provides engineers and land managers with the information needed to make informed decisions about development in or near watercourses. The Peak Discharge Estimation Program is based on a modified version of the U.S. Geological Survey's "Bulletin 17b." The U.S. Geological Survey is in the process of updating this bulletin. OWRD's methodology will need to be brought up to date to reflect these recent findings.	OWRD	X				This work has not been prioritized at this time but remains on our list of needed updates.
78	Develop guidance on determination of mudslides triggers and relation to rain or flood events. Work with FEMA Region 10, DOGAMI, and other interested parties to develop scientifically- and legally-based guidance on when mudflows are to be considered part of a rain or flood event pursuant to the NFIP. Address the definition of mudflow, regulatory factors, scientific understanding of mudslides, and implications for flood insurance.	DOGAMI, DLCD			X		Completed June 2023. DLCD now has a FEMA Fact Sheet, Understanding Mudflow and the NFIP.
79	Strengthen the existing Community Rating System (CRS) rating of at least five jurisdictions, with emphasis on coastal jurisdictions, during the life of each Oregon NHMP. The CRS, part of the NFIP, is a program that rewards communities for going above and beyond the minimum requirements of the NFIP in minimizing potential losses due to flooding. There are a number of measures a community can implement to obtain a CRS rating, and most communities do not implement them all. As a community implements more CRS flood protection measures, its CRS rating is strengthened, and the community is rewarded with better flood protection and lower flood insurance rates.	DLCD		X			Salem (4 to 3) and Lane County (7 to 6) improved their CRS ratings.
80	Install High Water Mark (HWM) signs after flood events and co-locate stage crest gages on select HWM signs. HWM signs installed in high visibility areas increase the general public's awareness of flood risk and drive flood mitigation actions in communities. They spark conversations about past floods and are a good entry point for discussions promoting mitigation actions such as elevating buildings, purchasing flood insurance, and participating in FEMA's Community Rating System Program. Stage crest gages co-located with select HWM signs will capture new high-water data when floods occur.	Silver Jackets		X			Albany, Oregon City, Portland, Turner, Vernonia, all have HWM signs (pre-2017). Signs for King Tides were installed in coastal communities w/in last 5 yrs.
81	Develop a statewide strategy to encourage the purchase of flood insurance. It's well-known that well-insured communities recover faster. A strategy will help the state direct information to under-insured areas thereby reducing vulnerability, facilitating recovery, and increasing access to "increased cost of compliance" funding.	DLCD	X				Flood Insurance as a mitigation strategy is regularly recommended as part of public outreach during flood studies.

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82	DCBS-DFR will teach classes about Flood Insurance in 2020-21. While Oregon does not regulate the NFIP, it does regulate the agents who sell it. It also has an interest in leading Oregonians towards financial resiliency. Flood insurance plays an important part of that objective. DFR hosts information about flood insurance on our website and will continue to lead outreach to the public about the value of flood insurance for both homeowners and businesses.	DCBS-DFR, ~~State Lands DLCD~~		X			DFR primarily utilizes its website, including links to related websites; it also utilizes social media; for this row and the three above, they also do in-person events; ODF staff members also noted a post-disaster claims guide and post-event work with the public at in-person opportunities.
83	Create new lidar-based Landslide Inventory and Susceptibility Maps, especially near population centers. DOGAMI will create these maps in cooperation with local jurisdictions. Specific methods and priority locations are still to be determined. The locations will be determined by the Oregon Landslide Workgroup (#6, Priority). These new maps will enable communities to introduce development restrictions or recommend mitigation strategies in areas highly susceptible to landslides.	DOGAMI		X			DOGAMI has issued numerous publications and will continue to inventory population centers until all have been completed. Once completed, DOGAMI will continue to inventory less populated areas until the entire state has been inventoried. This action is dependent on external funding. Estimated completion date unknown.
84	Assist 5 communities with post-fire landslide risk reduction. After a wildfire, there is an increased potential for landslides and specifically debris flows which are potentially life-threatening. We should be assisting communities in understanding where this hazard exists.	DOGAMI		X			This project was started in 2020 with four wildfire areas (multiple communities). DOGAMI is in the middle of this project, including conducting several community meetings. DOGAMI received 1-year extension by FEMA on this project. The expected completion is Fall 2025.
85	Upgrade the Oregon Landslide Warning System. The current warning system needs updating to include rainfall thresholds from local rainfall gauges. A permanent real-time website will be constructed to show the areas under a landslide warning that will include guidance on what people should do to help protect their life and property from a landslide.	DOGAMI		X			In 2021 DOGAMI issued a report evaluating the existing Oregon Landslide Warning System (https://pubs.oregon.gov/dogami/ofr/p-O-21-01.htm). The report included next steps and recommendations on how the existing system could be improved. Since the report was issued, no action has been taken. Continuing this project will be dependent on funding and resolution.
86	Evaluate the impact of climate change on landslides. The precipitation-triggered landslides will increase or decrease with changes in climate. Evaluation of this change will be important for the future of Oregon.	DOGAMI	X				Minimal steps have been made by other agencies or entities regarding climate change, but not specific to landslides. Start date unknown. Action #93 is dependent on this action. Consider combining #86 and #93 actions.
87	Use Lidar along State's ROW (rights of way) in 5 communities to map landslides and model where future landslides may occur. Because most landslides are reactivations, mapping the existing landslides is essential to future landslide prediction and mitigation.	DOGAMI		X			This project is being conducted with each landslide mapping project performed by DOGAMI. This is an ongoing action as funding dictates.
88	Lidar survey the State's ROW (rights of way), west of the Cascade Range, to determine where landslide potential exists. The acquired information can improve critical	DOGAMI		X			This project is being conducted with each landslide mapping project performed by DOGAMI. This is an ongoing action as funding dictates.

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	infrastructure resilience in the face of landslide events, by providing useful information to planners, design professionals and decision makers prior to delivery system construction.						
89	Collect repeat LIDAR in 5 communities and use it to monitor areas of movement. After the landslide inventory has been mapped, additional information about each landslide will assist in understanding the hazard. Specifically, the landslide activity is important and can be determined using repeat LIDAR surveys and differencing of the surveys to detect movement.	DOGAMI		X			DOGAMI is currently working on Eagle Creek and Ecola (State Park) projects. Additionally, a BRIC grant was recently submitted for the Bull Run project. This is an ongoing action with no completion date known and is based on funding availability.
90	Install landslide mitigation measures along transportation corridors that impact 5 most vulnerable communities. Landslide mitigation measures, such as rock bolts, rock nets, catchment basins, benched slopes, horizontal drains, retaining walls, will be installed to reduce the risk of landslide hazards along key corridors. This will improve the reliability of transportation mobility.	ODOT		X			ODOT continues to install landside mitigation measures as time, resources, and funding allows. ODOT hopes to identify more funding sources for these projects once the grant application group has been established and developed.
91	Collaborate on a landslide workshop to increase the State's understanding of post-fire landslide hazards in Oregon. We have a very poor understanding of the post wildfire effect on landslide risk. Understanding this relationship will help us to understand the hazard and how to mitigate.	DOGAMI		X			First workshop conducted in 2023 at the Oregon Post-fire Research and Monitoring Symposium (https://nwfirescience.org/oregon-post-fire-research-and-monitoring-symposium). This should remain as an ongoing action since the information will need to be updated and shared into the future.
92	Evaluate sediment impacts on Oregon's water resources. Oregon has unique water resources, some of which are for drinking water. Landslides can have a great impact on this resource by inputting large amounts of sediment. Evaluation of erosion potential by watershed would help the regulators and providers identify areas for mitigation.	DOGAMI		X			This is not a DOGAMI project, but DOGAMI does assist USGS/DEQ in the task. DEQ might have more information on action status.
93	Collaborate on a landslide workshop to increase the State's understanding of climate change effects on landslide hazards in Oregon. Climate change may have multiple effects on landslides in Oregon including increased post wildfire and intensity/duration rainfall events. Understanding these factors better will help us understand the change to the landslide hazard and how to mitigate.	DOGAMI	X				To achieve or start this action, Action #86 needs to occur first. Consider combining #86 and #93 actions.
94	Implement better way-finding solutions for tsunami evacuation. Create hardened and improved evacuation routes to include elevated safe areas above the level of modeled inundation. After a Cascadia Subduction Zone earthquake, a tsunami could arrive within minutes. It is essential that residents and visitors be able to quickly move to high ground on foot. This requires clearly marked and safe routes that pedestrians are able to navigate even in dark and stormy weather. Where high ground is available, projects should be identified that will enable Oregon to establish new standards and guidelines for methods to harden and mark wayfinding of tsunami evacuation routes to natural high ground. Where natural	OEM, DLCD		X			DOGAMI's Beat the Wave tsunami evacuation analyses have been completed for every community on the Oregon Coast over the past ~10 years (Brookings-Harbor and communities along the Columbia River shoreline upriver from Astoria will be published this fall). Improvements including hardening existing routes, developing new evacuation trails, retrofitting bridges, constructing one or more vertical evacuation structures, where applicable.

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	high ground is not within the expected evacuation time, evaluate the retrofit of existing facilities and/or construction of new facilities that rise above the level of tsunami inundation and can serve as safe haven refuges.						
95	Assist one coastal community per year in considering vertical evacuation structures and improved evacuation routes due to evacuation constraints. Use the anisotropic path modeling to measure the time needed to evacuate all parts of the maximum-considered Cascadia tsunami inundation zone in order to evaluate the need for vertical evacuation structures and improvements in evacuation routes. These actions will provide guidance to communities on the best locations to build vertical evacuation structures that will save lives in a catastrophic tsunami event. The results will also inform communities of priority evacuation routes needing additional signage or way-finding markers. Beat the Wave modeling is currently underway in Port Orford and Manzanita/Nehalem and planned for Gold Beach, Astoria, and Bandon.	DOGAMI, DLCD, OEM			X		DOGAMI's Beat the Wave tsunami evacuation analyses have been completed for every community on the Oregon Coast over the past ~10 years (Brookings-Harbor and communities along the Columbia River shoreline upriver from Astoria will be published this fall). Improvements including hardening existing routes, developing new evacuation trails, retrofitting bridges, constructing one or more vertical evacuation structures, where applicable.
96	Develop evacuation plans for ports and harbors at the rate of one per year. Ports and harbors are havens for commercial and recreational fishing and recreational boating industries. They are often the major centers of economic activity in coastal communities that have bays. To protect the vessels from tsunami damage requires a unique evacuation plan for both distant and local tsunamis. The plans should be integrated with community evacuation plans. The Oregon State University Extension Sea Grant Program has identified this as a major issue in their pilot project in Yaquina Bay. Their project is titled *Reducing Earthquake and Tsunami Hazards in the Pacific Northwest Ports and Harbors.* For distant tsunami events and storm surge events that can occur during any winter, evaluate potential port and harbor mitigation retrofit projects that protect and strengthen floating and anchored infrastructure such as piers, bulkheads and landings.	DOGAMI, DLCD			X		Ports were included in DOGAMI's Beat the Wave analyses, so where appropriate they considered improvements including hardening existing routes, developing new evacuation trails, retrofitting bridges, constructing one or more vertical evacuation structures, where applicable. They have not assisted any ports with their designated evacuation routes.
97	Fund and provide technical assistance for local Gov'ts to engage in evacuation route planning and project implementation. After a Cascadia Subduction Zone earthquake, a tsunami could arrive within minutes. It is essential that residents and visitors be able to quickly move to high ground. Some evacuation planning is already underway. Local Gov'ts need funding and technical assistance to begin or continue to engage in evacuation planning.	DOGAMI, DLCD			X		DLCD published "Preparing for a Cascadia Subduction Zone Tsunami: A Land Use Guide for Oregon Coastal Communities," designed to assist local jurisdictions with land use planning and resilience strategies for a Cascadia tsunami event. TsunamiLandUseGuide_2015.pdf (oregon.gov) DLCD also worked with Gearhart, Rockaway Beach, Tillamook County, Manzanita, and Lincoln City to implement tsunami resilience planning through maps, evacuation facility

STATUS: 2020 Oregon NHMP Priority Mitigation Actions							
Priority #	2020 Oregon NHMP Priority Mitigation Action	Lead Agency	Not Started	Progressing	Completed	Not Pursuing	Explanation
							improvement plans, comprehensive plan policies, and transportation system plans.
98	Prepare/Publish 5 multi-hazard and risk studies for communities around Cascade Volcanoes, including Newberry (e.g., Burns and others, 2011). To help 5 communities on or near Oregon Volcanoes become more resilient to geologic hazards (volcano, landslide, flood, and earthquake) by providing detailed information about the hazards and the community assets at risk.	DOGAMI				X	No funding streams identified or available.
99	Create LIDAR-based channelized debris flow hazard maps in 5 communities. Models are needed to assess areas of potential channelized debris flow hazards. These areas are potentially life threating.	DOGAMI		X			This action was conducted in conjunction with lidar produced for the post-fire debris flow project noted in action #84. See applicable comments. Consider combining with other PFDF project actions.
100	Develop volcano hazard evacuation maps for 5 communities in the proximal vicinity of Cascade volcanoes. Hazard maps exist for major Cascade Volcanoes, but evacuation maps based on predicted events are not yet available. Develop evacuation maps in 5 most vulnerable communities, and conduct outreach on the maps.	DOGAMI				X	No funding streams identified or available.
101	Update 2 volcano hazard maps. New highly detailed geologic maps produced with LIDAR around Oregon Volcanoes should be used to update at least 2 volcano hazard maps (e.g., current Mount Hood mapping)	DOGAMI				X	No funding streams identified or available.
102	Conduct LIDAR-based geologic mapping targeted around 2 Cascade and other Quaternary volcanoes. There is a continuing need to have detailed geologic maps that portray and thoroughly detail the eruptive histories of all major volcanoes in the Cascade Range, starting with two Quaternary volcanoes that pose hazards to most vulnerable communities.	DOGAMI		X			A new geologic map for Newberry Volcano in central Oregon is currently in progress by USGS as is a new map for Mount Hood Volcano. Need to get a timeline for completion update from USGS.
103	Update statewide volcano inventory database and map. Revise the statewide spatial database/interactive web map of active/dormant/extinct volcanoes in Oregon attributed by type, eruptive history, tectonic setting, and age. Significant data is not shown in the present database.	DOGAMI				X	No funding streams identified or available.
104	Update wildfire risk assessment data every 5 years with more up to date data. In 2019 the Oregon Wildfire Risk Explorer (OWRE) Tool was completed through federal grant funding to make available the most up to date information available on wildfire risk. This tool was created to develop an online portal available to the public to look at current and potential risk and assist in planning and development. Data utilized as a base for this wildfire risk portal was taken from the Quantitative Wildfire Risk assessment developed by the USFS. The purpose of this online tool is to deliver the best wildfire risk information to	ODF		X			The OWRE was established, and updates have occurred. The underlying data will continue to be updated regularly.

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Priority #	2020 Oregon NHMP Priority Mitigation Action	Lead Agency	Not Started	Progressing	Completed	Not Pursuing	Explanation
	homeowners, communities, local managers, and planners. It has been utilized in updating CWPP's and provides guidance and educational resources for the public. Beyond the wildfire risk information, this tool is used as an avenue to show current large fire perimeters and where historical fire starts have happened. ODF has goals to improve and add to this mapping tool in collaboration with OSU into the future by adding in a new Wildland Urban Interface layer and a new Communities at Risk layer. Other updates will be implemented as data becomes available to help planners and the public assess wildfire risk.						
105	Add Climate change modeling into Oregon Wildfire Risk Explorer (OWRE). Add Prescribed fire live burns, WUI, and Communities at Risk data into the OWRE. Integrate data and assessment information from OSU Extension projects. In 2019 the Oregon Wildfire Risk Explore (OWRE) Tool was completed through federal grant funding to make available the most up to date information available on wildfire risk. This tool was created to develop an online portal available to the public to look at current and potential risk and assist in planning and development. Data utilized as a base for this wildfire risk portal was taken from the Quantitative Wildfire Risk assessment developed by the USFS. The purpose of this online tool is to deliver the best wildfire risk information to homeowners, communities, local managers, and planners. It has been utilized in updating CWPP's and provides guidance and educational resources for the public. Beyond the wildfire risk information, this tool is used as an avenue to show current large fire perimeters and where historical fire starts have happened. ODF has goals to improve and add to this mapping tool in collaboration with OSU into the future by adding in a new Wildland Urban Interface layer and a new Communities at Risk layer. Other updates will be implemented as data becomes available to help planners and the public assess wildfire risk.	ODF		X			The WUI has been added to OWRE.
106	DFR will teach classes about wildfire coverage in 2020-21. Wildfires are all too common in Oregon and have displaced thousands of Oregonians over the last few years. Homeowners and renters insurance are vital tools to financially withstand the impacts of wildfires. DFR hosts information about insuring against wildfire on its website and will continue to lead outreach classes to the public about the value of homeowners and renters insurance.	DCBS-DFR		X			DFR utilizes social media and publications; the approach is similar to earthquake above.
107	Establish a program for studying winter storms and their impacts statewide. As a part of that program, develop a system for gathering snowfall data statewide. Establish a network of snow accumulation tracking stations at strategic locations throughout the state to provide data tracking of snowfall accumulation over the short term and long term in order to develop statistics for studying snow level trends across the state.	ODOT	X				ODOT is not responsible for collecting snowfall data statewide. This is a function of the National Weather Service and local weather agencies. ODOT continues with their winter weather response operations as normal. This has not started in part due to personnel and structural changes at ODOT.

STATUS: 2020 Oregon NHMP Priority Mitigation Actions							
Priority #	2020 Oregon NHMP Priority Mitigation Action	Lead Agency	Not Started	Progressing	Completed	Not Pursuing	Explanation
DS1	Complete risk assessments for 18 state-regulated high hazard dams in Poor or Unsatisfactory condition (not meeting safety standards). This work is FEMA HHPD grant funded, with state match. The Dam Safety Program has partnered with FEMA to complete these as part of the HHPD grant. All work will be completed by the Dam Safety Program.	OWRD			X		Completed.
DS2	Complete risk assessments for remaining state-regulated high hazard dams. Partial funding for this work had been proposed in SB 1537 (Oregon's 2020 legislative session). The dam safety program will partner with the Governor's Office and the State Resilience Officer to continue to support this project.	OWRD		X			In progress. This action needs to remain in the Oregon NHMP for a while due to resource constraints.
DS3	Complete floodplain management plans for inundation areas below priority dams. The Dam Safety Program has partnered with FEMA to complete these as part of the HHPD grant. All work will be completed by the Dam Safety Program. The Dam Safety Program will partner with the Cities of LaGrande and Newport to complete these plans. Dam Safety staff will complete these assessments.	OWRD		X			This action will eventually be done for the HHPD Grant dams; OWRD will plug away at this over many years.
DS4	Support a task force to develop funding for and prioritize rehabilitation efforts. This task force and funding for it had been proposed as part of SB 1537 in 2020. The 2020 legislative session ended before action could be taken on most bills, including SB 1537. The Dam Safety Program will partner with the Governor's Office and the State Resilience Officer to continue to support this project.	OWRD		X			This may end up not being a task force. OWRD is in the early stages of identifying how best to do this. They are working with the Governor's Office.
DS5	Re-evaluate extreme flood potential and begin to develop new methodologies for determination of inflow design flood for state-regulated high hazard dams. This flood potential analysis and methodology and its funding had been proposed as part of SB 1537 in 2020. The 2020 legislative session ended before action could be taken on most Bills, including SB 1537. The Dam Safety Program will partner with the Governor's Office and the State Resilience Officer to continue to support this project.	OWRD		X			In progress. To be completed by Dec. 2026 at latest.

9.6.2 Status of 2020 Oregon NHMP Ongoing Mitigation Actions

The following table reports the status of the 2020 Oregon NHMP ongoing mitigation actions. DLCD gathered this data in July 2024 in preparation for evaluating the 2024 Oregon NHMP.

Table 9.6.1 Status of 2020 Oregon NHMP Ongoing Mitigation Actions

STATUS: 2020 Oregon NHMP Ongoing Mitigation Actions					
Priority #	**2020 Oregon NHMP Ongoing Mitigation Action**	**Lead Agency**	**Progressing**	**Not Pursuing**	**Explanation**
108	Continue to refine statewide natural hazard identification and characterization. The Oregon NHMP identifies the types of natural hazards affecting Oregon, their geographic extent, history, and probability of occurrence, and as they may be affected by climate change. Throughout the life of the Plan, new and continuing research studies and projects provide new data and analysis, improving our ability to identify and understand Oregon's natural hazards and their probability of occurrence. To advance hazard mitigation in Oregon, it is important for the State to plan, budget, and take advantage of opportunities that arise for continued research and new studies to enhance our knowledge of Oregon's natural hazards.	DOGAMI, ODF, OEM, ODOT, OHA	X		DOGAMI: All DOGAMI publications contribute to this action. Ongoing work in this area with studies. Identifying and characterizing geologic natural hazards is core to DOGAMI's mission. In recent years, DOGAMI has produced dozens of new studies that map the location of existing hazards and areas potentially at future risk from many hazards, including but not limited to landslides, earthquakes, tsunamis, floods, channel migration, and co-seismic hazards such as liquefaction. The agency also produces risk assessments using these hazard maps and coordinates the collection of lidar data. These different types of studies and datasets span the state and provide a critical basis for understanding hazards in Oregon. OWRD: The 2023 Oregon Legislature allocated $188,664 to OHA, with additional resources to DEQ, for the two agencies to jointly establish a state harmful algal bloom surveillance and monitoring program. This new funding will support systematic monitoring of recreational waters for the first time in the state. These investments in surveillance and monitoring will improve our ability to identify lakes and rivers with toxic blooms present in order to protect drinking water sourced from these areas and better inform the public about protecting themselves when recreating in Oregon rivers, lakes and reservoirs. ODF: SB 762 (2021) and SB 80 (2023) directed ODF and OSU to develop a statewide wildfire hazard map which will be used to direct state investments and downstream regulations to mitigate wildfire risk. This mapping is informed by the PNW Quantitative Wildfire Risk Assessment (QWRA). ODF leads the 20-Year Landscape Resiliency Strategy to improve forests and rangelands to reduce wildfire risk. In 2023, ODF developed the plan with private, local, state, and federal partners to target

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					about 13 million high-risk acres. This was also a requirement of SB 762 (2021). ODF has also made investments in and coordinates with other agencies on wildfire detection camera system and wildfire ignition investigation. ODOT: ODOT continues to identify new hazards to the transportation network as they arise. OEM is responsible for conducting hazard identification and characterization for Oregon's NHMP, and ODOT will continue to advise on this for their industry perspective, as necessary.
109	Continue to refine the State's risk assessment methodology and statewide assessments of natural hazard exposure, vulnerability, and potential losses. At the core of the Oregon NHMP is a statewide risk assessment of exposure and vulnerability, and an estimate of potential dollar losses to state-owned/leased buildings, infrastructure, and critical or essential facilities from natural hazard events. Schools, emergency facilities, water and wastewater, dams and levees, transportation, telecommunications, and energy facilities are examples of structures, infrastructure, and facilities that could be exposed and vulnerable to natural hazards. Other examples include populations, businesses, and industries. At this time, the state does not have a standardized risk assessment methodology across all hazards at the state and local levels. To advance hazard mitigation in Oregon, it is important for the State to plan, budget, and take advantage of opportunities that arise for continued enhancement of the risk assessment, better enabling limited mitigation resources to be directed to the areas that most need them.	DLCD	X		This is being done through the Risk Assessment Upgrade Project.
110	Continue to refine statewide identification and prioritization of the greatest risks from and communities most vulnerable to Oregon's natural hazards. Identifying and prioritizing the greatest risks from and communities most vulnerable to natural hazard events will enable the state to leverage its limited mitigation resources in ways that efficiently protect life, property, and the environment from natural hazard events and facilitate recovery.	DLCD	X		This is being done through the Risk Assessment Upgrade Project.
111	Continue to develop and implement resilience initiatives statewide. Natural hazard mitigation is a fundamental element of resilience. It is important for the state to plan, budget, and partner with other public and private entities to alleviate potential damage from natural hazard events before they occur by (a) improving the reliability of critical/essential facilities, services, and infrastructure during and after a natural hazard	DOGAMI, ODF, OWRD, OEM, ODOT, OHA,	X		DOGAMI: All DOGAMI publications contribute to this action. DOGAMI provides information to Oregon communities, state agencies, and federal partners that informs resilience initiatives statewide. This includes, but is not limited to, work to aid in the development within areas safe from geohazards, assessing which critical facilities are at risk, identifying

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	event; (b) developing evacuation routes and facilities; (c) informing the public; (d) planning for long-term recovery; and (e) taking other necessary actions.	OSFM			evacuation routes and safe zones in the event of a natural disaster, ensuring access to safe and reliable drinking water, conducting public outreach and education, and guiding long-term planning. Example may include DOGAMI's work with the Portland Water Bureau to reduce risk and make the Bull Run watershed more resilient. DOGAMI: DOGAMI provides information to Oregon communities, state agencies, and federal partners that informs resilience initiatives statewide. This includes, but is not limited to, work to aid in the development within areas safe from geohazards, assessing which critical facilities are at risk, identifying evacuation routes and safe zones in the event of a natural disaster, ensuring access to safe and reliable drinking water, conducting public outreach and education, and guiding long-term planning. OEM: Many efforts are happening to improve transportation and other critical lifelines, DOGAMI continues to improve tsunami evacuation modeling and outreach, OEM has developed new outreach program, "Be 2 Weeks Ready", OEM has developed a tsunami debris guidance doc. ODF: SB 762 (2021) and subsequent legislation directed the investment of general fund dollars and some downstream regulations to support community wildfire risk reduction and landscape resilience, and wildfire detection. Additionally, this legislation addressed related wildfire mitigation programs related public health, smoke management and mitigation, sheltering, public safety power shut offs, and workforce development. ODOT: ODOT has many ongoing projects to address resiliency of the transportation network. ODOT hopes to improve these efforts with the creation and development of the grant application group.

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Priority #	**2020 Oregon NHMP Ongoing Mitigation Action**	**Lead Agency**	**Progressing**	**Not Pursuing**	**Explanation**
112	Provide support for development and update of local and state hazard mitigation plans. The State of Oregon provides support for development of local NHMPs and the Oregon NHMP by managing federal grant funding in ways that assist the state and local governments with NHMP development and update tasks and processes.	OEM	X		The Oregon Department of Emergency Management utilizes federal Hazard Mitigation Assistance (HMA) grant funding to support the development or update of local NHMPs and the Oregon NHMP. It does this by working with FEMA to award subgrants to local and state entities for work that leads to FEMA approved or reapproved state and local NHMPs. HMA funding sources that can support mitigation planning include HMGP, HMGP-PF, BRIC, and FMA.
113	Improve and sustain public information and education programs aimed at mitigating the damage caused by natural hazards. While ongoing efforts are being made in this area, a strong message conveyed by several State IHMT Reports notes the need to strengthen and sustain public information, education, and training efforts by providing additional resources. Although commonly recognized that interest in reducing losses increases during and after events, there is an ongoing need to provide residents and key stakeholder groups (such as infrastructure operators) with hazard mitigation information. These reports cite the need to have timely seasonal information available, better methods to inform residents of sources of hazard mitigation information, use improved electronic methods (e.g., web sites), and materials oriented toward the intended users. This helps keep awareness levels higher, will stimulate actions by some, and reminds users to consider and include hazard mitigation measures in the contexts of regular activities, such as building a new home, relocating an office, or repairing a business.	OEM, DOGAMI	X		"Be 2 Weeks Ready" is a new public education and outreach program launched in 2024. It trains local community champions to work with their communities to be better prepared for all hazards.
114	Continue to improve inventory of state-owned/leased buildings in all hazard areas. Using DAS's data, DOGAMI developed an inventory of state-owned/leased buildings and identified those in hazard areas for the 2012 Plan and updated the inventory for the 2015 Plan. The data should be continuously updated by DAS-CFO to facilitate DOGAMI's inventory updates in future plan cycles.	DAS-CFO	X		DOGAMI is continuing to utilize and improve the state-owned/leased buildings dataset. DOGAMI is continuing to add or remove buildings as necessary.
115	Encourage citizens to prepare and maintain at least two weeks' worth of emergency supplies. State agencies should work with the American Red Cross and local emergency managers to encourage citizens to be prepared to survive on their own for at least two weeks.	OEM	X		"Be 2 Weeks Ready" is a new public education and outreach program launched in 2024. It trains local community champions to work with their communities to be better prepared for all hazards.
116	Use lidar for statewide analysis of all natural hazards. Lidar is currently the best source of regional topographic data and allows for highly precise and accurate natural hazard mapping (landslide, flooding, volcanic hazards, channel migration zones, tsunami, geologic faults, wildfire, etc.) and infrastructure inventories (buildings, utilities, lifelines,	DOGAMI	X		DOGAMI is continuing to use lidar for studies related to landslides and channel migration, tsunami hazard zones, faulting, as well as building and other infrastructure inventories. Recently DOGAMI provided lidar to ODF for use in

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	etc.). Many Oregon state agencies currently use lidar for natural hazard analyses and will continue to do so where lidar is available.				wildfire response. As the landscape changes and disasters occur, new studies will require lidar. Progressing, no estimated completion date.
117	Support research proposals by PSU, OSU, and UO to improve Oregon's disaster resilience. Support research proposals by PSU, OSU, and UO to improve Oregon's disaster resilience, in particular to federal agencies including the National Science Foundation	DOGAMI	X		DOGAMI has published many studies that support and are used by partners in Oregon's higher education system. This includes, but is not limited to, creating geohazard maps and risk assessments that inform natural hazard mitigation plans written by university staff and direct collaboration with university researchers on projects such as earthquake-induced landslides and tsunami modeling.
118	Evaluate and update mitigation priorities regularly and as otherwise necessary. The current pandemic has created a less-than-optimal situation for full vetting and prioritization of mitigation actions. With the changing revenue, budget, and social landscapes, continuing to review the actions and assess priorities on a regular basis and as otherwise necessary is the most prudent and practical course of action for continuing to advance mitigation in the State of Oregon.	DLCD	X		This is a responsibility of the IHMT which DLCD was anticipated to lead as a follow-up to leading the Oregon NHMP update (2020). With many personnel, structural, and budgetary changes in OEM and the State as a whole, this was discussed and minimally acted upon. OEM did begin to update mitigation actions in 2021 and 2022 but was unable to complete the project.
119	Support awareness and activities on FEMA Community Lifelines, Functional Recovery and BRIC. Support meetings to improve awareness of FEMA Community Lifelines, Functional Recovery and the Building Resilience Infrastructure and Communities (BRIC) to increase awareness, activities, preparedness, mitigation and response and recovery.	DOGAMI		X	No funding streams identified or available.
120	Integrate Climate Change Adaptation throughout Agency Operations. Require that state agencies address climate change adaptation at every budget cycle in their strategic plans. Regularly assess progress towards adaptation objectives.	DLCD	X		The Climate Change Adaptation Framework Implementation Team informally assesses progress toward adaptation objectives. As the current Governor has not prioritized climate adaptation, and there is no leadership structure yet for state policy making on climate adaptation, agencies have not been instructed to address it in their strategic plans. While some agencies have done so on their own, others have not.
121	Enable continued interagency collaboration on climate change adaptation. Provide state agencies with a curated information platform and a means to continue collaborating. This includes access to internal file sharing platforms, electronic meeting space, internal blogs, and other cross-agency communication systems, equipment, and venues.	DLCD		NS	Not Started.

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122	Embrace diversity, equity, and inclusion (DEI) in climate change adaptation planning and investment. Produce and implement a DEI Blueprint that will outline guiding principles and include one or more Equity Lens tools that will assist state agencies in taking the first steps toward integrating DEI best practices into their climate-related work. The DEI Blueprint will draw from the Environmental Justice Task Force (EJTF) Best Practices Handbook and other existing resources.	DLCD	X		Produced DEI Blueprint 2021. Some agencies are implementing it. It is being reviewed for integration into the Climate Change Adaptation Framework which is a part of the Oregon NHMP.
123	Support the Interagency Workgroup on Climate Impacts and Impacted Communities. Many of the agencies involved in the Climate Adaptation Framework (CAF) are also beginning to engage in a new workgroup on climate impacts and impacted communities as directed through Governor Kate Brown's Executive Order 20-04 on Climate Change. This workgroup will intersect with the work of the CAF Climate Equity Workgroup. This work, along with future interagency vulnerability analysis, will further define and identify populations most vulnerable to climate change in Oregon.	DLCD	X		This group has been disbanded and the task is being pursued by the Environmental Justice Council.
124	Fund targets set by the CCA Leadership Team. Foster interagency cooperation to develop and put forth climate change adaptation actions in state agency biennial budget requests according to targets set forth by the CCA Leadership Team.	CCAWG		X	We cannot do this without the Leadership team. See #34.
125	Measure overall state progress toward climate adaptation. Develop baseline metrics against which progress toward adaptation is compared.	Global Warming Commission		NS	Not started. The Climate Action Commission has not yet taken this up.
126	Foster exchange of information about climate adaptation strategies. Sponsor the first annual "state of the climate" conference open to all employees and the public.	DLCD		NS	Not started. There is no funding for this action.
127	Provide materials and opportunities to learn about direct and indirect climate change effects generally and on natural hazards in Oregon. Provide a comprehensive information portal for use by state agencies, local government, businesses, non-governmental organizations (NGOs), and individuals to learn about direct and indirect climate change effects in Oregon. The portal would be scoped with feedback from users during multiple stages in the development process. Involving stakeholders in the scoping process is critical to its success.	DLCD		NS	The Oregon Explorer did provide some of these functions but is no longer being supported. Coordination among state agencies has continued and advanced, but no single portal has been constructed.
128	Incorporate the social cost of carbon into cost-benefit analyses. Develop guidelines on use of social cost of carbon to perform cost-benefit analysis.	Global Warming Commission		X	Not started and not pursued. Not adaptation, but carbon reduction and sequestration. State doesn't design the mitigation BCA formula. Remove.

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Priority #	**2020 Oregon NHMP Ongoing Mitigation Action**	**Lead Agency**	**Progressing**	**Not Pursuing**	**Explanation**
129	Measure progress toward actions prioritized by the Climate Change Adaptation Leadership Team. Report progress toward and challenges with completing projects identified in previous budget requests with each agency budget request.	DLCD		NS	Not started. Cannot do this without a Leadership Team in place.
130	Continue to act upon opportunities to advance the State's lifeline mitigation investment practice. Expand upon the State's mitigation investment practice by (a) supporting efforts by jurisdictions and transportation districts to develop mitigation policy and retrofit plans for lifeline assets and service facilities; (b) continuing to advance design and maintenance standards and requirements for bridges and unstable slopes, transit, rail, ports, and priority lifeline airfields; (c) developing a temporary bridge installation policy and standards; (d) supporting research on retrofit methods and strategies for Cascadia subduction zone earthquake loads and tsunamis.	ODOT	X		ODOT is creating a grant application group to help identify and apply for appropriate grants. Focus will be placed on actual mitigation projects, however, compared to research or assessments. We feel it is necessary to address and remedy the problems and improvements ODOT and the State has already identified before we attempt to find more.
131	Improve reliability and resiliency of critical infrastructure statewide by adopting industry-specific best practices, guidelines, and standards. Lifeline Service Delivery Systems (critical infrastructure), including electric supply, natural gas, telecommunications, water/wastewater, hydraulic structures (e.g., dikes, levees, dams), transportation corridors, pipelines and petroleum fuels storage facilities, are all vital resources for a community's life-safety and economic viability. However, much of Oregon's existing critical infrastructure has not been designed or constructed to withstand the impact of severe natural disasters such as extreme wind & winter storms, major earthquakes, or large landslides. Lifeline Service Delivery Systems (critical infrastructure) should be evaluated statewide, and reliable and measurable performance objectives which insure the region's critical infrastructure can withstand future damage without crippling consequences should be instituted.	OPUC, OWRD, ODOT, DOGAMI	X		ODOT is continuously working to improve the reliability and resiliency of the transportation network by conducting projects already slated and funded for development as well as creating the grant application group to pursue additional funding sources.
132	Acquire statewide lidar coverage for the purpose of improving natural hazard mapping and infrastructure inventories. Lidar is currently the best source of regional topographic data and allows for highly precise and accurate natural hazard mapping (landslide, flooding, volcanic hazards, channel migration zones, tsunami, geologic faults, wildfire, etc.) and infrastructure inventories (buildings, utilities, lifelines, etc.). The state should continue to invest in lidar acquisition for the purpose of understanding risk to natural hazards at a local scale.	DOGAMI	X		DOGAMI has had significant lidar acquisition in the last five years. Within next five years, there will be complete baseline lidar coverage of the state, however the landscape changes through natural and human processes so there is an ongoing need to keep refreshing the lidar in places that are changing to ensure accuracy. DOGAMI focuses on areas with more extensive changes, e.g., post-wildfire or flooding disasters. There is a national goal to have recollection of lidar on an eight-year cycle. DOGAMI would also like to obtain bathymetric data for rivers, estuaries, and other waterbodies.

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133	Provide technical assistance and funding to local governments to evaluate the need and opportunities for inter-tie projects in Local Natural Hazards Mitigation Plans. The capital expense associated with this action needs to be carried mostly by local governments, perhaps with some grant or low-interest loan funding provided by the state or federal governments. The role of the state in this action is to encourage local governments located proximate to one another, yet with separate water systems, to develop the physical capability to send water from one system to the other. Often during drought situations, one local government will have a bit of water to spare while a nearby government is struggling to meet its needs. Transferring water by truck is expensive and inefficient when compared to transferring water via pipeline. Water inter-ties are also effective mitigation for the flood and earthquake hazards where one system can serve as backup for another.	OWRD	X		Addressed in the 2017 Integrated Water Resources Strategy. Water project Grants and Loans or Feasibility Study Grants may be available in some circumstances.
134	Continue to maintain the existing roster of qualified post-earthquake, flood, and wind inspectors with ATC-20 earthquake and ATC-45 flood & wind inspection training. Continue to compile and maintain a list of individuals trained and certified for post-disaster inspection. Support the recruitment and training of qualified ATC-20 post-earthquake inspectors and inspection teams.	BCD	X		The legislature moved this program over to the State Fire Marshal with 2019 House Bill 2206. It's now the Oregon Safety Assessment Program. Rewrite the Statement: Continue the Oregon Safety Assessment Program. Rewrite the Description: The Oregon Safety Assessment Program (OrSAP) provides professional resources to local governments to help with post-disaster building safety evaluations. When disaster strikes a community, numerous facility and infrastructure inspections may be necessary. At the request of local government, OrSAP makes volunteers available to conduct rapid post-disaster building safety evaluations related to structural safety and habitability. OrSAP evaluators also provide recommended posting of placards that denote the condition of each structure evaluated. OrSAP seeks qualified volunteers to provide these services. Volunteers are engineers, architects, building inspectors, general contractors, or people with ICC certifications who want

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					to be certified as a post-disaster safety evaluator and have completed an approved ATC-20 or OrSAP training course.
135	Expand the state's stream gaging network. Seek stable funding for the operation, and maintenance of stream gages. The availability of timely and accurate telemetered data from stream gages is essential for flood forecasting, for prediction of imminent flood hazards, and for response to flood emergencies. Streamflow data also provides basic hydrologic information for floodplain mapping and watershed management by communities throughout the state, and is critical for understanding and forecasting drought conditions. Numerous local, state and federal water management agencies rely on data from stream gages for effective management of projects and resources. The installation and maintenance of stream gages has traditionally been a responsibility of state and federal agencies. State agencies plan to work with their partners, including the United States Geological Survey and Bureau of Reclamation, to ensure adequate funding and support for existing gages and for the installation of new gaging sites where needed. It is recommended that state agencies endeavor to leverage federal funding with state resources and local matching commitments to achieve a reliable network of stream gages around the state. The data from these gages is used to support the RAFT and Raptor tools highlighted in Action #10, Priority.	OWRD	X		We currently run about 255 gages but will be installing about 10-15 new gages this biennium. Funding from GF has fluctuated since 2020.
136	Educate homeowners about choosing ice and windstorm-resistant trees and landscaping practices to reduce tree-related hazards in future ice storms. Trees that don't stand up well to ice and wind, especially when planted near power lines, can cause power outages and other damage. Certain species of trees hold up better to winter's fury than others. Other factors, such as where a tree is planted and use of proper pruning techniques, can also help trees be more resistant to ice storm damage.	ODF	X		ODF has expanded its Urban and Community Forestry Program and has grants that are being implemented over this biennium. There are also tie ins to wildfire mitigation and defensible space. Summer windstorms are also a concern related to wildfires and power outages.
137	Each year, ask the Governor to designate October to be Earthquake and Tsunami Awareness Month. Practicing to "Drop, cover, and hold" is critical in reducing injury and loss of life in the workplace and home during an earthquake. The more people practice the drill, the better they will respond to a real event. A gubernatorial declaration will promote increased participation in the Great Oregon ShakeOut, or other annual earthquake Drop, Cover, and Hold On drill.	OEM	X		In most years, we have used September as "Preparedness month", but with "Be 2 Weeks Ready" launching, we plan to start to introduce this.
138	Continue to facilitate accessibility and use of the Coastal Atlas GIS resources. Make the Coastal Atlas geographic information system (GIS) more useful for a wider audience,	DLCD, OPRD	X		DLCD continues to maintain and update the Coastal Atlas with data and links such as the Ocean Shores Data Viewer, the

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	from local and state staff to interested citizens, by continuing to improve its data and tools, and providing training on how to access and use them.				Estuary Data Viewer, Sea Level Rise maps, and the Coastal Access Inventory.
139	Research the effects of changing ocean water levels and wave dynamics along the central and southern Oregon coast, and use that data to augment the coastal geomorphic database. As recent research has shown, ocean water levels and wave dynamics along the Oregon coast are changing. These will, in turn, affect beach sand budgets and rates of erosion. More research must be done on alternative shore protection methods, effects of hard shore protection structures, near-shore circulation processes and sediment budgets, sea cliff erosion processes, and other hazard processes.	DOGAMI, OSU	X		DLCD has published the "Sea Level Rise Planning Guide for Coastal Oregon" to assist local jurisdictions with implementing resilience and mitigation measures and incorporate sea level rise data and maps into planning regulations. SLR_Planning_Guide_V1.pdf (coastalatlas.net) DLCD also worked with a 2-year NOAA Sea Level Rise Fellow to work with Clatsop County on sea level rise mitigation and a vulnerability assessment by holding public workshops, mapping community assets at risk from sea level rise, and produce a Sea Level Rise Community Engagement Guide to assist other coastal communities in doing similar work.
140	Survey coastline to monitor erosion. Continue to periodically measure and monitor the Oregon coastline in order to document the response of Oregon's beach and bluffs to changes in ocean water levels (sea level rise and storm surges), storms (frequency and intensity), precipitation patterns that may threaten lives and property. Maintain a long-term, permanent Oregon Beach and Shoreline Mapping and Analysis Program (OBSMAP). The program will be a partnership with local, state, and federal agencies that have responsibility over coastal and ocean activities.	DOGAMI	X		Dune-backed beach coastal erosion analysis/hazard zone reports cover most if not all dune-backed beaches on the coast. Bluffs included in some reports but not all. Erosion due to storms is always incorporated. Also considered when relevant: large landslides, geology, CSZ subsidence, etc. The newer reports include SLR, the oldest ones do not. Clatsop Plains: https://pubs.oregon.gov/dogami/ofr/O-01-04.pdf Tillamook County (new, but dunes only): https://pubs.oregon.gov/dogami/ofr/p-O-14-02.htm Till Co (old, but includes bluffs): https://pubs.oregon.gov/dogami/ofr/O-01-03.zip South Clatsop County: https://pubs.oregon.gov/dogami/ofr/O-09-06.zip South Lincoln County: https://pubs.oregon.gov/dogami/ofr/O-07-03.zip North Lincoln County: https://pubs.oregon.gov/dogami/ofr/O-04-09.zip

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					Central Curry County: https://pubs.oregon.gov/dogami/ofr/O-04-20.zip
141	Maintain the updated inventory of shoreline protection structures. Maintain the inventory of existing and new coastal engineering (shore protection) structures on the Oregon Coast in order to provide local governments and applicable agencies an important coastal management tool to address anticipated increasing coastal erosion. It is anticipated that this inventory and information will assist in potential future policy changes to address a changing climate and associated coastal erosion impacts.	OPRD	X		OPRD has hired a Sea Grant Fellow to document and digitize previous permits for shoreline protection structures as well as develop an app for mobile phone use to document structures and violations in the field. This app is currently being tested in situ for the Salishan Spit area of Lincoln County but will be used coastwide by rangers and permitting staff.
142	Provide information and technical assistance to implement mitigation of non-structural hazards in K-12 schools. Provide training to school officials and teachers in reducing non-structural hazards in schools such as unsecured bookcases, filing cabinets, and light fixtures, which can cause injuries and block exits. The program should include a procedure for periodic life safety inspections of non-structural seismic hazards in schools that can be implemented by local fire department inspectors. BCD will have an important role in providing technical assistance in the development of educational materials.	OEM	X		We have offered FEMA NETAP courses in the past, but attendance has not been very high.
143	Each year, ask the Governor to designate the third Thursday of the month of October as the Great Oregon ShakeOut Day by proclamation. Practicing to "drop, cover, and hold" is critical in reducing injury and loss of life in the workplace and home during an earthquake. The more people practice the drill, the better they will respond to a real event. A gubernatorial declaration will promote increased participation in the Great Oregon ShakeOut, or other annual earthquake Drop, Cover, and Hold On drill.	OEM	X		We have done this sporadically, but the plan is to be more regular.
144	Include information about the benefits of purchasing earthquake insurance in public outreach materials and disseminate those materials through appropriate public outreach programs and venues. Unlike flood insurance, which is underwritten by the U.S. Government (through the National Flood Insurance Program), earthquake insurance is offered by private sector agents, generally as a rider to a standard homeowner or business property insurance policy. Because earthquake insurance is a type of catastrophic coverage, most policies carry a high deductible. Oregon's Department of Consumer and Business Services Insurance Division offers information about earthquake insurance on its website and provides personal assistance through its insurance hotline. In addition, the Division is active in outreach activities,	~~DCBS-ID,~~ DCBS-DFR	X		DCBS-DFR continues to do this work and issue PSAs. Consider combining with #58 (Priority).

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	partnering with other agencies and organizations to bring insurance information to the public.				
145	Continue seismic rehabilitation of hospital, fire, and police facilities under the Seismic Rehabilitation Grant Program administered by Business Oregon's Infrastructure Finance Division. Continue to rehabilitate to operational readiness in the event of an earthquake essential hospital buildings, fire, and police stations that pose a threat to occupant safety. Senate Bill 15 of the 2001 Legislative Session requires that rehabilitation or other actions to be completed by January 1, 2022. Senate Bills 2 to 5 (2005) provided the mechanism to accomplish some of these legislatively mandated tasks. Under SB 2, Oregon Department of Geology and Mineral Industries developed a seismic needs assessment database of emergency response facilities buildings. These data are being used by the Seismic Rehabilitation Grant Program to provide funding for seismic rehabilitation of eligible buildings (SB 3). Senate Bill 5 allows the State Treasury to sell Government Obligation Bonds to fund the program.	BusOR-IFA	X		The Oregon Legislature has continued to fund this work.
146	Continue seismic rehabilitation of public school buildings under the Seismic Rehabilitation Grant Program administered by Business Oregon's Infrastructure Finance Division. Continue to rehabilitate to occupant life safety standards certain public school and community college buildings. Senate Bill 14 from the 2001 Session of the Oregon Legislature requires that the State Board of Education examine buildings used for both instructional and non-instructional activities, including libraries, auditoriums, and dining facilities in order to determine which buildings are in most need of additional analysis. Following the identification of high-risk buildings and additional analysis, high-risk buildings must be rehabilitated by January 1, 2032, subject to available funding. SJR 21 and 22 are bond measures (November 2002 election) which would provide funding to implement this proposed action. SB 2 to 5 (2005) provided the mechanism to accomplish some of these legislatively mandated tasks. Under SB 2, Oregon Department of Geology and Mineral Industries developed a seismic needs assessment database of K-12 and Community College public school buildings. These data are being used by the SRGP to administer a grant program for seismic rehabilitation of eligible buildings (SB 3). SB 4 allows the State Treasury to sell Government Obligation Bonds to fund the program.	BusOR-IFA	X		The Oregon Legislature has continued to fund this work.

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147	Track progress on the 2013 Oregon Resilience Plan. In 2013, OSSPAC released the Oregon Resilience Plan with over 100 recommendations. A tracking method is needed to better understand where resilience progress is being made and where more attention is needed. This is in the area of responsibility of the State Resilience Officer in the Governor's Office.	OSSPAC	X		OSSPAC has an effort underway to assess and analyze progress of the 2013 recommendations.
148	Continue implementing the Oregon Community Rating System (CRS) Users Group Program. DLCD will continue to coordinate Oregon's two NFIP CRS Users' Groups. Each group will meet a minimum of three times per year to share floodplain best management practices and to receive technical support from the State, FEMA's Insurance Support Organization, and others as needed. The State anticipates that the support provided through the CRS Users' Groups will encourage more communities to participate in the CRS program and participating communities to strengthen their CRS ratings, resulting in greater protection from flood damage at lower cost to property owners.	~~DLCD~~		X	This is now being implemented by a contractor to FEMA.
149	Monitor the effectiveness of the statewide strategy to encourage the purchase of flood insurance by demonstrating that the number of flood insurance policies held throughout the state continues to increase. Despite the statewide availability of flood insurance, coverage in place in most communities in Oregon varies from 10% to 20% of the homes and businesses located in the Special Flood Hazard Area (100-year floodplain). Not only does flood insurance reduce the financial vulnerability of individuals, families, businesses, government agencies, other organizations, and the community to the costs posed by flooding, but through the "increased cost of compliance" provision of flood insurance, it also provides funding for the elevation, flood-proofing, demolition, or relocation of homes and businesses when required due to "substantial damage" to the structure.	DLCD	x		DLCD engages in ongoing communication with Department of Insurance on flood insurance outreach and training. DLCD shares NFIP informational materials during floodplain trainings and Community Assistance Visits (CAVs). Note: this action and description need revised due to trending purchase of private flood insurance policies which are not tracked. Need baseline data and revised strategy.
150	Maintain the Riparian Lands Tax Incentive Program. This program is administered by the ODFW. This program involves the preparation of a plan and agreement between the landowner and the ODFW. The plan details measures the landowner will implement to preserve, enhance, or restore the riparian areas. Landowners receive a complete property tax exemption for the riparian property (up to 100 feet from the top of stream bank or the edge of non-aquatic vegetation). This program helps reduce sediment and protect stream banks which helps reduce the filling of river and stream channels.	ODFW	X		ODFW continues to receive inquiries on this program, so they continue to educate and continue to check on compliance.

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151	Provide information and potentially resources to local governments for developing "flood fight" plans and protocols. Several post-disaster mitigation strategy reports call for the development of flood fight plans and protocols in advance of flood emergencies. In addition to the state agencies potentially involved in flood fighting such as OEM and OWRD, environmental protection and habitat conservation agencies such as DEQ and ODFW should be involved in flood fight planning. At the federal level, the U.S. Army Corps of Engineers is a key partner. These plans and protocols might include improving emergency warnings, strengthening communications systems, stockpiling needed materials, preparing procedures for emergency vehicle access to flooded areas, and other related subjects, including ongoing public education efforts.	OEM, DLCD	X		No progress due to pursuing other activities.
152	Continue the State's active Floodplain Management Outreach Program. DLCD has an active floodplain and natural hazards outreach program. The department publishes and distributes newsletters and other outreach information to local governments and other interested parties. DLCD also maintains a website which includes a link to this NHMP. The natural hazards website (https://www.oregon.gov/lcd/NH/Pages/Mitigation-Planning.aspx) contains information and links to floodplain management information including many of the documents and booklets prepared by FEMA. DLCD uses an email distribution service for its Natural Hazard Newsletter and other correspondence. The email distribution service affords interested subscribers a greater opportunity to obtain flood management and natural hazards information from DLCD in a timely manner and for DLCD to more readily share information from a variety of sources.	DLCD	X		DLCD updates and maintains the DLCD – NFIP webpage (Department of Land Conservation and Development : National Flood Insurance Program (NFIP) in Oregon : Natural Hazards : State of Oregon). DLCD began using GovDelivery in 2024 for floodplain newsletter and other correspondence, and continues to add local floodplain staff to this distribution list. DLCD supports Oregon Floodplain Managers Group offering trainings, answering technical inquiries, and helping increase awareness of participation in this new group which started in 2024.
153	Continue the State's active Floodplain Management Training Program. DLCD and other State IHMT participants conduct or sponsor training sessions and meetings throughout the year focused on up-to-date floodplain management practices and projects. DLCD will continue to deliver focused training to surveyors, building officials, real estate agents and planners as well as local floodplain managers. The interdependent relationships among these key players in providing comprehensive floodplain management will also be highlighted during trainings.	DLCD	X		DLCD holds regular trainings with staff and professionals on floodplain management and permitting
154	Prepare text for local broadcast of one Public Service Announcement (PSA) each year on a seasonal topic. PSAs are an effective method for disseminating pertinent seasonal information about hazard preparedness and mitigation.	DLCD	X		DLCD sends annual PSA on preparation for flood season in collaboration with Silver Jackets
155	Assist local communities in securing funding to mitigate damage to repetitive flood loss properties or those substantially damaged by flooding. The state maintains an inventory of high priority repetitively damaged buildings located in floodplains. DLCD and OEM	OEM, DLCD	X		The state assisted with acquisitions of three Tribal and residential buildings funded through HMGP and one residential building funded through FMA since January 1, 2020.

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	have worked closely with communities to secure funding to mitigate buildings located in the flood hazard zone and to buyout properties located in the floodway. These agencies will continue to provide such expertise statewide where needed.				
156	Continue developing Emergency Action Plans for all remaining high hazard dams in Oregon. In Oregon, money from FEMA grants and state funds is used to help dam owners create Emergency Action Plans (EAP). An EAP helps identify situations where a dam failure might occur, actions to take that could save the dam, if possible, and evacuation routes for a dam failure situation. There is an Oregon-specific EAP template available, designed for owners of remote dams that have limited personnel. Approximately 75% of state-regulated high hazard dams have or are currently developing EAPs. There are 67 state-regulated high hazard dams, and another 65 federal high hazard dams in which OWRD plays a coordinating role.	OWRD	X		For all the currently designated HHD dams, EAPs exist. OWRD is revaluating approximately 20 dams, which may ultimately become HHPD-designated due to that reevaluation.
157	Acquire existing homes and businesses seriously threatened or damaged by landslide hazards. When opportunities and funding become available (pre- and/or post-disaster) explore options for the acquisition of developed property, particularly homes, in areas of repetitive or ongoing landslide hazards. Acquired properties will be maintained as open space in perpetuity and may also provide a buffer for landslide movements and debris that could otherwise impact improvements such as transportation routes.	OEM		X	The state has not acquired any homes or businesses seriously threatened or damaged by landslide hazards since January 1, 2020. This situation has not been researched and no one has made any requests for such assistance.
158	Assist local governments in implementing the tsunami land use guidance. The risk of tsunami hazard for Oregon's coastal communities is well-documented with the completion of comprehensive tsunami inundation maps developed by DOGAMI. The State of Oregon can assist affected communities with its implementation, leading to better protection of life and property from tsunamis.	DLCD	X		DLCD published "Preparing for a Cascadia Subduction Zone Tsunami: A Land Use Guide for Oregon Coastal Communities," designed to assist local jurisdictions with land use planning and resilience strategies for a Cascadia tsunami event. TsunamiLandUseGuide_2015.pdf (oregon.gov)
159	Monitor implementation of the tsunami land use guidance by tracking the number of jurisdictions that have used it. The risk of tsunami hazard for Oregon's coastal communities is well-documented with the completion of comprehensive tsunami inundation maps developed by DOGAMI. Monitoring success of the guidance will allow the State to adjust its approach and update the guidance as necessary, leading to better protection of life and property.	DLCD	X		DLCD worked with Gearhart, Rockaway Beach, Tillamook County, Manzanita, and Lincoln City to implement tsunami resilience planning through maps, evacuation facility improvement plans, comprehensive plan policies, and transportation system plans.

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160	Continue to renew coastal communities' enrollments in the Tsunami Ready Program. The Tsunami Ready Program is a program sponsored by the National Weather Service that is designed to provide communities with incentives to reduce their tsunami risk. Cannon Beach was the first community for Oregon. Under a proposed plan through the NTHMP, additional communities will be added until there is full participation. This program is currently evolving through a review process being carried out by the NTHMP National Coordinating Committee. OEM is the primary point of contact for more information about the Tsunami Ready Program.	OEM	X		Oregon has added five counties and 19 communities, and eight supporters since Cannon Beach joined the program. A supporter is an organization, business, facility or local government entity that is actively engaged in tsunami planning and preparedness but does not have the ability to meet all the formal recognition guidelines. Full participation is difficult to assess because the definition of a TsunamiReady Community is very broad. The program is still evolving and the criteria for becoming a Tsunami Ready Community are changing. The new criteria may be adopted within the next few months.
161	Continue supporting school participation in annual tsunami evacuation drills. Increase the ability of Oregonians to prepare for and recover from earthquakes and tsunamis on the Oregon Coast.	OEM, DOGAMI	X		"Be 2 Weeks Ready" is a new public education and outreach program launched in 2024. It trains local community champions to work with their communities to be better prepared for all hazards.
162	Continue supporting local agencies and local non-profits, such as CERT, in participating in educational efforts such as door-to-door campaigns to educate those living or working in the inundation zone on how to respond to an earthquake and tsunami. Increase the ability of Oregonians to prepare for and recover from earthquakes and tsunamis on the Oregon Coast.	OEM, DOGAMI	X		OEM has hired a Community Preparedness Coordinator who has increased CERT activity and outreach efforts.

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163	Continue innovative outreach activities, such as tsunami evacuation route fun runs. Increase the ability of Oregonians to prepare for and recover from earthquakes and tsunamis on the Oregon Coast.	OEM, DOGAMI	X		COVID slowed OEM efforts down, but we are starting to resume.
164	Continue to develop training and information packets and articles for local building officials informing them of their responsibilities and authority under ORS 455.446 and 455.447 and the State Building Code. Statutes and the State Building Code limit construction of new essential facilities and special occupancy structures in the mapped tsunami inundation zone. Definitions of essential and special occupancy structures are in the Oregon State Structural Specialty Code. As personnel change and time passes, additional training and information for officials will be provided.	BCD, DLCD	X		DLCD published "Preparing for a Cascadia Subduction Zone Tsunami: A Land Use Guide for Oregon Coastal Communities," designed to assist local jurisdictions with land use planning and resilience strategies for a Cascadia tsunami event. TsunamiLandUseGuide_2015.pdf (oregon.gov) This land use guide includes guidance, sample policies, and model language for local jurisdictions to use in updating or strengthening their tsunami planning and building regulations.
165	Work with ODOT to replace or move existing Entering/Leaving Tsunami Hazard Zone signs to correspond with the XXL inundation line developed by DOGAMI. Existing tsunami hazard zone signs are considered inadequate for placement along stretches of US-101, or on any roads, that are within the tsunami hazard zone. A single tsunami hazard zone sign will not indicate the boundaries of the inundation zone. Tsunami Hazard Zone signs should be located to correspond with the XXL inundation line developed by DOGAMI.	OEM		C	This action has been completed by DOGAMI.

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166	Develop volcanic hazard evacuation maps. Volcanic eruptions often produce lahars that travel down river valleys. Evacuation maps should include the hazard area as well as preferred evacuation routes and evacuation sites. USGS staff should support local and state agencies in this effort.	DOGAMI		X	No funding streams identified or available.
167	Each year, ask the Governor to designate May to be Volcano Awareness Month by proclamation. Working with federal partners, such as the USGS Cascades Volcano Observatory, the state of Oregon will increase the ability for citizens to respond to volcanic eruptions by increasing the level of awareness and preparedness in the public and governmental agencies.	OEM	X		We have done this occasionally, but starting in 2025, there will be a more concerted effort to promote volcano awareness.
168	Support development, enhancement and implementation of local education programs designed to mitigate the wildfire hazard and to reduce wildfire losses, such as the Firewise Communities/NFPA Program and the annual Wildfire Awareness Week Campaign. As part of its statewide fire prevention program, the Oregon Department of Forestry actively encourages and promotes local education and awareness programs that are designed to mitigate or reduce the impacts of wildfires. This action reflects ODF's ongoing intentions to: (a) collaborate with agencies and organizations to promote consistency in the development and application of fire prevention standards, (b) work to make individuals aware of their personal accountability and responsibility for wildfire safety, (c) determine local resources and capacity, and (d) define needs and solutions required to increase capacity.	ODF	X		ODF coordinates with OSFM and other agencies and organizations to deliver fire prevention and wildfire risk reduction education programs. OSFM has launched a robust defensible space education and assessment program in coordination with local fire agencies.

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169	Continue to increase the number of local governments using the Wildfire Hazard Zone process to mitigate wildfire risk and losses. The Wildfire Hazard Zone (WHZ) process allows local governments to require the use of fire-resistant roofing materials in jurisdictions assessed to be at a high risk of wildland fire. Currently, only a few eligible entities have used the WHZ process. To promote additional use, an assessment will be made of the portions of the state where it appears the WHZ process will have the greatest benefit. Following this assessment, local governments in the areas identified will be educated on the desirability of implementing the process. Those governments that express an interest in applying the process will be assisted in completing the required analysis work.	ODF, BCD	X		Two jurisdictions have adopted WHZs locally. In 2021, legislation (SB 762, refined by SB 80 in 2023) passed requiring the state to develop a statewide wildfire hazard map identifying wildfire areas (low, medium, and high) and the wildland urban interface (WUI), with home hardening building codes (ORSC, R327) and defensible space standards applying to development in areas identified as high hazard and in the WUI. The BCD will finalize the updated R327 building code after the wildfire hazard map is finalized (anticipated late 2024). After the statewide wildfire hazard map is finalized and the new building code is effective, the WHZ process will no longer be available to local governments. WHZ program will be phased out in 2025 when R327 requirements are in place in conjunction with the statewide wildfire hazard map. BCD developed an educational video on R327 and offers rebuilding grants for voluntary fire-hardening for homes lost in the Labor Day fires. These financial incentives have been popular, and the program was extended to apply to subsequent fire years. BCD is currently evaluating the feasibility of a proactive home hardening grant program.
170	Continue to develop and increase the number of updated Community Wildfire Protection Plans (CWPPs) with the goal of aligning CWPP updates with 5-year NHMP updates, where possible. The federal Healthy Forests Restoration Act (HFRA) includes statutory incentives for federal agencies to give consideration to the priorities of local communities as they develop and implement wildfire hazard mitigation projects. To become eligible for priority consideration under HFRA, a community must first prepare a Community Wildfire Protection Plan (CWPP). Most Oregon counties and many Oregon communities have completed CWPPs. To encourage the completion of additional CWPPs, as well as future updates of CWPP's counties and communities will be informed of the benefits to be gained from maintaining a CWPP and assistance will be offered to help facilitate the development and/or update of the plans. Because the majority of Counties	ODF	X		ODF continues to support and encourage the development and update of CWPPs. The department will be working on requirements for modernization updates to CWPPs. ODF participated last year with DLCD, OEM, OSFM, and other entities in conversations regarding the alignment and integration of CWPPs and NHMPs.

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	refer to CWPP's as their Wildfire Chapters, aligning CWPP updates with NHMP updates will ensure consistency and promote efficiencies in planning processes.				
171	Continue to provide technical assistance in accessing funding for fire prevention or wildfire mitigation projects through Title III, the National Fire Plan, or other funding mechanisms. Under the federal Secure Rural Schools and Community Self-Determination Act of 2000 (Title III, Section 301(5) of PL 106-393, commonly known as Title III), counties have the ability to receive and spend federal funds for projects that educate homeowners about wildfire mitigation efforts they can apply on their property and for planning projects that increase the protection of people and property from wildfires. National Fire Plan and other funding mechanisms may also be available for assisting communities in preventing wildfires and implementing wildfire mitigation projects.	ODF	X		ODF continues to provide technical assistance to counties to access funding, including access to additional federal funding through the Community Wildfire Defense Grant, which has a five-year federal appropriation (2022-2027).
172	Implement the Oregon Forestland-Urban Interface Fire Protection Act ("Senate Bill 360") in all Oregon counties that meet criteria under the law. The Oregon Forestland-Urban Interface Fire Protection Act, more commonly known as "Senate Bill 360," was enacted by the Oregon Legislature in response to the growing incidence of wildfire destroying homes and communities in Oregon's wildland-urban interface. The Act recognizes that individual property owners are in the best position to take mitigation actions which will have the most direct impact on whether or not a structure will survive a wildfire. Under this action item, the Act will be implemented county by county in those portions of the state, based on weather, fire incidence, fuels, or on the number of structures at risk. It has been Legislature's stated preference that implementation be accomplished with federal grant funds.	ODF		C	This action has been completed and the legislation is no longer in affect. SB 762 essentially replaced SB 360.
173	Analyze wildfire ignition probability statistics to better target prevention efforts at the leading causes of fires. There is currently no single database or common method of collecting fire cause information for wildfires occurring in Oregon. This results in different entities focusing their prevention and mitigation efforts on those causes which may not be the state's leading causes of fires. This likelihood can be lessened by developing a process to compare fire cause data collected by the Oregon Department of Forestry, the Office of the Oregon State Fire Marshal, and federal wildfire agencies. It is also important to understand the ignition probability from homes within and adjacent to the wildland interface because of the ignition risk to nearby wildlands.	ODF	X		ODF is continuing this work in partnership with state and federal partners.

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	While there is no centralized database, wildland and structural fire agencies will continue to work collaboratively to determine leading fire causes and focus efforts statewide and locally to prevent future ignitions.				
174	Collaborate through work groups within the Pacific Northwest Coordination Group (PNWCG) to continue collecting and analyzing wildfire occurrence data using the standardized statewide method and report to the state legislature as required. Previously, data concerning the causes of wildfire incidents was collected and analyzed by at least two state agencies, five federal agencies, and numerous local fire departments. These agencies had no database standardization or common reporting requirements. A standardized data collection system has been developed, and data collection and reporting continue collaboratively through work groups within the Pacific Northwest Coordination Group (PNWCG). The new system allows rapid identification of fire ignition trends and permits timely design and delivery of targeted prevention programs and activities.	ODF	X		ODF is continuing this work in partnership with state and federal partners.
175	Develop a single, comprehensive statewide method or process to collect and analyze wildfire occurrence data in a timely manner. Currently, data concerning the causes of wildfire incidents is collected and analyzed by at least two state agencies, five federal agencies, and numerous local fire departments. These agencies have no database standardization or common reporting requirements. This results in great difficulty, when attempting to determine the number of wildfires that occur in Oregon, when identifying fire cause trends, and generally in obtaining information concerning wildfire trends in a timely manner. Under this action item, all agencies responsible for suppressing wildfires will be requested to report incident occurrence information to a central data repository, in a standard format, and within prescribed reporting time limits. Such a system would allow for the rapid identification of fire ignition trends and would permit the timely design and delivery of targeted prevention programs and activities. The State Fire Marshal's Oregon All Incident Reporting System (OAIRS) may be a key component in the solution.	OSFM ODF	X		There has been statewide progress, but it is still bifurcated. ODF collects on the wildland fire side and OSFM collects on the structural fire side using NFIRS. Synthesizing the NFIRS data is challenging, information is not always complete. ODF's information is far more specific as to cause and origin. OSFM is still interested in a central data repository, however they are moving to a new national system (NEIRS) at the end of this year and once they know how the system works, can work with ODF and federal partners. OSFM has internal capacity to analyze data and outputs.
176	Upload the newest available data into the Oregon Wildfire Explorer portal as available. In 2019 the Oregon Wildfire Risk Explorer (OWRE) Tool was completed through federal grant funding to make available the most up to date information available on wildfire risk. This tool was created to develop an online portal available to	ODF	X		ODF works with state and federal partners to update the OWRE tool and underlying data on a regular basis.

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	the public to look at current and potential risk and assist in planning and development. Data utilized as a base for this wildfire risk portal was taken from the Quantitative Wildfire Risk assessment developed by the USFS. The purpose of this online tool is to deliver the best wildfire risk information to homeowners, communities, local managers, and planners. It has been utilized in updating CWPP's and provides guidance and educational resources for the public. Beyond the wildfire risk information, this tool is used as an avenue to show current large fire perimeters and where historical fire starts have happened. ODF has goals to improve and add to this mapping tool in collaboration with OSU into the future by adding in a new Wildland Urban Interface layer and a new Communities at Risk layer. Other updates will be implemented as data becomes available to help planners and the public assess wildfire risk.				
177	Continue to educate communities, workers, and the public about the role of proper tree pruning and care in preventing damage during windstorms. Arboricultural groups, public agencies, and utilities should cooperate in promoting proper tree pruning and care practices that can reduce the risk of tree failure and property damage. Common messages refined by state level entities such as the Oregon Department of Forestry (ODF) and OSU Extension can help provide continuity and efficiency across the state. While implementation of this action largely takes place at the local government level, the state has a role in encouraging and providing incentives for best management practices. ODF maintains and implements a communication plan that includes educational initiatives aimed at improving tree health in cities. This includes a variety of products, including a bimonthly newsletter, a website, and brochures that help convey these messages. OSHA requires utilities to: • Provide training to crews working on power lines in worker safety and the identification of trees to prune or remove; and • Review regulations and standards for easement and right of way maintenance, and provide training to foresters and logging crews. Utilities should instruct homeowners in pruning of vegetation, tree care safety, and proper tree care for trees bordering utility corridors and public rights of way.	ODF	X		ODF has a robust Community and Urban Forestry Program and works in coordination with other entities to promote proper tree care to reduce risks.

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178	Use industry best practices to minimize impact and outages to service delivery system of overhead line operators, during windstorm events. Implement outreach efforts through existing safety-related programs managed by the PUC in coordination with private and public utilities. Compliance with PUC administrative rules includes safety codes and vegetation management. The PUC provides administrative to support to the Oregon Utility Safety Committee where all utility operators (electric, natural gas, telecommunication & water) discuss safety issues and best practices.	PUC	X		PUC conducted investigation UM2225 into resiliency standards, has continued to evaluate reliability of investor-owned utilities and review major event actions and lessons learned and continues to support ESF-12 functions in the midst of emergencies, whether they reach designated status or are just localized.
179	Educate citizens about safe emergency heating equipment. Improper use of alternate heat sources during winter storms can cause fires. Ongoing efforts of the Office of Oregon State Fire Marshal and its work with local fire departments through the Oregon Life Safety Team (http://www.oregon.gov/OSP/SFM/Pages/CommEd_OLST.aspx). In addition, people can be killed by carbon monoxide emitted by fuels such as charcoal briquettes when used for heating homes. To reduce the threat of carbon monoxide poisoning, known as the silent killer, the 2009 Legislature passed HB 3450a requiring landlords to install carbon monoxide alarms in rentals with a carbon monoxide source and homeowners must ensure they are installed in homes at the time of sale, if the home has a source. Sources include gas heating or fireplaces, wood-burning fireplaces or stoves and attached garages. Partnerships for consistent public education messages and outreach are underway and will include information on the dangers of introducing a carbon monoxide risk.	OSFM	X		OSFM is continuing to implement and expand the smoke and carbon monoxide alarms program. This includes new tools and resources on the new OSFM website (https://www.oregon.gov/osfm/education/fire-safe/pages/smoke-co-alarms.aspx#RE_SOURCES) and through the Oregon Life Safety Team (https://www.oregon.gov/osfm/about-us/pages/oregon-life-safety-team.aspx) as well as the smoke alarm installation program through the Oregon fire service at the local level. OSFM is currently ramping up a new program for the distribution of carbon monoxide alarms modeled on the smoke alarm installation program.
180	Continue educating motorists on safe winter driving, including how to be prepared for traveling over snowy and icy mountain passes. Actions such as sanding, applying de-icing chemicals, and snowplowing do not make the road safe. Motorists must drive at speeds appropriate for the weather and road conditions and be prepared to handle adverse conditions. Many drivers do not carry chains and do not know how or simply do not install them when conditions warrant. Also, many drivers are not prepared for a long wait in their car. Education programs would help save lives on snowy and icy roads.	ODOT	X		This is normal operations for ODOT. In preparation for each winter, weather education and information are provided to the public for traveling on snowy or icy roadways. ODOT will continue to do this, as necessary, and will make changes to their methods, when required.

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